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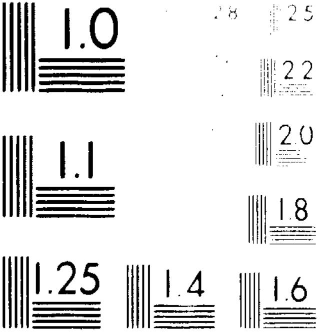
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SENER Reference: PG-3040

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SENER

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INDEX
OF
EVALUATION OF FEASIBILITY STUDY FOR JIBOA COMPLEX

SENER

SENER

ENCLOSURES

ED-Z1 DESIGN SPECIFICATION. BASIC DATA FOR PROJECTS Rev. O. Feb. - 81

MT-Y22 WORKING METHOD. TYPICAL CONTENT OF A PROCESS BOOK Rev. 1 Sep. - 81

APPENDIX II SPANISH LEGISLATION ON TREATMENT AND DISCHARGE WASTE WATER.

1. INTRODUCTION, BACKGROUND AND CONCLUSIONS

SENER

1. INTRODUCTION, BACKGROUND AND CONCLUSIONS

SENER has been commisioned by the UNDP/UNIDO to evaluate and complete the Preliminary Study of the Jiboa Industrial Complex at San Vicente (El Salvador), produced in April 1981 in respect of Project DP/ELS/78/001.

The scope of the work to be carried out by SENER was spelled out in the "Terms of Reference" attached to the contract, and in subsequent conversations between our staff and staff of UNIDO during visits to El Salvador and Vienna, in which the context of the terms of reference was slighthy revised.

In accordance with the terms of reference in the contract mentioned above, SENER produced a draft entitled Evaluation and Completion of the Feasibility Study of the JIBOA Industrial Complex, which was presented, delivered and discussed in El Salvador at meetings with representatives of UNIDO, UNDP, the Ministry of Planning and Development of the Government of El Salvador and the management of th JIBOA factory on 21 and 26 June 1982.

At these meetings, valuable contributions were made by the Salvadorian representatives, including those from high levels of government, particularly worthy of note in this regard being the reception given to the work, and the personal attention devoted to it, by His Excellency the Government Minister of Planning and Development. As a result of the meetings refered to, it was thought desirable to make certain amendments to this document, affecting basically sugar prices, molasses storage capacity, quantity of plant for the expansion of the factory and new considerations relating

SENER

to the possible opening of an alcohol distillery, which has been incorporated into this document and described as "Alternative D".

This document aims to approach the set objective within the framework of cooperation established between the Government of El Salvador and UNDP-UNIDO for the integrated explotation of raw materials and of the products of existing sugar factories.

The Preliminary Study dated April 81, which UNIDO handed over to SENER, proposed an imaginative solution which would involve implementing a plan for an industrial complex comprising a number of satellite plants interdependent with the classic sugar factory, but it was a solution whose technological, economic, and financial viability is open to argument, and which could create serious problems for the JIBOA factory in that it provided for the production of board and other products with an unknown market.

In pursuance of its Terms of Reference, SENER studied the the plant proposed in the Preliminary Study,especially that for separation by the TILBY method and that for vinasse treatment, and obtained results which differed from those of the Preliminary Study and which would, if confirmed, overturn the proposed programme of production. These results were brought to the attention of UNIDO, and that led to those adjustments in the Terms of reference to which allusion has been made.

The overall analysis of the Preliminary Study is presented in Chapter 2, while an independent report on the Tilby system is dealt with separately in Chapter 3 and one on vinasse treatment in Chapter 4.

SENER

SENER also carried out market studies of the principal products of the complex proposed by the Preliminary Study, and the conclusions reached on the basis of these are collected in Chapter 5.

The chapters which follow consist of the technical and economic proposals which are made to replace those of the Preliminary Study.

The proposed solution is presented from two angles: improvement of the existing factory so as to increase its sugar production capacity (as in Alternatives "A" and "B"), or raising of the profit on sugar production and also using part of the raw materials and intermediate products to obtain diversified products like fuel alcohol and boards (as in Alternative "C").

We should state straight away that the capacity of the board plant which we study is that laid down by our Terms of Reference, and that the recovery of potassium sulphate by the vinasse treatment process is not vouched for by the owners of that technology, so that it ceases to be of inmediate concern for our Study of Alternative "C".

As was stated above, the final version of this work incorporates a new alternative called Alternative "D" which may involve a less awkward solution for the future of the JIBOA factory and its environs. This alternative consists of increasing the sugar production capacity of the factory to an extent consistent with the development of cane production of the area and of envisaging the opening of a distillery with a capacity of 60,000 litres a day to be supplied by the "final extraction juices".

The plan proposed by SENER and included herewith is based on a gradual and unforced increase in the sugar cane production of the hinterland of the JIBOA factory, and provides for a schedule of small investments to enable the increasing supply of cane from the growers to be processed without either breakdowns or under-utilisation of plant. In this connection we believe that the alteration effected by Alternative "A" should come before those contained in Alternative "B" or "C", whichever of the two the Government of El Salvador chooses, installation being carried out in any event during periods outside the grinding season.

Another line of approach, and one in line with the comments contributed during the revision of the draft Evaluation in El Salvador, would be the alteration represented by Alternative "D", an expansion of the factory within the framework of the objective of sugar cane product diversification.

It may be noted that both the technical study (chapter 6) and the economic and financial study (chapter 7) have been done separately for each of the alternatives for the factory, and the economic and financial evaluation has also been completed by studying the distilleries by themselves, so as to explore the effect on the profitability of the factory of building these satellite plants into the Project.

In a changing industrial and commercial environment it was necessary to specify the base values used in the economic calculation (in 7.2) of the central case, variation in one of whose parameters from the base value indicated the sensitivity of the internal rate of return to that factor.

SENER

It was also necessary to outline the constraints which had to be net in crder for the project to be viable (chapter 9), and which would, if met, justify the making of decisions which could take place in the months to come.

In the Appendix we set out a document which could serve as a guideline for the tender document which might be required in due course for the basic engineering design contract to take the first external step of the "Implementation Plan" contained in Chapter 9.

From the analyses and studies which make up the main body of the document here presented we may extract the following non-exhaustive set of conclusions:

- It is not advisable to use the "Tilby"system for separation of sugar cane components, for this process is at an experimental stage and of doubtful efectiveness, nor is it advisable to use the process whereby it is allegedly possible to obtain potassium sulphate from vinasse.

- There does not seem to be any realistic prospect of finding a market for the production of a board plant with 60,000 tonnes annual output.

- Sharp increases in sugar cane production appear to be difficult to achieve and gradual increases are accordingly advocated.

- The profitability of sugar production is acceptable in normal circumstances, and the derivation from sugar cane of by-products for the manufacture of other materials may perhaps be possible to introduce into factories with greater assurance of success in the medium term.

SENER

- To optimise sugar production costs, small adjustments to the existing factory are proposed, as are improvements in the harvesting of sugar cane.

- The plan proposed for the expansion of sugar production capacity is one of programmed alterations over time, designed to put the JIBOA factory in a position to cope with gradually increasing cane supplies which may arise, up to a ceiling of 5,760 tonnes per day.

- The economic viability of the project holds up until the sugar price approaches $0.37 per kilogram. Increases of 40% in the cane price would involve a decrease in the internal rate of return of between 45 and 55%, depending on the alternative chosen, but the Project remains profitable as long as the sugar plant is included in the calculation.

SENER

2. ANALYSIS OF PRELIMINARY STUDY

INDEX

2. ANALYSIS OF PRELIMINARY STUDY

2.1 GENERAL ASPECTS

2.1 GENERAL ASPECTS

The purpose of this analysis is to review and evaluate the "Preliminary Study of JIBOA Sugar Plant in San Vicente (El Salvador)" of April 1981, providing the technical, economic and commercial bases for a final decision on the implementation of the Project and the financial outlay required.

With this in mind, we have paid special attention to those aspects of the P. S. that, on a realistic and practical view, may be critical for its technical, financial and social viability.

This criterion has lead us to treat the various chapters of the P.S. differently, which is reflected in our analysis in as much as the more generally known subjects are dealt with briefly, whereas those essential for right decision-taking are treated at length.

First of all, the P.S. shows both a very commendable and valuable imaginative effort on the part of the authors, and a significant vision of the future that, beginning now, addresses possible alternative solutions to the grave present and future problems of energy and raw material supply. It also shows the way for a return to agro-industry and bio-mass which may turn out to be the key for survival of humanity.

Realism and our consideration of technical and economic feasibility have counselled us to make a profound analysis of the technical outline of the complex proposed in the P.S., leading us to different conclusions on that subject and, as a result, on the volume of investment in the complex and on its financial profitability.

SENER

2.2 TECHNICAL ASPECTS

SENER

2.2 TECHNICAL ASPECTS

In this chapter technical comments are made on the P.S. for integration of the JIBOA sugar plant, to determine its viability so that a final decision may be taken.

First of all, we must point out that in developing the job we shall use more traditional and well-tried approaches, having argued the disadvantage of following the new technologies proposed in the P.S. Because of the importance they have in the P.S., and as required in the terms of reference of our contract, the comments on these new technologies, specifically to the "TILBY" system and to the concentration/incineration of vinasses, will be dealt with in a separate chapter.

Therefore, we shall concentrate here on the remaining aspects related to sugar, alcohol and cane-board production.

Since 1979, the volume of sugar El Salvador has been able to export has dropped considerably. In 1980 it dropped 80% in comparison with the previous year. In 1981, although the volume was larger than in the year before, only about 50.000 m.T. could be exported, whereas in 1974, 150.000 m.T. were exported. For El Salvador, sugar is a source of foreign exchange income and for many years it has been the third most important source.

The JIBOA sugar factory is in full working order. On page 7 of the P.S. it is stated that maximun capacity of the factory was reached in 1977/78 with 2,856.2 short tons of sugar per day. However, during last season production was 3,840 short tons per day, in 1980/81 it was 3,600 short tons of cane per day, and in 1978/79, 3,768 short tons per day.

On the other hand, according to data obtained from INAZUCAR, of commercial sugar yields have been improving at JIBOA. In the 1977/78 harvest it was in the 11th place of all sugar factories of El Salvador and in 1980/81 LA MAGDALENA and JIBOA were the two most efficient sugar factories of the nation with a yield of 1.98 quintals per short ton.

On page 8 of the P.S. the price of sugar cane during the 81/82 campaign is given as 60 colones. In fact, the price paid was 50 colones per ton. Our view is that it is profitable to use sugar cane for the production of sugar alone. In the development of the sugar industry, which involves so many social and economic interests, most nations or groups have to adopt other than market prices to assure self-supply and agricultural stability.

Regarding expansion of cane cultivation, it is our opinion that the means proposed in the report is not the most realistic one.

Cultivating and bringing into production 7.000 has. of land in sugar-cane implies serious difficulties, as in principle it affects numerous growers, who would have to see the advantages of this production in a very homogeneous way and in an excessively short period of time.

However, we consider that the policy followed for about the last four years by those in the sugar-factory responsible for expansion of cultivation is

SENER

the correct one, in as much as they take care to select suitable types of cane, which have been tried in the San Miguel center, they show farmers rational techniques to obtain good yields, etc. This process is more gradual in increasing cultivated area, but it is a lot safer and more realistic than that proposed in the P.S.

The changes suggested in sugar-factory do not seem sufficiently justified to us; they are mentioned and specified on page 60. Although, according to the report sugar production would go from 877,000 q. with 450,000 short tons of cane to 1,250,000 q. with 99,000 short tons of cane, the resulting sugar yield would fall from 10.80% to 7.72%. We consider it very relevant to analyse what would happen in all the factory departments with this increase in sugar out put.

It turns out that installed capacity for sugar granulation is insufficient to achieve the sugar production aimed at.

To avoid repetition, we would simply refer to part 6.2.1 of this report where the matter is dealt with in more detail and proposals are made for equipment expansion in the evaporation, striking and centrifugation departments.

As regards boilers installed in the sugar factory, we would merely state that the design would have to be changed in order to obtain an efficiency similar to that presently achieved, since the fuel proposed by the P.S. would be completely different from traditional fuel.

Comments on alcohol plant

As indicated under c) in the Terms of Reference and developed in the P.S., an alcohol plant would be installed in the JIBOA complex with a capacity of 220,000 litres of alcohol per 24 hour day, working 220 days per annum.

According to the P.S., the raw material, containing fermentable sugars from the transformation of which 220,000 l/day of ethyl alcohol would be obtained, would be derived from :

- The COMRIND difussion operation, the purpose of which is to obtain inert bagasse. With this COMRIND treatment, a dilute liquor would be obtained with a Bx of 2.65 (page 141 of study).

- From dilute liquor obtained in rotary mud filters, with a Bx of 4.78.

- From molasses derived from massecuite A; with a 10.72 Bx.

- If prix values given for liquors are considered very low, that of molasses A is extremely low, as it is usual to obtain 75 Bx from centrifugation.

Here below we give a reasoned exposition of points which may enable us to find out the raw material requirements, in form of fermentable sugars, for this alcohol plant.

The development of JIBOA industrial complex is based on the assumption that 900,000 metric tons of sugar cane will be produced, from which 1,200,000 quintals commercial sugar will be obtained.

On that basis, sugar output for each metric ton of sugar cane would be 66.67 kg.

The P.S. and "Terms of Reference" foresee the possible installation of 6 TILBY units with a transformation capacity of 6 x 40 = 240 metric tons of sugar cane/ hour, which means 5,760 metric tons of sugar cane per day. To transform the 900,000 metric tons of sugar-cane, the grinding season would have to last 156 days. During the remaining time, up to the 220 days of operation foreseen for the alcohol plant, only molasses would be used as raw material.

Weighted mean polarization of sugar cane processed in the JIBOA sugar factory during recent seasons has been as follows in terms of mean polarization obtained and amount of cane processed:

Harvest	Processed cane	Mean polarizarion
1977/78	434,752	12,32
1978/79	352,613	13.04
1979/80	248,838	12.12
1980/81	300,107	13.14
1981/82	338,059	12.69

Weighted mean polarization = 12.66 %

Since commercial sugar yield obtained would be 66.67% per 1,000 kg. of cane after accounting for identified and unidentified losses, there would be left for alcohol 126.60 - 66.67 = 59.93 kg. of saccharose for each 1,000 kg. of cane.

Identified losses may be evaluated as follows : in bagasse 0.7%; in mud cake 0.03%, in cane rind 1.0% (assuming that the Tilby machine is used); unidentified losses

0.8%. All percentages are based on total sugar content of cane.

Sugar per metric ton left over for fermenting would be:

59.93 - (7+3+10+8) = 31.93 kg. per 1,000 kg. of cane.

31.93 x 240 = 7,663 kg. saccharose per hour.

Amount of alcohol per day that could be obtained would be :

7,663 x 0.6 x 24 = 110,347 litres/day. Let us take 110,000 litres.

(We have assumed that by fermenting 1 kg. of saccharose we shall obtain 0.6 l. of alcohol).

The remaining fermentable sugars to obtain 220,000 litres of alcohol per day would have to come from molasses.

If we consider that we have molasses with 45% fermentable sugar content and a density of 1.40 kg/l.,in order to obtain a litre of alcohol we would need approximately 2.50 litres of molasses.Therefore, the amount of molasses required per day for the total number of days the alcohol plant is assumed to operate will be:

- Grinding season

  220,000 - 110,000 = 100,000 litres/day.
  110,000 x 2.50 = 275,000 litres of molasses per day
  275,000 x 1.4 = 385 metric tons of molasses per grinding day.

  $385 \times \frac{900,000}{5,760}$ = 60,156 metric tons of molasses for the whole grinding season.

SENER

- Period outside the grinding season:

  Molasses that would be needed after the grinding season up to the end of the 220 days the alcohol plant is assumed to operate:

  220 - 156 = 64 days.
  220,000 x 64 x 2.50 = 35,200 m3 of molasses.
  35,200 x 1.4 = 49,280 metric tons of molasses for the whole of the period outside the grinding season.

Amount of molasses to be brought to JIBOA sugar factory would therefore be the sum of both periods:

60,156 + 49,280 = 190,436 metric tons of molasses.

Production of molasses in all El Salvador sugar factories may be valued as 4.5% of the weight of sugar cane. Cane production in the 1981/82 season has been 2,100,000 short tons; cane production in the hinterland of the JIBOA sugar factory was 340,000 short tons, which, assuming that Tilby machines were in use, would not yield molasses.

The amount of molasses produced in El Salvador would be (2,100,000 - 340,000) x 0,045 x 0.9 = 71,280 mT.

If all the molasses produced in El Salvador were sent to the proposed alcohol factory, which is not advisable since some goes to an already existing alcohol factory and some is used as animal feed, 109,436 - 71,280 =38,156 mT. of molasses would have to be imported. Besides, under a contract signed by the Government of El Salvador with the firm of Bienes y Tecnología, S.A. of Caracas, Venezuela, which appeared in the press on March 1, 1982, a 60,000 l/day alcohol factory is to be installed to process all the molasses in El Salvador.

In view of the above we may conclude that it is not advisable to attempt to instal a 220,000 l./day alcohol factory.

Comments on cane board plant.

As indicated under d) of the Terms of ference and developped in the P.S., a cane board plant would be installed in the JIBOA industrial complex with a yearly capacity of 60,000 m.T., operating 330 days per annum.

In the present stage of the technology developed by Intercane Systems, it would not be advisable to use the raw material obtained from sugar cane with the Tilby machine in the form of COMRIND, or sugar-cane rind, for the manufacture of boards since its 4.4% sugar content is not well extracted and residual sugar in the rind would ferment and cause the board to deteriorate.

We consider that, in order to extract sugar from rind produced by the Tilby machine, it would have to be shredded finer employing a much more efficient diffusion system. Shredding of cane and diffusion are both still in an experimental phase.

On this basis we believe that the board factory is not technically viable as proposed. As an alternative we propose a board factory with traditional processes starting from a raw material (sugar cane fibre) with lower sugar content and with a sufficiently prove perfomance.

SENER

Comments on the potassium sulphate plant

As a result of our study we are sorry to have to report the technical non-viability of this plant.

As explained in more detail in our report on concentration /incineration of vinasse (chapter 4), information obtained from various specialist in this field, among them Alfa-Laval and Sulzer- Escherwys, has given negative results.

This technology is not sufficiently developed and it is not advisable to install a plant for incineration of vinasses with which potassium sulphate could in theory be obtained.

2.3. ECONOMIC AND FINANCIAL ASPECTS

2.3 ECONOMIC AND FINANCIAL ASPECTS

As a result of the foregoing technical comments , it must be concluded that they suggest that suitable modifications be made to some aspects of the Study, and in particular they demolish the energy and market plan for the complex that served as the basis for the global economic calculations and forecasts setout on pages 20 and 21 of the Study. They also affect the theses of sections 23 and 24.

Apart from this general comment, we shall concentrate below on examining other economic and financial aspects of the Study which struck us.

a) Investments

We consider it very useful to have available a break-down of Capital costs under at least two heads: local costs and imports. This break-down is fundamental later on, to evaluate net social benefit of the project. Neither is applied in the Study.

The follow the same order as in the Study, we shall start with section 3.

Estimated value for the railway system(stock and rails) seem low to us. It is our opinion that infra-structure costs (bridges, viaducts, civil engineering works,etc.) should be added as well as possible land acquisition in general costs with the associated social problems.

The estimates for modifications to the sugar factory (section 4) which are underwritten on page 60 do not seem sufficient to us, specially bearing in mind that changes will necessarily have to made in pans, turbines, sugar drier and other impórtant parts not

SENER

mentioned. If we compare the figure of $ 2,668,000 taken on page 319 as investment earmarked for this item, there are $ 2,100,000 not explained on page 60 which still would not meet the cost of the additional modifications indicated.

Dismantling an important item of cost, is also missing the study. The present system for unloading, mills, etc, will require it.

Although there are no statistical investmt data available for such plants (which are at the present only experimental), from documents and from contracts with people in the processing field, we predict that the cost of the Incineration Plant for Vinasses will be almost double the estimate if the aim is to recover also potassium sulphate on a commercial scale.

Moreover, the economic approach used for the pyrolysis plant in paragraph 17.12 of the P.S., which aims to explain low investment cost by the use of second-hand equipment from closed-down factories or manufacturer locally from construction drawings produced by third parties, seems to us, lacking in consistency.

This surprises us for two reasons: depreciation for this equipment is put at 12 years (page 235), which is one of the longest specified in the P.S.; it is postulated that an industrial complex planned on a revolutionary basis and incorporating vanguard techniques is to be provided with something as vital as energy by equipment salvaged from closed-down plants.

SENER

Furthermore, it is to be assumed that expansion of JIBOA by adding other satellite plants will entail larger offices, maintenance shops and warehouses. No investment estimates for these items appear in the P.S. In the same context, we notice that investment costs for important items such as addition of the three /electric-turbo generators (mentioned on page 199) modifications in steam generation, new water requirements, etc., are missing.

Complete automation of the complex, with the exception of the pyrolytics plant and complete computerization of the Administration (page 373) also merit special mention. Besides maintenance and training costs, to be dealt with later on, reference must be made to the cost of the hardware and software required, which may be quite considerable.

In our opinion, some investment items charged to the Complex should be separated from the P.S. as they should be considered rather as national development objectives whose benefits are clearly of a social character. These items are the expansion of the railway system and the pilot plantation of Melia with a view to possible replacement of energy derived from pyrolysis of agricultural waste by the lumber of that fast-growing tree. In the Study this item has a value of $ 7,528,000, which should be committed under some other section of the State budget.

b) Production costs

Analysing components of production costs we do not see any clear basis for their distribution among the plants.

Equally there appear repercussions of common services on the sugar factory without previous provision of adequate investment for producing them. See table on the following page.

The sum of $ 2,899,600 reserved for production costs (excl. cane) at the sugar-factory seems to us low.

In the costs of raw materials for the boards plant we cannot find that for oxa-chloro-hexahydro-methanoindine for treatment of board. Annual cost for gum will be :

66,000 x 0.03 x (1,660 + 210) = $ 3,702,600 to which

importation costs, from Canada to El Salvador for example, must be added.

For this plant (page 133) and others (page 81) no cost for "shift back-up" personnel has been calculated, which is considered necessary with three-shift working.

In the distillery, the cost of nutrients, sulphuric acid, phosphates, etc, does not figure.

In general, we do not deal here prices for cane, sugar and alcohol, as these will be studied later on in our report.

PRODUCTION COSTS (u. S. dollars)

	SEPARATION	BOARD	DISTILLERY	VINASSES	PYROLYTICS PLANT
A. RAW MATERIAL	to be distri- buted cane	3,503,000 + to be distri- buted cane	6,368,000 (3) including cane	1,300,000	
B. ENERGY	From JIBOA - no change	self-sufficient in heat (1)	Excluded (4)	self-sufficient?	Included
C. LABOUR	73,200 + bs from JIBOA	292,500	204,000	104,000	
D. DEPREC. CAPITAL COST	954,800 10%	1,980,000 9%	1,956,000 10%	620,000	8%
E. MAINTENANCE + SPARE PARTS	120,000	350,000	245,000	120,000	
F. GENERAL EXPENSES	140,000	2,820,000 (2)	801,400	220,000	
	1,288,000	8,945,000	9,574,400	2,364,000	3,923,440

NOTES : (0) In no single case are costs for water, demineralization, etc. charged.

(1) Where is an estimate for generation ? For electric power a 2000 kw. turbogenerator is required.

(2) Includes local taxes + interest on working capital. Other plants do not include this item.

(3) Represents total molasses plus aliquot párt of cane for 240 day operatopm.

(4) Charged to global fuel budget.

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c. Economic studies.

Economic analysis of the Study are not generally made until parameters or conventional profitability indicators have been obtained, such as "internal rate of return", "net present value", "pay back in real terms".

Therefore, it is not easy to assess the possible economic viability of the project with the data given in Section 20.

On the other hand, production costs calculated for individual plants are not reflected exactly on table III (page 324) which covers in theory all production costs.

On page 313 of the Study it is commented how extremely difficult it is to evaluate each plant separately at this stage. This is not the same view as is taken when trying to justify each plant separately as generating an acceptable and even ample gross margin, when the overall economy position of the complex might not be so rosy after taking into consideration all expenses.

In addition to the considerations already set forth under a) regarding Melia and railway building, we wish to mention here that working capital of $ 3,000,000 seems low, especially considering that it will be necessary to store molasses in the plant to assure production continuity after the sugar campaign. As suggested on page 159 molasses reserve storage in warehouses of other factories would imply part payment in advance. We also believe that general costs allowed for the pyramidal management structure of the complex are insufficient.

Without making obvious deductions from the foregoing, it is worth noting that financing sources for the substantial investments proposed are not mentioned but

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might be critical for the viability of the project.

Our recent experience raises serious doubts as to the possibility of maintaining the low rates of interest appearing in the financial plan.

The sensitivity analysis is practically limited to the various capacities of the complex and the sugar price. Although these are fundamental factors, variation in investment, sugar-cane price, alcohol price, operation costs., etc, are not less constraining.

In general terms, technical viability (which is a necessary condition of financial and economic viability) is weakened by introducing three new technologies in an experimental phase and not sufficiently prove technically and commercially, which adds unnecessary risks to the implementation of a project of the scope of this one. It would have been helpful to find in the Study some investigation of what plants in operation vouched for the proposed technologies.

In our judgement the solution to JIBOA's present problem must be found by making a minimum investment far below 71 million dollars, especially considering that the greater part of the recent initial investment in the sugar plant has not been amortized as yet.

We believe that the execution programme is not realistic, especially since it is based on new tecnology plant. Usually such plant takes months to operate at full capacity, and to design specification, and since this is vital for the energy needs of the complex as a whole, as it has been conceived the date for normal operation would slip beyond the 1984/85 season.

Finally, it seems risky to predict now in 1982 that oil prices will increase more rapidly than inflation over the tinespan of this Study.

Construction of fuel alcohol plants has been urged less forcefully in some countries lately, and they have gone down in the priority rank order for solutions to the energy crisis.

3. REPORT ON TILBY SYSTEM

3. REPORT ON TILBY SYSTEM

On the first page of the Terms of Reference it is indicated that main units to be installed in the complex on the basis of the P.S. would be the following:

a. Existing installations of the JIBOA sugar - factory plus a few improvements and amplifications required, except in the milling part, to which separating machinery would be added.

b. Six separating machines with the capacity to process 40 tonnes/hour each, or a total of 240 tonnes/hour. According to the P. S. the separating machines neatly separate cane pulp and rind. Pulp would go to the sugar mills, where the juice would be pressed out, to be used in part for sugar production in the factory and in part for alcohol distillation in the alcohol plant. Clean rind would go to the sugarcane board plant.

The P.S. is based fundamentally on the installation of Tilby separating machines with a capacity to process 40 tonnes of sugar cane per hour each.

During our visit to El Salvador it was agreed to made an inspection of the Tilby machinery proposed in the documentation at the earliest possible date, since because of the importance it assumes in the study, it was considered important to give this matter priority.

The visit to Canatlantica, S.A. at Vitoria, Brazil was prepared with cooperation of Messers. Claro and Schultz.

Under (iii) of Scope and Contents of Work of the Terms of Reference it is stated that SENER is to "examine and make a visual inspection of the separation process and equipment (Tilby trademark) manufactured by Intercane Systems Inc. of Windsor, Canada, under commercial operation conditions in order to determine its technical and economic adequacy for the project". The installation we visited in Vitoria does not fulfil the condition of commercial operation.
In our opinion the Tilby machine inspected, which has an operating capacity of 20 tonnes/hour, is working on an experimental basis.

According to data gathered in the UNDP offices in El Salvador during the month of February 1982, two Tilby machines working with sugar cane and with a capacity of 10 tonnes/hour are installed in the world. One is in the Dominican republic and the other in Guatemala. These machines operate on cattle ranches to facilitate preparation of sugar cane as animal food.

We also wish to mention the request made from the UNIDO office in Vienna by Mr. Soloviev, who contacted with Intercane Systems, Inc. to find out in which parts of the world the Tilby machines are working as equipment in the sugar industry, in order to inform SENER where they would have to go to make the inspection agreed upon.

SENER

As said before, it was finally decided to visit the Victoria installations as it was thought they would be closed to the purpose pursued. Messers. Martinez and Pablo carried out an inspection of the Tilby machine installed in Victoria.

This machine is installed in a very old sugar-factory, which at present is not working as such. It is our belief that the accessory equipment for this machine is undergoing trials.

In the following description we shall start by referring to the feeding of the machine, thereafter we shall report on the machine itself and we shall finish by reporting on the impact of this system on the remaining plant.

Equipment installed for transportation of cane from load platform to machine is not industrially viable because of the number of operators required to see to the flow of cane, in spite of which there are constant obstructions, which cause many stoppages of the transportation system. Where these handicaps could be most clearly perceived was at the moment of the cane entering the machine. Cane fed into the machine must make a change of direction of a little less than 90º. Besides, since the metal feeder line from the last belt to the machine is relatively narrow, obstructions are very frequent.

The problem of separating out stones and metal objects has still to be resolved in the transportation system used for cane. At the plant visited, efforts have been made to minimize it by mean of two belt-conveyors placed in line and moving at different velocities. The first belt has a linear velocity which is half of the secound one; between the two belts there is an opening through which theoretically objects which might demage the Tilby machine should fall.

We think that this solution for separation is provisional and not completely suitable for an industrial process. During our visit we observed the presence of three operators arranging cane at the beginning of transportation for the machine with the 20 tonnes per hour theoretical capacity. These operators had to be very careful to make sure that canes started as straight as possible and were the proper length since canes with larger than optimal lenght or curved ones caused obstruction when they entered the machine. As can be deduced, significant work still remains to be done to make transportation system fit for industrial use, especially considering the new capacity of the system which would have to be 40 tonnes/hour to feed the hypothechnical Tilby machine with this production capacity.

Cane has to go into the Tilby machine vertically. Theoretically it is split in half lengthwise along the axis of what is supposed to be a cylinder. These two halves in their advance through the machine are subject to the action of sets of blades installed on the generatrices of the lateral surfaces of some cylinders which rotate on an axis perpendicular to that of the cane. The action of the blades inside the machine produces a woodflour, called COMFITH by the manufacturers of the Tilby machine which represents 80 % of the weight of cane.

Once this woodflour has been separated, what is left of cane continues advancing through the machine and is subjected to blades that work similary to the aforementioned ones, but on the outside. With the action of the secound set of blades DERMAX is separated, which is 2 % of cane weight.

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What is left of the cane comes out of the machine in that shapes 2 mm in thickness. The manufacturers of the system call it COMRIND. This product represents 18 % of the weight of cane.

The three products CONFITH, DERMAX, and COMRIND come out of the bottom of the machine through three separate channels

According to b) of the UNIDO Terms of reference, the Tilby separating machine neatly separates cane pulp and rind.

In fact, this neat separation does not take place. It can be appreciated that, given the heterogeneity of sizes and shapes of sugar cane, and the way the Tilby machine is designed this neat separation is very difficult to achieve. It is enough for the shape of cane not to be close to that of a cylinder or constant diameter for the products to come out of the Tilby machine rather mixed, for the distances between the blades and the cylinders which move the cane through the machine are practically constant.

We believe it is important to devote some attention to the characteristics of the pulp obtained from the Tilby machine.

As indicated under b) of the UNIDO Terms of Reference, cane pulp obtained from the Tilby machine would be used to feed the sugar mills. The pulp is so shredded that it is difficult to see how it can be treated by mills designed for cane which is shopped so that it retains its full fibre content, which is precisely what gives "grip" to cane when passing through the rolls. According to our information this sort of work has not been done in any sugar mill in the world.

We imagine that the main handicaps will be those which may arise when trying to make the pulp pass through mills which are mechanical and those connected with extraction.

It is our opinion that passing pulp through the rolls of mills would be difficult. This new system completely changes the conception and approach of traditional systems. We believe this pulp would adhere to the rolls and it would not be possible to have it pass between the rollers. As a fairly concrete fact to back up the above, we may say that the operating capacity of a group of mills is fixed by the fibre content of the cane. If one worked with the proposed new system, a pulp with a theoretically very low fibre content, completely new theories would have to be considered to enable us to use such important concepts as the working capacity of a group of mills, theories founded on completely different criteria from those existing present.

From the point of view of sugar extraction from this type of very shredded pulp, we consider that making the imbibition with water and juice, in order to get an acceptable sugar extraction, would be very difficult, even if in the case it were possible to pass the pulp through the rolls, with the pulp so shredded and pressed, we consider it would be practically impossible for the imbition liquid to get through the mass that would form. In sum percolation would diminish and the extraction yield would be seriously affected. On the other hand, with the pulp being so shredded, it is our belief that if traditional imbition could take place there would be much more organic material in the juice obtained from the mills with an increase of organic material in colloidalform. This would cause less efficient purification. Therefore the sugar obtained would be of inferior quality and as a consequence of this organic material unidentified losses of sugar during processing would increase, mainly due to saccharose inversion

In the installation visited, sugar is extracted from the pulp obtained from the Tilby machine by means of a horizontal worm-driven press. Although we were unable to evaluate technical parametres such as dry material content, juice polarization and pressed pulp, results of this press from a sugar extraction point of view, as could be observed, must be worse than those obtained by traditional procedures.

Later on we were informed by Canatlantica that the sugar content of COMRIND emerging from the machine is 4,4, %.

We are facted therefore, with a proposal for the use of a particular system, but cannot considered in isolation as it would be deployed in a process to be considered as a whole.

Although we consider that the system proposed is in itself genuinely innovative and valuable, the consequences it produces on the remaining plant are at present unknown in the best of cases.

The system proposed implies a profound revision of a good deal of the technology employed and proven over a long period without its own performance being sufficently proven and evaluated.

In our view it is not advisable to use the Tilby machines in the sugar extraction prices of the JIBOA complex.

SENER

4. REPORT ON CONCENTRATION/INCINERATION OF VINASSES

INDEX

4.1 INTRODUCTION

The purpose of this report is to submit for the consideration of UNDP/UNIDO, discussion on the possible treatment of effluents of the alcohol plant for the JIBOA project, with a view to their approval.

Disposal of by products generated in the distillation of fermented sugar cane masses, called vinasses, is a problem common to all alcohol plants, owing to their contaminating effects (especially in distilleries operating with molasses) if discharged untreated into watercourses.

However, since the JIBOA plant will operate more than half with cane juice, pollution effects from vinasse discharge are expected to be approximately half of what they are in distilleries using only molasses as raw material.

4.2 SUGGESTED TREATMENT

We have studied all possible vinasse treatments for the JIBOA plant and have considered the great financial significance of the introduction of any type of treatment. We have paid particular attention to the fact that all treatment methods still have their problems even where the plant is modern, for there are cleaning problems leading to down time and reduced profitability.

We have also taken into account the certainty that any of these plants will have to be extensively modified in the years to come.

We cannot therefore recommend any installation, especially considering the present high money cost, and we believe it more prudent to adopt the following solution :

Because of the lie of the land, we discard the solution of installing a ductwork and pump system (or irrigation channels) to conduct vinasses as fertiliser to farmland. We believe that the most appropiate solution is to instal holding reservoirs for vinasses in which a natural evaporation would gradually occur; farmers and stock-rearers of the area would be free to take any vinasses they needed. These pools would be connected to the main drainage system.

We have made the following background assumption:

1) The land available is suitable for vinasse, with good permeability characteristics but poor in potassium. We therefore estimate that 50 m3 of vinasse could be spread per ha. of land.

2) When the distillery is working with cane juice or when the season of torrential rain comes, we shall open tne connecting valves to the general drainage system to the river since then contamination problem will be less important.

3) During the dry season, vinasse will be subjected to natural evaporation, leaving a concentrate rich in vitamins and ell-suited for cattle in the area and sold a nominal price, attractive to local stock-rearers.

   In our opinion this is the simplest solution, it represent a far smaller financial outlay, and could enable the distillery operation to be profitable.

Other alternatives are described below :

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4.3. ALTERNATIVE TREATMENTS

4.3.1 Concentration of Vinasses by Evaporation

Dilute vinasses (8-10% solids) may be concentrated up to 60% solids through water evaporation in a multiple-effect evaporator, thus producing a much lower effluent flow and rendering handling much easier.

Concentrated vinasses may be used as fertilisers or animal food, but the difficulty is that sales are very difficult to achieve and the prices that can be obtained usually very low.

In fact, sale of concentrated vinasses not being easy, in return for this plant we set only better handling facility as compared with the dilute vinasses (as it does not even solve the contamination problem). Therefore, the problem posed is only very partially solved.

Of the various concentrator systems studied, we prefer the Alfa-laval since the system they propose is based on a quintuple effect evaporation plant with a surface condenser, as opposed to a quadruple-effect system with the end concentrator in line.

From data known on the latter type of plant, we may indicate that there have always existed many problems due to the numerous stoppages required for cleaning purposes.

First of all we wish to point out that this plant reaches a concentrate of 60% solids with a fairly high viscosity of about 100 cp at 95ºC and 200-300 at 50ºC, for which reason the system will work advantageously (liquid concentrate temperatures of 95-98ºC) as compared with final concentration in a high vacuum at 50ºC. There will also be savings in energy since the circulating pump works at much higher efficiency with a low viscosity liquid.

Another factor to be considered is the tendency of vinasse to form foam. Especially with increased concentration there may be a great amount of foam, if one is working with a high vacuum or using forced circulation in the end concentrator. In fact, it is known that tests conducted in laboratories on forced circulation pilot plants have not succeeded in achieving a high concentration of vinasse in vacuum conditions.

Therefore, it has been proposed that evaporator no. II, a falling-film unit working at nearly atmospheric pressure is the best suited to achieving a concentrate of 60% solids.

Finally, having a quintuple-effect evaporator has the advantage that either no.I or no. II may be used as the end evaporator, and the one left free can be cleanedonce a week, while operations continue in four stages during the cleaning, steam consumption going up at that time.

In any case, for the JIBOA project, vinasse concentration unit data is as follows:

Flow of dilute vinasse	55 t/h
maximum concentration	8-10% solids

Flow of concentrated vinasse	4.59 t/h
Concentration	60% solids
Evaporated water	50.41 t/h
Steam consumption	11.8 t/h at approx.1.8 atm.
Cooling water	700 m3/h
Installed power	245 kw.
Power consumed	190 kw. max.
Personnel	6 men

Total cost of installed unit: $ U.S. 6,070,000

Conclusions

This unit involves the tremendous complication of stoppages for cleaning (no supplier guarantees the reliability of figures for weekly down-time) and it is a plant with high consumption of all services.

Moreover, it does not in itself wholly solve the relevant problem (see point 3.3 above).

4.3.2 Anaerobic treatment of vinasses

This treatment converts most of the organic material contained in diluted vinasses into useful biogas (methane). This occurs through the action of bacterial degradation taking place naturally in an anaerobic medium (in the absence of air).

Approximately 80% of organic pollution of vinasses (measured by Biological Oxygen Demand) is converted into biogas.

The remaining 20% of initial organic pollution goes with the effluent. In our case it is equivalent to approximately 5,000 mg. oxygen/l. of B.O.D.

This means tnat problems occasioned by discharge of this effluent cannot be considered as solved with only the anaerobic treatment, since it would have to be followed by another aerobial treatmenmt involving additonal investment and operation costs.

However, for the JIBOA project, data concerning anaerobic treatment of vinasses are the following:

Flow of dilute vinasses	55,000 kg./h.
maximum concentration	8-10% solids
D.B. 05 BO_5D	30,000 $mgO_2/l.$
D.Q.O. Chemical Oxygen Demand	42,500 $mgO_2/l.$
D.B.O5 reduction.Reduction in BO_5D	80%
Final B.O.D.	5,000 $mgO_2/l.$
Methane production	436 $Nm^3/h.$
Total investment in installed unit	$ U.S. 8,135,000

The biogas (methane) produced may be burnt in the steam production boilers. In our case this gas comsuption is equivalent to 10,000 tons of bagasse per season.

It must be stated, however, tnat anaerobic digestion of cane vinasses has not so far been tested in any commercial installation and we therefore believe that there is no guarantee as to process perfomance.

SENER

4.3.3 Incineration of concentrated vinasses

After concentration, vinasses may be subjected to incineration with the purpose of obtaining useful steam and content ashes of high potassium that can be recovered.

Before analysing commercial solutions we wish to point the problems currently involved in vinasses incineration.

1. The characteristic of concentrated vinasses are similar to "black liquor" effluents in the paper industry with the only difference that they contain potassium salts instead of sodium.

2. Low melting point which makes possible the formation of an insoluble eutectic without any potential value at all.

3. The chlorine radical causes problems in the operation of the furnace.

4. The sulphate/chloride eutectic considerably lowers the melting point.

5. We do not know what in practice are the generation and maintenance problems of incinerator.

Finally, we would indicate that if it were decided to instal a vinasse concentrator and incinerator, it would be advisable to use one single supplier, thus avoiding the problem of guarantees and design features of products at the interface between two contracts.

For the JIBOA project, estimated figures are as follows:

Flow of concentrated vinasses	4,590 kg./h.
Concentration	60% solids
Calorific value	2,000 kcal/kg.
Steam production (26 bar)	13,000 kg/h.
Ash production	900 kg/h.
Fuel oil consumption	150 kg/h.
Power consumption	350 kw/h.
Boiler feedwater consumption	14,000 l/h.
Total investment installed unit	$ U.S 4,930,000

We would like to add here some relevant material supplied by Alfa-Laval, as follows :

A) Composition of chimney gas Vol. %

CO_2	13.10
H_2O	25.73
SO_2	0.08
N_2	58.84
O_2	2.25

B) Composition of Ashes

K OH	38.2
MgO	6.2
Na_2SO_4	6.6
C_aO	8.5
$K CO_3$	40.5

The above figures are based on certain suppositions regarding the composition of the vinasse. Apart from calorific value, the most important factor is the composition of salts and even the ratio between certain inorganic salts which affects the various melting and evaporation points. Therefore the possibility exists that instead of ashes one might obtain a type of products which would make cleaning operations a lot more difficult.

According to data on hand the steam production of the plant is quite safe and reliable. However, we wish to point out that estimated steam production has about the same value as steam consumption in vinasse concentration. These estimates cannot be considered definite so long as no complete analysis is available of the different types of vinasses in question, assuming that these are comparable to the ones of which we already have experience. If they are not laboratory tests with approximately 1 tonne of concentrated vinasse will be required to determine whether the proposed design must be changed or not.

Regarding ashes obtained, very rich in potassium, they constitute a valuable by-product. We have therefore included a cleaning system for exhaust gases, as well as ash handing equipment. (These are included in the investment cost given).

In our opinion, the previous paragraph is very important, since we obtain clean ashes and can handle them, but that is all.

To obtain potassium sulphate, another production unit is needed, which has not yet been put on the market by such important companies in this field as Alfa-Laval or Sulzer-Escherwyss. This supplement-

SENER

ary, unit would represent an additional cost which cannot be specificated at this moment any more than can the efficiency, operation, guarantees, etc. of the plant.

4.4 CONCLUDING REMARKS

It would be right to emphasize here that SENER has been studying the subject of vinasse treatment for six (6) years. This research culminated in the presentation in the PHILLIPPINES of a global study of all possible methods of treatment which might be introduced in San Juan de Batalan to complement a distillery producing alcohol for automotive fuel. The study indicated the non-profitability of any type of installation, but it yielded us abundant technical material from various companies specialising in this field, which served to widen our knowledge of the subject.

The characteristics of the plant in question were similar to those of JIBOA and we have therefore contacted again the companies selected then and also Sulzer-Escherwyss (because of its selection by the P.S.), in order to bring our information up to date and to adapt it to the particular features of the JIBOA project. The results are equally negative with regard to installation of a plant for treatment of vinasse. In view of all the above, therefore, we are sorry not to be able to comply with point IV of the Terms of reference of our contract concerning "examination, visual inspection and observation in conditions of commercial operation of the process and equipment for production of vinasse and especially the use of the liquors as a fuel, in order to determine its technical and economic viability.

5. MARKET STUDY

5.1 STUDY OF THE SUGAR MARKET

CONTENTS

5.1 INTRODUCTION

The project for the industrialization of sugar by-products also envisages the maintenance of sugar production until the levels reached a few years ago are regained or even surpassed. Therefore it is of interest to also be acquainted with the situation and evolution of the sugar market, even when its results do not condition sugar production when it is one of the main sources of national wealth.

The study looks initially at the problems and conditioning factors of the economics of sugar, and then goes on to analyse the world, regional and local markets and their prospects.

5.2 THE ECONOMICS OF SUGAR

5.2.1 General Aspects

Sugar is a product basically destined for human consumption, either directly or incorporated into other food or drink. Its average worldwide consumption is 20 kg per inhabitant per year and it provides 9% of the calories received by the population. It accounts for 90% of world consumption of sweeteners.

Sugar is consumed all over the world and is produced in most of it. Its characteristic of being obtainable from plants as different as sugar cane and sugar beet makes possible the worldwide distribution of its production, as sugar cane needs a tropical or sub-tropical climate, whereas sugar beet is native to the temperate zones. In this way, the tropical and temperate zones, the production of which is usually complementary in character, are competitive in the case of sugar.

The average sugar cane output worldwide in 1978-1980 was 56.5 tonnes per hectare of land cultivated. As the extraction percentage of sugar is approximately 10%, each hectare of sugar cane produces approximately 5.65 tonnes of refined sugar. Beet has had an average yield worlwide of 31.1 tonnes/Ha in the same period, which, with an average extraction rate of 13%, gives an average production figure of 4.04 tonnes/Ha. This is assuming that, on average, one hectare of cultivated land with sugar cane produces 40% more sugar than a similar plot cultivating sugar beet. However, the installation and maintenance costs are higher in the case of a beet sugar plant than in the case of a cane sugar plant, and also in the first case, the wages and wage-related costs are higher, being, naturally, the case of more developed countries. For all these reasons, beet sugar cannot compete, in price, with cane sugar, and this gives rise to several protectionist measures by the producing countries.

Cane sugar is a highly perishable commodity and has to be processed immediately after harvesting and, naturally, in the producing country. Sugar factories are usually located near the cultivated areas, although the refineries are located near the consumption, near the big cities and even in the receiving countries, in the case of exportation. Beet admits a certain storage time and its processing is continuous up to the refined state.

Both production processes leave molasses as a by-product, which is a sweet juice with very varied further uses, from the obtainment of yeast to the manufacture of alcohol, varnishes and other products. 3.4 tonnes of molasses are usually obtained from each 10 tonnes of sugar. The left over fibre also has a use: it is usually used as fertiliser or cattle feed. In the case of sugar cane, "bagasse" is traditionally used to fuel the boilers of the sugar factories, although lately it has given rise to an important manufacturing industry of composite boards with uses similar to those produced from wood.

5.2.2 Supply

The traditional raw material for the obtainment of sugar has been sugar cane. Its origin appears to be in Asia, where it has been cultivated for thousands of years, and did not suffer the effects of competition from beet until the beginning of the 19th century. It is from 1800, during the Napoleonic age, that the intensive cultivation of beet is introduced into Europe, to alleviate the effects of the continental blockade.

At the turn of the 20th century world production from both plants is more or less equal. During the First World War beet production fell noticeably and this fall went on in the post-war period, so that 1920 marks its lowest production figure in history: only 22% of sugar comes from beet, as against 78% from cane. The Second World War marks another considerable drop but production does not fall below 30%. At present, beet makes up for a little more than a third of world sugar production, the other two thirds going to sugar cane.

Sugar supply is conditioned by a broad series of factors. The most important are considered below.

WORLD SUGAR PRODUCTION OF BEET AND SUGAR CANE

1907/08 - 1980/81

(1000 Tm. - Raw value)

CAMPAIGN	WORLD TOTAL	BEET	SUGAR CANE	PORCENTAGE % BEET	PORCENTAGE % SUGAR CANE
1907/08	13 706	7 063	6 643	51.5	48.5
1908/09	14 358	6 986	7 372	48.7	51.3
1909/10	14 690	6 648	8 042	45.3	54.7
1910/11	16 824	8 668	8 156	51.5	48.5
1911/12	15 518	6 947	8 571	44.8	55.2
1912/13	18 008	9 039	8 959	50.2	49.8
1913/14	18 715	9 054	9 661	48.4	51.6
1914/15	18 213	8 312	9 901	45.6	54.4
1915/16	16 721	6 111	10 610	36.5	63.5
1916/17	17 038	5 865	11 173	34.4	65.6
1917/18	16 863	5 153	11 710	30.6	69.4
1918/19	15 880	4 428	11 452	27.9	72.1
1919/20	15 213	3 350	11 863	22.0	78.0
1920/21	16 831	4 906	11 925	29.2	70.8
1921/22	17 870	5 130	12 740	28.7	71.3
1922/23	17 857	5 357	12 500	30.0	70.0
1923/24	19 579	6 059	13 520	31.0	69.0
1924/25	23 201	8 295	14 906	35.8	64.2
1925/26	23 759	8 618	15 141	36.3	63.7
1926/27	23 211	7 896	15 315	34.0	66.0
1927/28	25 118	9 165	15 953	36.5	63.5
1928/29	26 801	9 613	17 189	35.9	64.1
1929/30	26 740	9 359	17 381	35.0	65.0
1930/31	27 863	11 921	15 942	42.8	57.2
1931/32	25 007	8 791	16 216	35.1	64.9
1932/33	22 746	8 004	14 742	35.2	64.8
1933/34	24 282	9 169	15 113	37.8	62.2
1934/35	24 644	9 802	14 842	39.8	60.2
1935/36	27 038	10 440	16 598	38.61	61.39
1936/37	28 642	10 226	18 416	35.70	64.30
1937/38	29 273	11 082	18 191	37.85	62.15
1938/39	28 472	10 562	17 910	37.09	62.91
1939/40	30 352	11 621	18 731	38.28	61.72
1940/41	29 902	11 684	18 218	39.07	60.93
1941/42	27 322	8 699	18 623	31.83	68.17
1942/43	25 294	8 816	16 478	34.86	65.14
1943/44	24 878	7 605	17 273	30.57	69.43
1944/45	21 739	6 497	15 242	29.88	70.12
1945/46	19 162	6 221	12 941	32.46	67.54
1946/47	22 946	7 389	15 557	32.20	67.80
1947/48	24 565	7 546	17 019	30.71	69.29
1948/49	28 030	10 076	17 954	35.94	64.06
1949/50	29 002	10 695	18 307	36.87	63.13
1950/51	33 576	14 102	19 474	41.98	58.02
1951/52	36 000	14 164	21 836	39.35	60.65
1952/53	34 590	13 421	21 169	38.80	61.20
1953/54	38 583	16 606	21 977	43.04	56.96
1954/55	38 405	15 189	23 216	39.55	60.45
1955/56	39 882	16 097	23 785	40.36	59.64
1956/57	42 286	16 632	25 654	39.33	60.67
1957/58	45 874	19 123	26 751	41.68	58.32
1958/59	50 892	21 616	29 276	42.47	57.53
1959/60	50 084	20 312	29 772	40.56	59.44
1960/61	55 442	24 266	31 176	43.77	56.23
1961/62	52 542	22 670	29 872	43.15	56.85
1962/63	51 382	21 847	29 535	42.52	57.48
1963/64	55 032	23 497	31 535	42.70	57.30
1964/65	66 365	30 310	36 055	45.67	54.33
1965/66	62 882	26 915	35 967	42.80	57.20
1966/67	65 016	27 839	37 177	42.82	57.18
1967/68	65 314	28 864	36 450	44.19	55.81
1968/69	68 819	30 771	38 048	44.71	55.29
1969/70	72 992	29 727	43 265	40.73	59.27
1970/71	72 001	29 721	42 280	41.28	58.72
1971/72	71 667	30 700	40 987	42.83	57.17
1972/73	76 724	30 533	45 191	40.32	59.68
1973/74	79 581	31 742	47 839	39.89	60.11
1974/75	77 585	28 343	49 242	36.53	63.47
1975/76	80 809	31 615	49 194	39.12	60.88
1976/77	85 858	32 552	53 306	37.92	62.08
1977/78	92 110	35 146	56 964	38.16	61.84
1978/79	90 950	35 363	55 587	38.88	61.12
1979/80	84 134	33 931	50 203	40.33	59.67
1980/81	86 466	32 430	54 036	37.51	62.49

SOURCE: F.O. LICHT
International Sugar Economic Year Book and Directoy 1981

The ratio existing between cane and beet sugar and the nature of cultivation of the various producing countries has a decisive influence on the supply trends in the world sugar market. Beet sugar is produced fundamentally in the more developed countries, whereas cane sugar is a typical product of less developed economies, where production costs have been until now, traditionally lower. However, the mechanization of beet cultivation has produced a rapid change in the cost situation. So, the yield of beet has grown much more than that of cane in the last twenty years. Prices are always a factor determining the supply of any product. But in the case of sugar, its variations do not have a direct repercussion on world supply.

In recent years, production has begun to show signs of responding more faithfully to the level of prices. The extension of cultivation in various zones of the world - thus compensating variations due to climatological causes - and the lessening of the differences in technology between the various countries, has made the contingency of annual sugar production in the world to be reduced. Although this response to the price is not uniform, it is expected that it will be more and more in the future.

Many factors influence the cyclical behaviour of the sugar market, but the nature of cane cultivation is one of them. The fact of there being 18-24 months between sowing and harvesting makes the response to price levels by cane sugar very inflexible. The production cycle of beet is noticeably shorter than that of cane, which also tends to facilitate a response to price fluctuations.

The existence of high sugar stocks and a great number of bilateral agreements reinforces this trend.

Production costs have a decisive importance in the supply configuration. Over the last 20 years, real production costs - without taking subsidies into account - have grown at levels higher than sugar prices. If this growth trend continues, the sugar market will be affected by it, especially if we bear in mind that substitutes are more and more economical.

However, we cannot talk of the average production cost of sugar. The various conditions of production and techniques implanted in the various countries, and between cane and beet, make that in the various areas there are producers with high and low costs and remarkable differences in profitability.

The measurement of costs is made more difficult by the lack of information or by the existence of information highly influenced by national policies, government subsidies, incentives, customs tariffs, etc.

As already stated, the production cost of beet tends to be higher, although improvements to productivity and the use of less intensive labour methods tends to make up for this, so the growth rate is less than that of the costs of sugar cane.

Generally, the high proportion of fixed costs to total costs in the production of sugar may justify from the economic point of view that a country should continue to produce sugar as long as the prices cover the variable costs, as the abandonment of production would be a greater loss for the country. The product may be destined for the domestic market or maintained with subsidies, at least temporarily.

If the production costs of cane sugar were to continue to increase more rapidly than those of beet sugar, and even at a faster rate than the average world prices, a reduction in cane sugar production could result - owing to a loss of competitiveness in the market - balancing out at a higher price, but a lower level.

In this connection, it is important to consider improvements to the cultivation and harvesting methods of both plants.

In the field of beet ,remarkable improvements have been made over the last 20 years, tending towards the achievement of a more modern manner of cultivation. Progress has been made especially with the monogerm seed, with modern agricultural machinery and the use of increasingly efficient weed-killers.

Unlike beet cultivation, little or nothing has been done in the field of reasearch into sugar cane cultivation. Therefore important changes are to be expected this decade. Work has been carried out with more disease resistant varieties, with higher sucrose contents, more easily cut varieties, etc. One of the most important fields of research is that of varieties with shorter growth periods. Another is the use of fertilisers and agrochemical products.

At the present time only around 28% of sugar cane is harvested mechanically, so the improvement objectives in this field are considerable.

Apart from the basic relationship between prices, costs and production levels, there are other important factors influencing supply at the level of the world market. Among them are the manners of cultivation (large plantations or small plots), the influence of the large companies with interests in several countries, government intervention either in an isolated way, on their own production, or by means of bilateral or multilateral agreements, or the participation of multilateral bodies, controlling or financing the development of new projects.

5.2.3. Demand

During the fifties, sugar demand rose at a rate of 5% per year, 4% during the sixties, and 3% in the seventies. In general terms the main factors influencing demand in the sugar market have been the following:

- The income level of potential consumers
- The price of sugar
- Sugar production in their own country

The demographic increase has also been important in the developing countries.

Consumption increases with the standard of living, reaching saturation point in some countries. This is the case of the developed countries, with levels of consumption of 45-55 kg per inhabitant per year, the demand of which does not depend on domestic production. In these, the elasticity of demand with regard to income is very low and elasticity with regard to price is of almost equal value, but with a negative sign. (see following table).

In the developing countries, domestic demand is highly influenced by local production. In countries which

ELASTICITY OF SUGAR DEMAND WITH RESPECT TO RENT AND PRICE IN SELECTED COUNTRIES

COUNTRIES	ELASTICITY RESPECT TO RENT	ELASTICITY RESPECT TO PRICE	CORRELATION COEFFICIENT
DEVELOPED COUNTRIES			
EUROPE			
Austria	0,22	-0,22	0,92
Belgium	0,29	-0,29	0,87
Finland	0,10	-0,10	0,70
France	0,24	-0,24	0,94
Greece	0,32	-0,32	0,91
Ireland	0,19	-0,19	0,88
Italy	0,33	-0,33	0,94
Nederlans	0,16	-0,16	0,88
Norway	0,00	-0,26	0,82
Portugal	0,47	-0,47	0,99
Spain	0,39	-0,39	0,97
Switzerland	0,14	-0,14	0,74
Turkey	0,53	-0,36	0,99
West Germany	0,16	-0,16	0,96
Yugoslavia	0,43	-0,43	0,99
NORTH AMERICA			
Canada	0,13	-0,13	0,83
USA	0,10	-0,10	0,76
OTHERS			
Australia	0,04	-0,04	0,66
Japan	0,35	-0,22	0,99
South Africa	0,16	-0,30	0,82
COUNTRIES IN DEVELOPMENT			
CENTRAL AMERICA			
Costa Rica	0,47	-0,47	0,97
Dominica Rep.	0,42	-0,42	0,92
El Salvador	0,46	-0,58	0,95
Guatemala	0,84	-0,84	0,92
Honduras	0,43	-0,43	0,98
Jamaica	0,20	-0,09	0,95
Mexico	0,30	-0,30	0,98

ELASTICITY OF SUGAR DEMAND WITH RESPECT TO RENT AND PRICE IN SELECTED COUNTRIES

COUNTRIES	ELASTICITY RESPECT TO RENT	ELASTICITY RESPECT TO PRICE	CORRELATION COEFFICIENT
SOUTH AMERICA			
Argentina	0,29	-0,05	0,67
Brazil	0,23	-0,25	0,82
Chile	1,12	-0,22	0,86
Colombia	0,67	-0,20	0,96
Ecuador	0,36	-0,36	0,98
Peru	0,59	-0,23	0,92
Venezuela	0,50	-0,50	0,98
ASIA			
India	0,71	-0,71	0,48
Indonesia	0,71	-0,41	0,86
Iran	0,14	-0,14	0,81
Iraq	0,42	-0,25	0,96
Israel	0,21	-0,10	0,96
Jordan	0,90	-0,90	0,89
Malaysia	0,83	-0,61	0,93
Pakistan	1,30	-1,30	0,88
Philippines	1,05	-1,05	0,85
South Korea	0,53	-0,19	0,87
Sri Lanka	3,06	-4,10	0,84
Syria	0,45	-0,45	0,93
Thailand	0,71	-0,30	0,95
AFRICA			
Algeria	0,44	-0,44	0,86
Cameroon	1,89	-0,54	0,90
Central African Rep.	2,66	-2,66	0,84
Egypt	0,40	-0,40	0,98
Ethiopia	0,77	-0,77	0,91
Ghana	0,76	-0,76	0,83
Ivory Coast	1,20	-0,60	0,92
Kenya	1,42	-1,42	0,91
Madagascar	0,55	-0,62	0,96
Morocco	0,28	-0,28	0,73
Nigeria	0,34	-0,34	0,93
Senegal	1,68	-1,68	0,69
Tanzania	2,55	-1,45	0,87
Tunisia	0,33	-0,33	0,80
Uganda	0,98	-0,98	0,83
Zaire	0,32	-0,32	0,90
Zambia	0,91	-0,91	0,68

are net exporters (usually in America) consumption is placed at between 35 and 45 kg/inh./year, with a tendency to increase and domestic prices do not appear to be conditioned by the world price. The elasticity of demand with regards to income and price move at intermediate levels, with considerable variation from one country to another.

Lastly, the developing countries which are net importers of sugar (almost always in Asia and Africa) have a very low average consumption, 5-10 kg/inh./year and elasticities frequently around or over one, which implies heavy variations with income or price. In these countries there is a trend towards a rapid increase in local production.

Sugar obtained from cane and beet receives the name of centrifugal sugar. However, in some countries of Asia, Latin America and Africa different processes are used and so-called non-centrifugal sugar is produced, which does not enter world statistics but the volume of which in the world may be approximately 12% of world production. This type of sugar does not present competitiveness at all in the market.

The main source of competition for sugar comes from sweeteners, which may be classified into two groups: calory and non-calory. The latter are usually used in diets, whereas the former is a sugar substitute for industrial uses.

The estimated figures of world consumption are the following:

WORLD CONSUMPTION OF ALL TYPES OF SWEETENERS
1960 - 1980

	1960 Volume	%	1970 Volume	%	1980 Volume	%
Centrifugal sugar	48.3	81.2	72.1	82.7	91.0	81.3
Non centrifugal sugar	8.4	14.1	10.2	11.7	12.0	10.7
Starch based	2.4	4.0	3.6	4.1	7.5	6.7
Low calorie	0.4	0.7	1.3	1.5	1.5	1.3
T O T A L	59.5	100.0	87.2	100.0	112.0	100.0

SOURCE: Estimates of the Sugar Industry
Taken from Chilvers and Foster. The International Sugar Market
E.I.U. London 1981.

These sweeteners have had an important penetration in the market in the seventies. Although their consumption represents 10% of world sugar consumption, their influence in the market has been greater, being concentrated in a few developed countries, especially the USA and Japan.

The success of these sweeteners, especially low calorie sweeteners, can be summarized in two of the commonest attacks on sugar: sugar is harmful to health and sugar causes weight problems.

The most used up till now has been saccharine although a substitute is being looked for as it leaves a bitter aftertaste and there are suspicions of it being a cancer causing substance.

Starch based calorie sweeteners have made great progress in the food industry, to sugar's cost. The most important product is High fructose Corn Syrup (HFCS) owing to its greater sweetening power and relative low cost

There are at present three generations of HFCS classified according to their fructose content:

1st generation	42%
2nd generation	55%
3rd generation	90%

This introduction of sweeteners, especially in the American markets will cause problems for the sugar market.

Over the last years its use has become generalised in the USA and Japan. At present it can only be produced in liquid form, which still restricts its application. Its share of the American market in 1980 was 30%. Sugar consumption in the U.S. decreases as HFCS is being implanted and improved.

HFCS demand in the USA reached a record level in 1980 but by all accounts it has not yet reached optimum levels and will continue to capture its market quota in the coming years.

In the long term, however, the permenent sucess of HFCS depends on the price and availability. HFCS producers tend to set the price at a margin below the price of sugar. For the present, the problem faced by HFCS producers is insufficient capacity to supply the market. However, numerous expansion projects are underway.

The use of HFCS is also growing in Japan and it is expected to obtain 20% of the Canadian market by 1985. However, in the European market and due to the encouragement given to beet production there are barriers controlling the production of HFCS. The use of sweeteners will tend to depress sugar prices and the appearance of granulated HFCS is feared, which would deal a death blow to sugar.

If sugar has a strong future competition with sweeteners, it also has new fields of use, both of itself and of its by-products. Both sugar and molasses are currently being converted into alcohol and this used as fuel added to gasoline (petrol) in a proportion of up to 20% and even without mixing, adapting car engines for use with alcohol only. Brazil is the leader in these experiments. In earlier chapters of this Study the markets of sugar by-products have been considered, such as the manufacture of boards from bagasse , alcohol from molasses and the manufacture of potassium sulphate (sulphate of potash) for use as a fertiliser.

It is important to note that the industrial use of sugar by-products can collaborate effectively in improving the profitability of cane sugar production. The main problem is the lack of suitable technology which would make it possible to reduce the conversion costs.

5.2.4 Prices

The free market price of sugar has been traditionally characterised as following certain cycles. These were represented by long periods of very depressed prices followed by short periods of high prices. The causes of this cyclic behaviour have been discussed, though the conditioning factor of this seems to be the slow response of supply, both to the rising prices caused by greater demand, and to a period of unremunerative prices.

As was stated earlier, in the case of sugar cane, the first harvest takes place 18-24 months after planting, whereas beet is an annual harvest which needs 6-8 months between sowing and harvesting.

Therefore the cane growers are less capable of expanding production in response to higher prices than the beet producers. In the same way if production should be reduced, the cane growers are at a differential disadvantage, as they have already incurred the cost of sowing.

The procedure of the cycle is the following: from a position of balance of supply and demand, an alteration occurs, caused, for example, by a disastrous harvest in some important country from the point of view of production. As the market adjusts, prices rise, the growth of consumption de-accelerates and producers embark on expansion projects.

There are some years of growth of production with only a constant or negative growth of consumption, which leads to a fall in the level of prices. When production decreases surplus is replaced by deficit, stocks fall and prices recover.

The residual and minority character of the free market in international trade in sugar tends to create price instability, making sugar one of the most unstable markets.

The competition developed in the seventies by sweeteners has been a new factor of unbalance in the market.

Variations in prices have been very large over the last 30 years (see following graphs). The fifties decade was all low prices and a downward trend. The sixties was very irregular, with a heavy rise in 1963 lnd 1964 (poor harvests in Cuba) followed by a brutal fall to the lowest prices of the whole period (1.23 US cents per pound at the beginning of 1967) between 1966 and 1968. The trend has been upward until 1974, in which a maximum price of 56.5 US cents per pound was reached, followed again by a decrease until 1978 and a sharp increase in 1980. The following table shows the monthly price situation between 1970 and 1980.

The broad variations in the free market prices for sugar suggest that it is affected by many and unpredictable factors, such as: climatic conditions, changes in government policies, strikes, armed conflict, etc.

Taking prices from 1950 to 1976, G.B. Hagelberg has made an attempt to analyse its structure by means of an analysis of time series. We take the results of his study as they appear in the Licht Yearbook for 1979. Figure I shows the estimated price trend. From an examination of the cyclic variations it is deduced that a more sophisticated procedure could have obtained a trend adjustment of greater precision. The breakdown of the series of prices confirms that cyclic variations are the main cause of the price instability of sugar.

Precio diario I.S.A. de azúcar[a]
f.o.b. y estibado en puerto del Caribe, a granel
Promedios mensuales: 1970-80

Mes	*Promedios de cinco años* 1970-74	1975-79	*Años civiles* 1975	1976	1977	1978	1979	1980
			(Centavos EE.UU. por libra)					
Enero	8,05	15,40	38,31	14,02	8,34	8,77	7,57	17,16
Febrero	9,25	14,56	33,98	13,50	8,59	8,48	8,23	22,75
Marzo	9,27	13,27	26,40	14,79	8,98	7,74	8,46	19,64
Abril	9,16	12,69	23,95	14,05	10,04	7,59	7,82	21,25
Mayo	9,52	11,21	17,37	14,54	8,95	7,33	7,85	30,94
Junio	9,41	9,98	13,65	12,99	7,87	7,23	8,14	30,80
Julio	9,62	10,45	16,69	13,21	7,39	6,43	8,52	27,70
Agosto	10,78	10,43	18,61	10,02	7,61	7,08	8,85	31,77
Septiembre	11,60	9,84	15,50	8,31	7,31	8,17	9,90	34,74
Octubre	12,91	10,04	14,07	8,03	7,09	8,96	12,05[d]	40,55
Noviembre	16,38	10,04	13,47	7,88	7,07[c]	8,01	13,78	37,81
Diciembre	15,15	10,50	13,19	7,55	8,09[c]	8,00	15,67	28,79
Promedio	10,93	11,49	20,37	11,51	8,10	7,81	9,65	28,69
Cotizaciones diarias:								
Máxima	2,77	6,03	45,55	15,65	10,81	9,30	15,96	43,10
Mínima			12,18	7,10	6,11	6,03	7,41	14,43
Precio deflacionado[b]	17,63	10,84	22,14	12,51	8,10	6,79	7,37	19,79

Fuente: Archivos de la O.I.A.

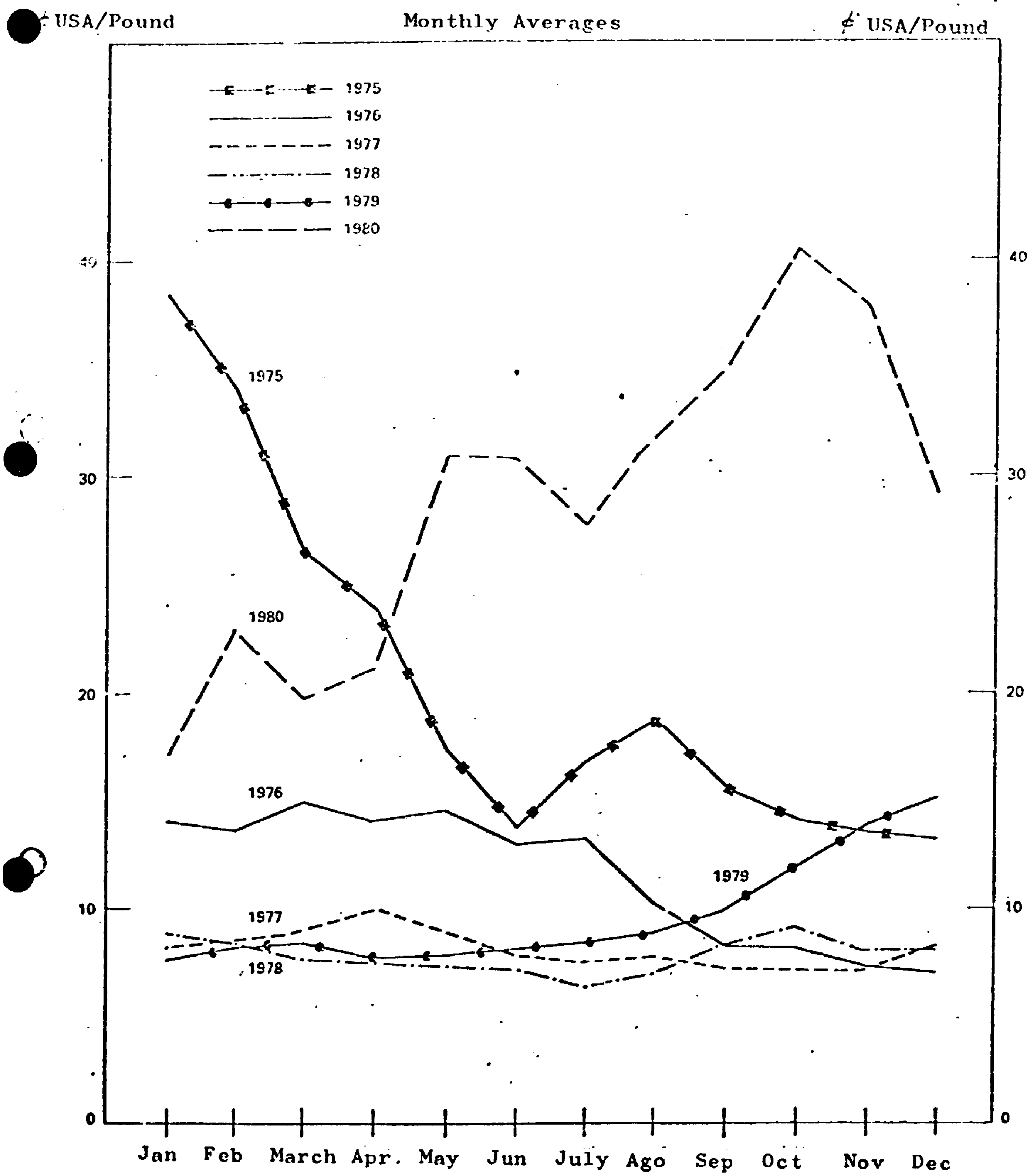
[a] Calculado conforme al párrafo 1 del artículo 61 y a las reglas económicas 611-2 y 611-3 del Convenio Internacional del Azúcar de 1977 desde 1978, a la regla estadística S-14 (2) del Convenio Internacional del Azúcar de 1973 para 1974-77 y al artículo 33 del Convenio Internacional del Azúcar de 1968 para 1969-1973. La serie de precios desde 1974 no es estrictamente comparable con las series para años precedentes, ya que desde 1974 el precio de Londres fue convertido al tipo diario de cambio, mientras que anteriormente fue convertido a un tipo fijo. Además, desde 1974 el precio diario fue el promedio de los dos precios f.o.b. o bien, si la diferencia entre ambos era mayor de diez puntos, añadiendo cinco puntos al menor; en años anteriores, fue el promedio de los precios menores más tres puntos, si la diferencia era mayor de seis puntos.

[b] Promedios anuales del precio diario del Convenio (ISA) deflacionados por el índice de las Naciones Unidas (1977 = 100) de valores unitarios de las manufacturas exportadas por países desarrollados con economía de mercado (Sudáfrica, Canadá, Estados Unidos de América, Israel, Japón, Europa Occidental (incluida Yugoslavia y excluida Turquía), Australia y Nueva Zelandia.

[c] Tras la suspensión de las cotizaciones para pronta entrega del Contrato N° 11 de Nueva York desde el 3 de noviembre de 1977, el Consejo acordó en su décimo período de sesiones que el precio diario de Londres, después de su correspondiente conversión, sería el precio diario del Convenio.

[d] A raíz de una decisión del Comité Ejecutivo, las cotizaciones de precio para pronta entrega del Contrato N° 11 de Nueva York, reanudadas desde el 20 de agosto de 1979, han sido utilizadas a partir del 17 de septiembre de 1979 en el cálculo del precio diario del Convenio.

DAILY SUGAR PRICE ASPER AGREEMENT: 1975-1980
f.o.b. and bulk loading in a Caribean Port



DAILY SUGAR PRICE ASPER AGREEMENT
f.o.b. and bulk loading in a Caribean Port
Annual Averages: 1961-1980 and monthly averages 1977-1980

¢ USA/Pound ¢ USA/Pound

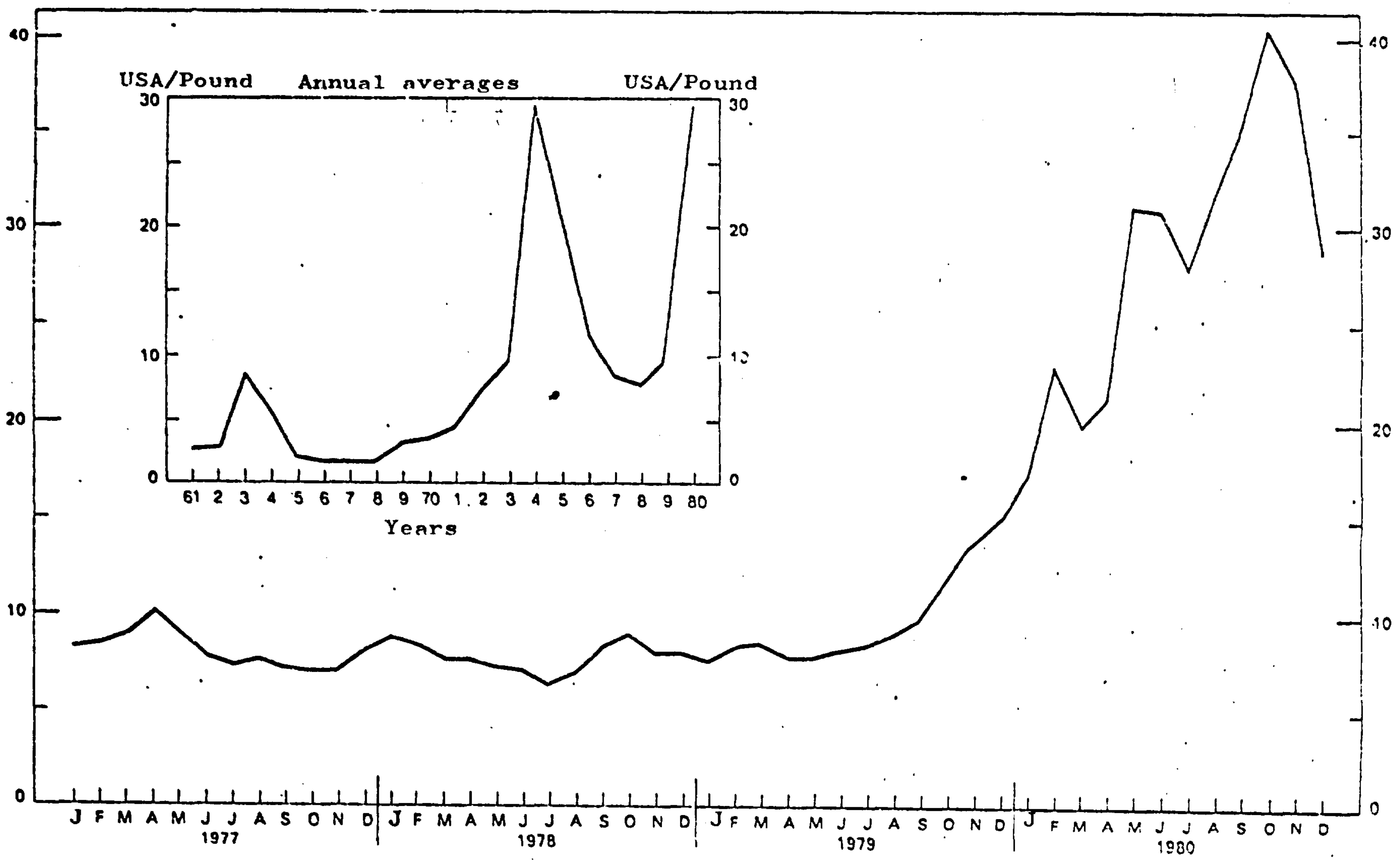
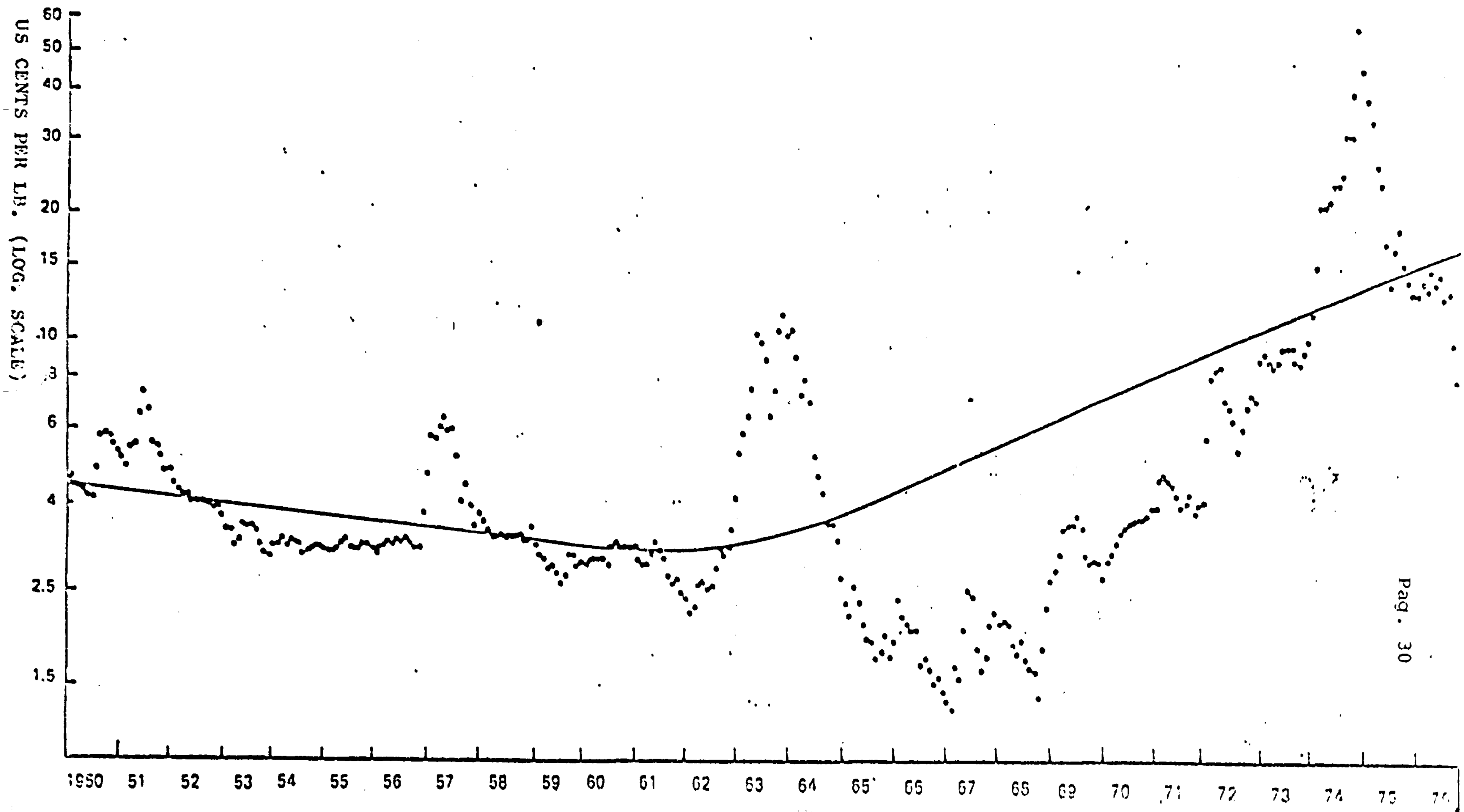


Figure 2 shows the importance of the fluctuations, especially those of the most recent cycles. The graph also shows that between the greatest cyclic movements there was a number of less intense and briefer subcycles.

Figure 3 shows the relationship existing between the cyclic variation in the average price in the year n and the ratio of final stocks/consumption expressed as a percentage in year n^{-1}. A correaltion coefficient of 0.64 was obtained.

In comparison with the cyclic variations, irregular fluctuations (figure 4) are of less magnitude and more normally distributed, in the sense that small deviations occur with great frequency, whereas large deviations are infrequent.

FIGURE 1: MONTHLY SPOT PRICES, NEW YORK CONTRACT, AND ESTIMATED TREND



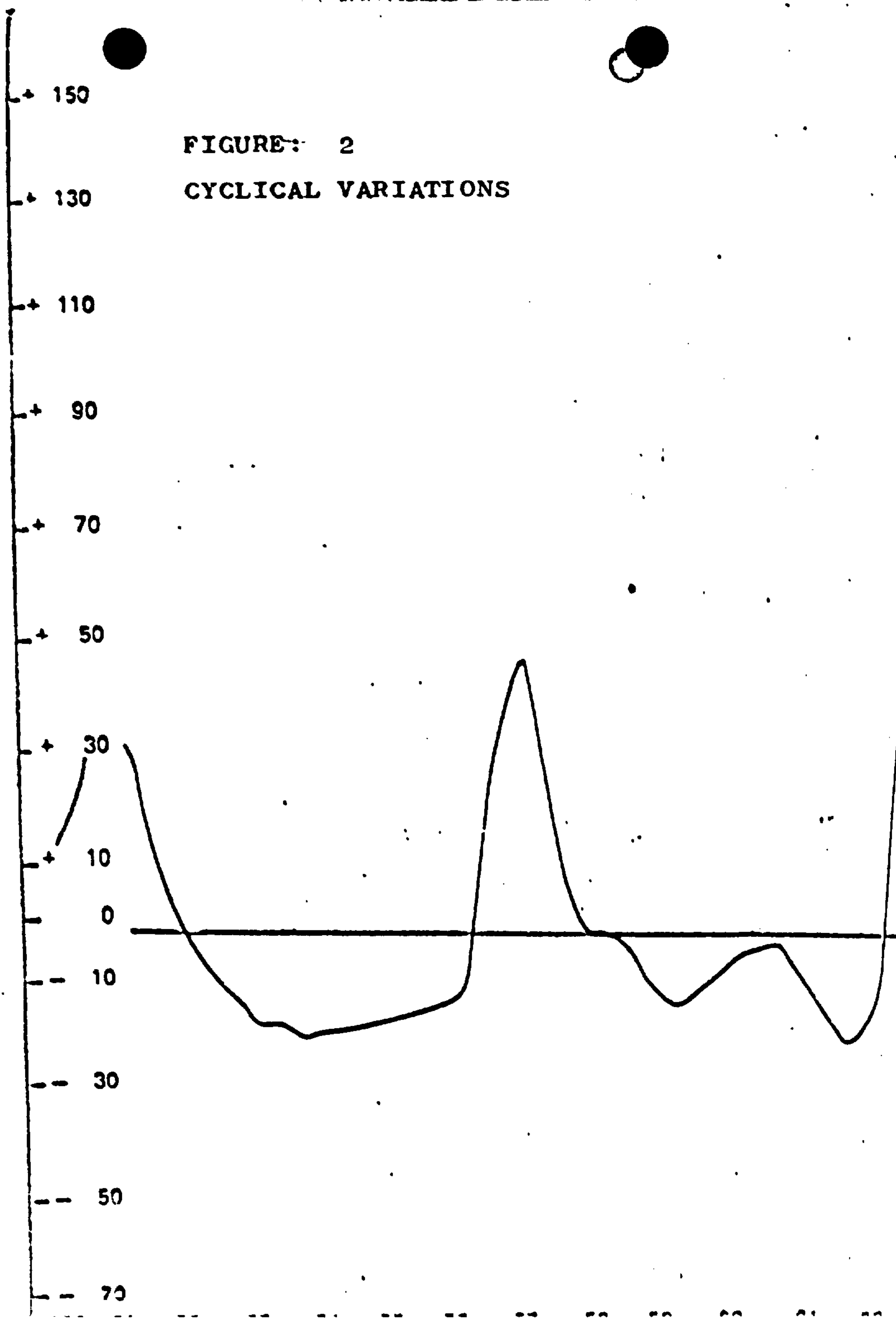


FIGURE: 2

CYCLICAL VARIATIONS

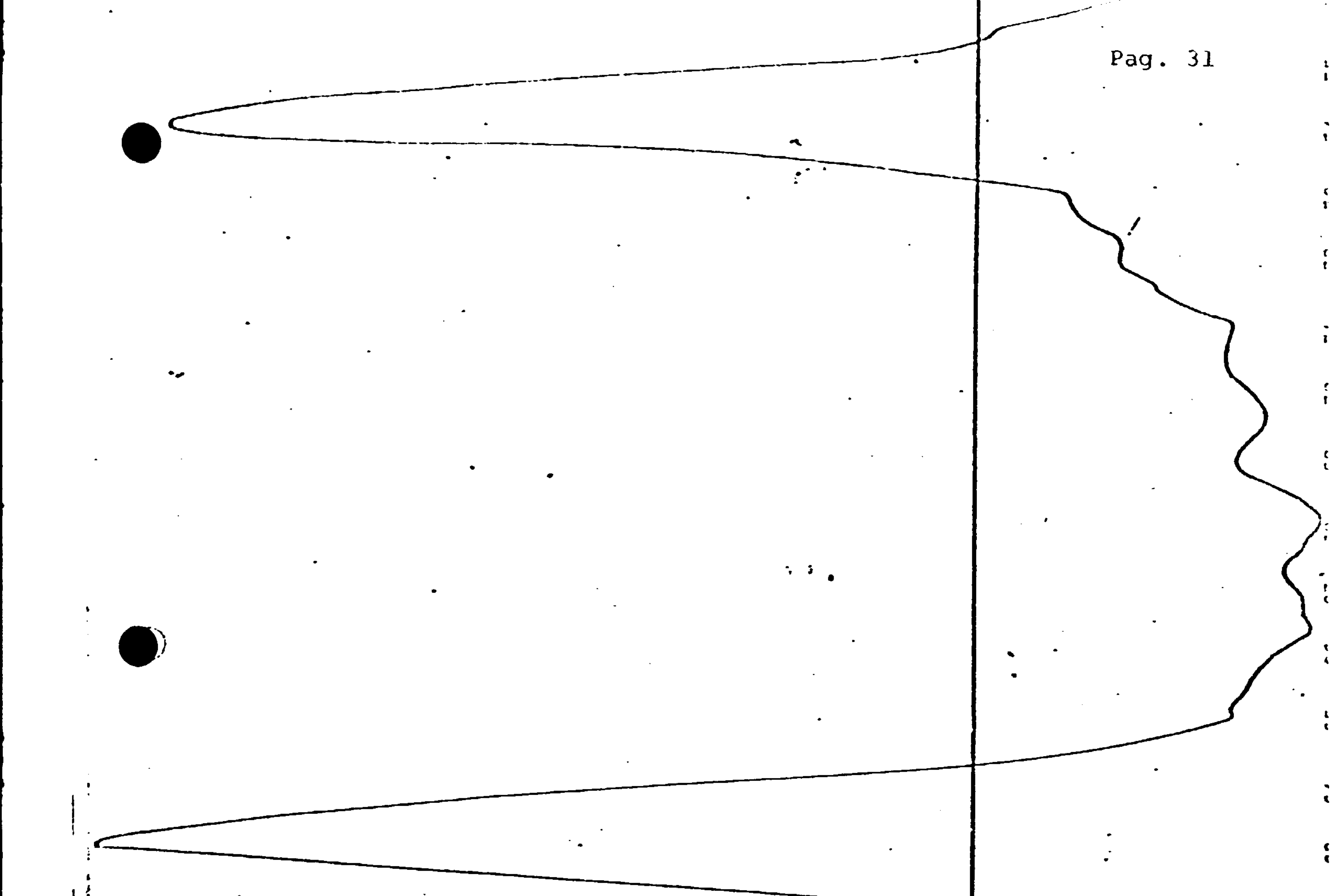


FIGURE 3: RELATIONSHIP BETWEEN STOCK/CONSUMPTION RATIO AND CYCLICAL PRICE VARIATION.

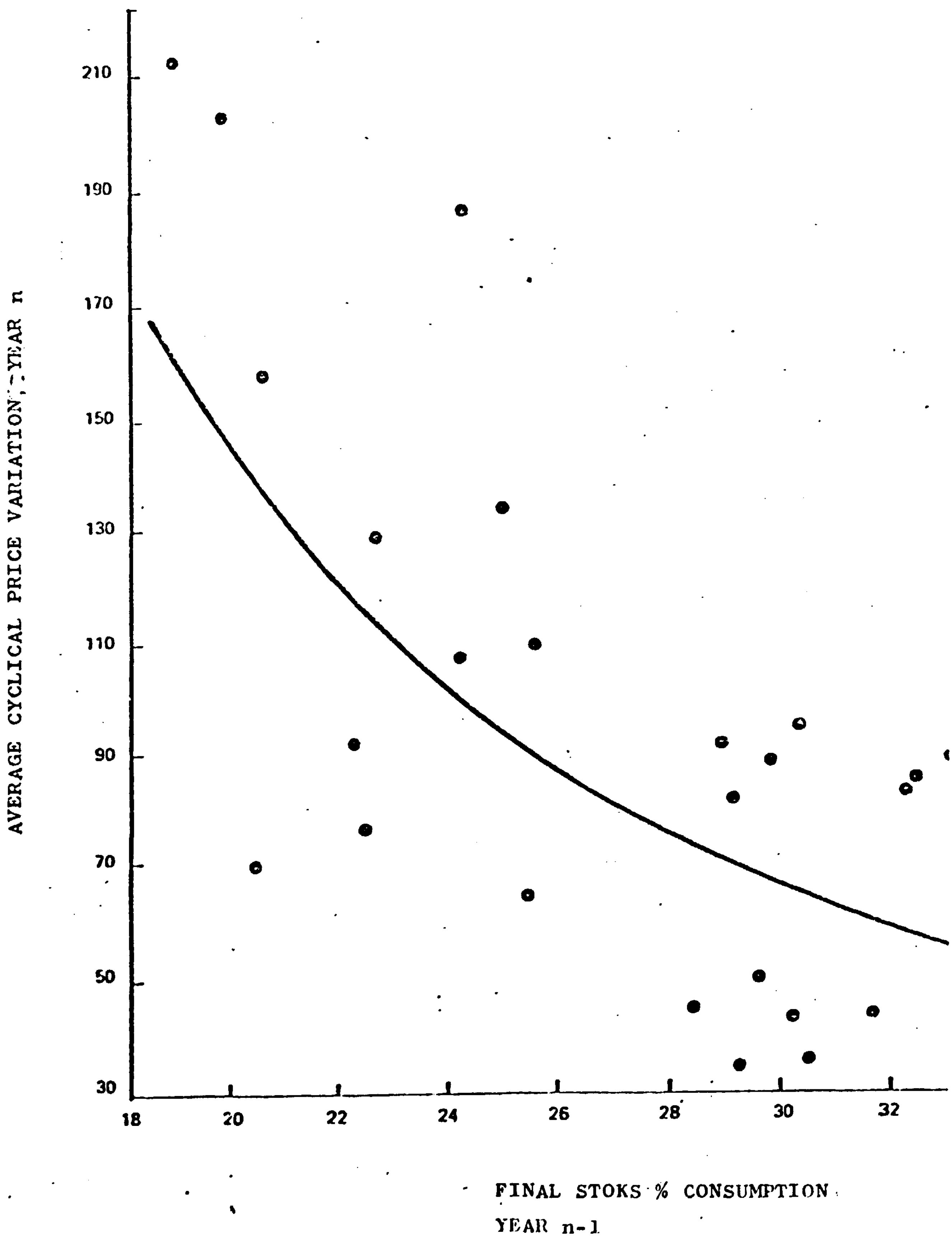
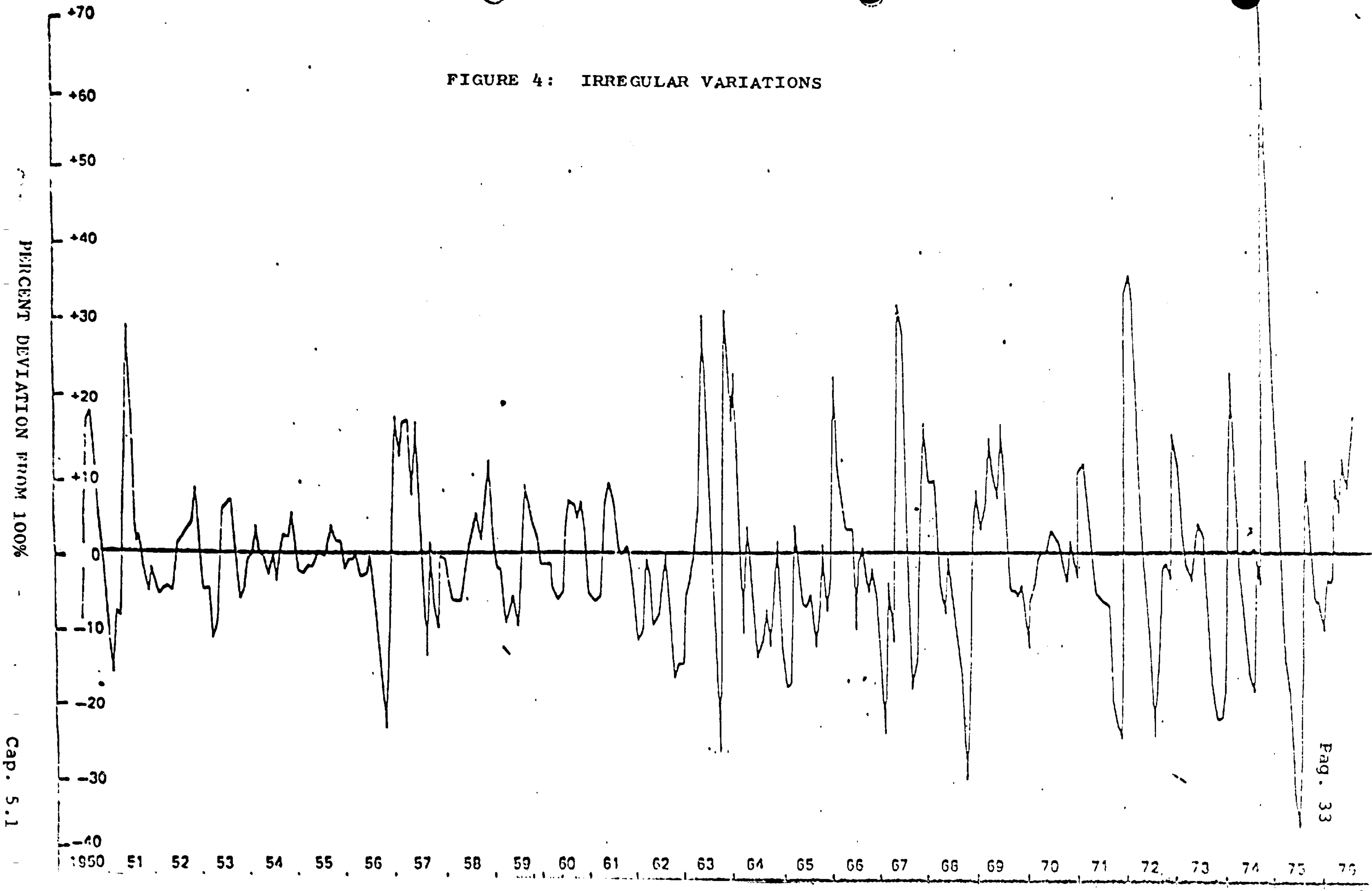


FIGURE 4: IRREGULAR VARIATIONS



5.2.5 International Agreements

Sugar has been one of the first products to be subjected to international control. As early as 1864 four European countries made a 10 year agreement to liberalize trade and progressively decrease the limitations on free trade. Success was slight.

They had to wait until the Brussels Convention, in 1903, for the limitations to disappear and by a reduction in prices achieve an increase in demand. This lasted until the First World War. Between the war years and more exactly until 1931, five European countries, Peru, Cuba and Java concluded the Chadbourne Agreement to reduce sugar production and raise prices. The agreement failed after five years, as the non signatory countries increased their sugar production. This led to the more general agreement regulating the international market.

This agreement was called the "International Agreement on the Regulation of the Production and Sale of Sugar" and its aim was to attempt to solve the surplus supply by means of a reduction in stocks and production. It was signed by 17 countries all over the world.

This agreement divided the market into special trade agreements and a residual free market. It did nor have many opportunities to demonstrate its effectiveness as it came into operation in April 1938, one year before the Second World War began. The agreement was only kept alive as a forum for negotiation, until a new agreement was established in 1953. This was made for a five year period, until 1958, when it was replaced by another five year agreement. The number of signatories was gradually increased over this period and in 1960 the agreement covered 95% of net exports and 65% of net imports in the free market.

The 1953 and 1958 agreements are strongly reminiscent of the 1937 agreement. They imposed a limit on the stocks (20% of annual production at the beginning of the new harvest year). However, these agreements introduced new features as compared with the 1937 agreement. They did not only attempt to control overproduction, but in addition attempted to achieve stable prices and assistance for the maintaining of the purchasing power in the world markets of the producing countries. These agreements also attempted to achieve specific price objectives, and the member countries undertook to limit imports from non-member countries.

This agreement lasted until 1968 when another agreement came into force. However, the United States did not sign and neither did the member countries of the European Economic Community, boycotting from outside the actions taken in it.

The 1968 agreement is similar to its predecessors. The fundamental changes were produced in the member countries, such as the need to show Cuban trade with the Eastern Block countries. The price band was also widened.

It lasted until 1973, but in its period of validity there was great disconcertment due to the great leap in prices, which lasted until the 1977 agreement exceeding all expectations. The new agreement retains all the 1968 members and includes the USA. The EEC has still not subscribed to it, which is increasingly harmful, as the Community is one of the strongest exporting blocks.

The Stock Financing Fund was set up, financed by the members and destined to partially offset the maintenance costs of stocks.

The agreement presented two problems: First export quotas were kept too high and although prices remained

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low, there was still too much sugar on the free market. In addition, the United States did not ratify the agreement so the Stock Financing Fu was practically inoperative. At the beginning of 1980, the USA ratified the agreement, but when it was no longer so important.

Recently the Council of the International Sugar Organization has approved a two year extension to the International Sugar Agreement from its near expiry date at the end of 1982. Changes may be made in this modifying the amount of tonnage for export. The USSR has shown its opposition and the European Economic Community has begun to consider the possibility of its joining an improved agreement, as the present conditions are not acceptable from the point of view of the community.

For its part, the EEC approved last year new regulations on sugar, which came into force in July 1981. It maintains basically the structure of the quota system and it seems that the problem of sugar overproduction has not been solved. The EEC being one of the great sugar exporters in the world, its joining the I.S.A. would be basic to reinforcing its effectiveness.

5.3 THE WORLD MARKET

5.3.1. Evolution 1970-1980

The world production of centrifugal sugar has risen from 73 to 84 millions of tonnes (unrefined), in the last decade, which represents a total increase over the period of 15.8% and a growth rate of accumulated yearly average of 1.46%. This total growth is unequal at the level of continents. So, while South America has increased her production by almost 50% and Europe, North America and Africa have done so above the world average, Asia has had growth smaller than that average and Oceania and Central America have seen a decrease in production in real terms, although by a small amount.

Consumption has increased at a higher rate than production - 21.5% or 1.97% yearly accumulative - although the average figure per inhabitant has been maintained due to the population increase. The highest percentages appear in Africa and South America (63%), Europe and Oceania being below the average world increase, possibly because many of those countries are approaching saturation. The only continent in which consumption has suffered a reduction (10%) was North America. One must take into account the penetration HFCS and other sweeteners have had during this decade. Per capita consumption has also fallen in North America and Oceania.

As a consequence of all this, North America has made a hefty decrease in its imports over the period (29%), whereas the world average has risen by 30%. The strongest growth has been in Central and South America, but in the first case it is a specific and untypical behaviour, as Mexico, a net exporter in the rest of the period, has had a high volume of imports in 1980. In parallel manner, the exports of Central America have been reduced by 13% over the period.

As a consequence of these differential variations in sugar supply and demand, the structure of the relative participation of the various continents in the world total of each heading has changed. The most important changes observed between 1970 and 1980 are:

- in production:
  the increase in the relative importance of South America to the cost of Central America;

- in consumption:
  the decrease in the participation of Europe and North America and the increase of South America and Africa;

- in imports:
  the increase of Central and South America and Africa and the decrease of North America;

- in exports:
  the increase of Europe and South America and the fall in Central America

So, in 1980 the configuration of the main continents for the four activities is as follows:

Production:	Europe (34% of world)
	Asia (17% of world)
Consumption:	Europe (37% of world)
	Asia (24% of world)

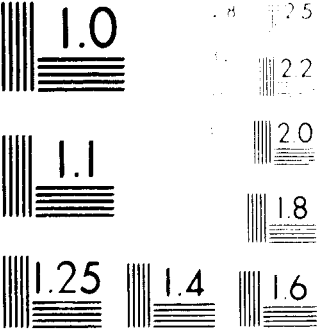
Imports Asia (35% of world total)

Europe (27% of world total)

Exports Central America (35% of world total)

South America (17% of world total).

Below are the tables containing the numerical information in detail on which this analysis was based.


1.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

CONTINENTAL SUGAR PRODUCTION, CONSUMPTION, IMPORTS & EXPORTS

Years 1980 - 1970

metric tons in thoushands 96º Pol. raw value

Continents and years	Production	CONSUMPTION Total	Kg. Per Cápita	Imports Nett	Exports Nett
WORLD TOTAL					
1980	84.392	87.621	20,0	23.021	23.194
1979	88.904	89.603	21,1	23.353	23.399
1978	90.786	86.181	20,7	22.161	22.355
1977	90.416	82.598	20,2	24.063	25.445
1976	82.453	79.277	19,7	19.258	20.061
1975	78.886	74.480	18,9	18.419	18.505
1974	76.397	77.290	20,0	19.351	19.914
1973	75.789	76.330	20,1	19.498	19.548
1972	75.652	75.834	20,3	18.421	18.973
1971	73.957	74.387	20,3	17.046	17.358
1970	72.986	72.121	20,0	17.658	18.081
EUROPE					
1980	28.686	32.859	41,2	6.292	3.501
1979	29.881	32.828	41,4	5.337	2.474
1978	31.361	32.626	41,5	5.102	2.504
1977	30.705	31.641	40,6	6.427	1.383
1976	25.903	31.720	41,0	5.977	499
1975	26.604	29.873	38,7	6.650	266
1974	24.862	31.913	41,7	5.066	188
1973	26.974	31.323	41,3	4.977	523
1972	26.950	29.961	39,8	4.184	612
1971	25.797	29.341	39,2	3.238	197
1970	24.353	29.156	39,4	4.366	523
NORTH AMERICA					
1980	5.405	10.344	41,1	4.108	-
1979	5.568	11.002	43,5	5.365	-
1978	5.256	11.053	44,9	5.184	-
1977	5.919	11.473	47,0	6.244	-
1976	6.595	10.964	45,2	5.046	-
1975	6.075	10.198	42,4	4.264	-
1974	5.497	11.309	47,6	6.093	-
1973	5.846	11.842	50,3	5.783	-
1972	5.857	11.655	49,9	5.890	-
1971	4.301	11.431	50,0	6.003	-
1970	4.385	11.475	50,7	5.787	-

CONTINENTAL SUGAR PRODUCTION, CONSUMPTION, IMPORTS & EXPORTS

Years 1980 - 1970

metric tons in thoushands 96º Pol. raw value

Continents and years	Production	CONSUMPTION Total	CONSUMPTION Kg. Per cápita	Imports Nett	Exports Nett
CENTRAL AMERICA					
1980	12.437	4.862	42,4	800	8.073
1979	14.337	4.821	41,7	30	9.596
1978	14.259	4.708	42,1	30	9.387
1977	13.312	4.384	40,7	60	8.726
1976	12.461	4.320	41,2	32	8.141
1975	12.305	4.096	40,4	20	8.132
1974	12.033	3.879	39,4	20	8.191
1973	11.213	3.725	40,1	36	7.549
1972	10.338	3.453	38,1	30	7.065
1971	11.643	3.503	38,4	19	8.160
1970	13.055	3.507	39,6	12	9.315
SOUTH AMERICA					
1980	13.315	10.703	45,9	738	3.888
1979	12.143	10.273	43,6	608	3.227
1978	12.852	9.389	40,8	596	3.085
1977	13.921	9.156	40,9	546	4.245
1976	12.635	9.035	40,9	210	2.417
1975	11.292	8.854	40,6	166	2.964
1974	11.994	8.369	39,6	229	3.984
1973	11.757	7.800	38,2	329	4.350
1972	10.746	7.647	38,7	326	4.077
1971	9.498	7.180	36,9	220	2.430
1970	8.943	6.592	35,0	132	2.222
ASIA					
1980	14.702	21.117	8,5	8.012	2.578
1979	17.405	23.266	9,8	8.270	3.461
1978	17.624	21.130	9,1	8.130	3.222
1977	16.615	19.023	8,3	8.148	5.120
1976	15.563	16.705	7,4	5.737	4.080
1975	14.178	15.342	7,0	5.468	3.129
1974	13.357	15.857	7,4	5.946	3.289
1973	11.737	15.817	7,5	6.469	2.430
1972	13.180	17.586	8,5	6.117	2.325
1971	13.558	17.518	8,6	5.808	2.496
1970	13.643	16.327	8,2	5.707	2.072

CONTINENTAL SUGAR PRODUCTION, CONSUMPTION, IMPORTS & EXPORTS

Years 1980 - 1970

metric tons in thoushands 96º Pol. raw value

Continents and years	Production	CONSUMPTION Total	CONSUMPTION Kg. Per cápita	Imports Nett	Exports Nett
AFRICA					
1980	5.979	6.717	14.4	2.842	2.295
1979	6.151	6.371	14.1	2.548	2.203
1978	6.098	6.252	14,3	2.923	1.848
1977	6.123	5.905	13.9	2.418	2.688
1976	5.694	5.520	13,4	2.054	2.036
1975	5.218	5.113	12,8	1.649	1.784
1974	5.419	4.953	12,7	1.731	2.168
1973	5.376	4.841	12,8	1.709	2.296
1972	5.391	4.597	12,5	1.687	2.289
1971	4.939	4.449	12,4	1.556	1.942
1970	4.606	4.114	11,8	1.460	1.940
OCEANIA					
1980	3.868	1.018	45,8	228	2.860
1979	3.419	1.042	47,2	195	2.438
1978	3.336	1.023	47.0	196	2.299
1977	3.821	1.016	47,3	220	3.283
1976	3.702	1.013	48,4	202	2.878
1975	3.214	1.004	48,6	192	2.231
1974	3.235	1.010	49,7	216	2.094
1973	2.886	982	49,2	195	2.400
1972	3.190	935	47,5	187	2.605
1971	4.221	965	48,6	202	2.133
1970	3.911	950	48,4	194	2.009

SOURCE: Sugar Year Book (several years). International Sugar Organisation.

CONTINENTAL SUGAR PRODUCTION, CONSUMPTION, IMPORTS & EXPORTS

INDEX 1980; BASE 1970=100

CONTINENTS	PRODUCTION	CONSUMPTION TOTAL	CONSUMPTION KG. PER CAPITA	IMPORTS NETT	EXPORTS NETT
WORLD TOTAL	115,8	121,5	100,0	130,4	128,3
EUROPE	117,8	112,8	104,6	144,1	669,4
NORTH AMERICA	123,7	90,1	81,1	70,9	0,0
CENTRAL AMERICA	95,3	138,6	107,1	6.666,7 (1)	86,7
SOUTH AMERICA	148,9	162,4	131,1	559,1	175,0
ASIA	107,8	129,4	103,6	140,4	124,4
AFRICA	129,9	163,3	122,0	194,7	118,3
OCEANIA	98,9	107,1	94,7	117,6	142,4

SOURCE: Own source.

(1) .- Change is due to appairance of Mexico as nett importer.

PERCENTAGE OF PARTICIPATION IN THE WORLD TOTAL IN 1970

CONTINENTS	PRODUCTION	TOTAL CONSUMPTION	IMPORTS NETT	EXPORTS NETT
EUROPE	33,4	40,4	24,7	2,9
NORTH AMERICA	6,0	16,0	32,7	0,0
CENTRAL AMERICA	17,9	4,9	0,2	51,5
SOUTH AMERICA	12,3	9,1	0,8	12,3
ASIA	18,7	22,6	32,3	11,5
AFRICA	6,3	5,7	8,3	10,7
OCEANIA	5,4	1,3	1,0	11,1
TOTAL	100,0	100,0	100,0	100,0

SOURCE: Own source.

PORCENTAGE OF PARTICIPATION IN THE WORLD TOTAL IN 1980

CONTINENTS	PRODUCTION	TOTAL CONSUMPTION	IMPORTS NETT	EXPORTS NETT
EUROPE	34,1	37,5	27,3	15,1
NORTH AMERICA	6,4	11,8	17,8	0,0
CENTRAL AMERICA	14,7	5,5	3,6	34,8
SOUTH AMERICA	15,7	12,2	3,2	16,8
ASIA	17,4	24,1	34,8	11,1
AFRICA	7,1	7,7	12,3	9,9
OCEANIA	4,6	1,2	1,0	12,3
TOTAL	100,0	100,0	100,0	100,0

SOURCE: Own source.

5.3.2 Present Situation

The year 1980-81 for sugar was a year of partially frustrated hopes. It was thought that demand and supply were going to be so adjusted that a boom similar to that of 1974 was anticipated.

It was thought that prices could reach a level near $1 per lb. However, such a deep fall has taken place that doubts have been cast on the forecasts and the validity of statistics.

Although forecasts of stocks were pessimistic, the reality was even more pessimistic, and they have been reduced much more than anticipated.

In general it was accepted that stocks would fall in 1980-81, but it was believed that the fall would not be as pronounced as in 1979/80. The phenomenon had its cause in an increase of 2% in production and world decrease in demand. Production only advanced in South America, Africa, Asia and Oceania whereas it fell in North America, Central America and Europe. Climatic problems affected the USSR and Cuba in a special way.

The Soviet shortage has been aggravated by the difficulties encountered by Cuba. Also other countries had to buy large amounts of sugar in the world free market.

Throughout the year 1980-81 it was clearly seen that consumption would be a lot less than anticipated. Actually it fell by 965.000 tonnes, in part due to the reaction of the countries which had to buy a large part of their needs on the world market at free prices. However, consumption in these countries represents only 20% of the world total. The economic recession, the availabilities of sugar and substitutes have played a dominant rôle.

Another important factor in the fall in demand was the boom of sweeteners in the USA. The adoption by Coca-Cola of the second generation of HFCS (55% fructose) for use in non-cola drinks, in 1979, has had notable influence. A similar situation has arisen in countries such as Canada and Japan.

Since 1978-79 stocks have been reduced by 7.5 million tonnes and at the end of 1980-81 it is expected that they will only be 27% of consumption or 23.9 million tonnes. The I.S.A. forecasts have been almost totally unworkable.

Up to 14th May 1981, the fall in prices did not set in motion the import restrictive quotas. But on that date prices had fallen almost to half, in the following progression:

SUGAR PRICES (USc/lb)

1980	December	28.79
1981	January	28.01
	February	24.26
	March	21.85
	April	17.90
	May	15.08
	June	16.35
	July	16.33
	August	15.42
	September	11.66
	October	12.19
	November	11.97
	December	12.98
1982	January	12.90

In mid-February 1982, prices are at an average level of 13.26 US c/lb. Below are the daily variations for the last four months available.

The drop in stocks has been so brutal that even a small deficit in 81-82 could cause a price boom. In order to avoid this deficit, world production should be increased by 4-5 million tonnes, a figure which seems impossible to reach although considerable increases in production are expected over the previous year.

RAW SUGAR: DAILY SPOT PRICES

Day of Month	NOVEMBER 1981 London (a) £ per tonne	London (b) U.S. Cents per lb.	New York (c)	I.S.A. d.p. (d)	I.S.A. p.p. (e)	DECEMBER 1981 London (a) £ per tonne	London (b) U.S. Cents per lb.	New York (c)	I.S.A. d.p. (d)	I.S.A. p.p. (e)
1			Sunday			159.00	12.72	12.61	12.66	12.04
2	153.00	11.72	12.05	11.77	11.76	159.00	12.76	12.47	12.52	12.08
3	155.00	11.88	12.20	11.93	11.75	159.00	12.64	12.38	12.43	12.11
4	157.00	12.10	11.88	11.93	11.72	155.00	12.33	12.63	12.38	12.14
5	157.00	12.06	11.88	11.93	11.69			Saturday		
6	157.00	12.09	11.93	11.98	11.69			Sunday		
7			Saturday			158.00	12.56	12.78	12.61	12.19
8			Sunday			162.00	12.85	12.83	12.84	12.28
9	157.00	12.19	12.15	12.17	11.71	162.00	12.83	12.50	12.55	12.35
10	159.00	12.19	11.80	11.85	11.73	163.00	12.71	12.88	12.76	12.43
11	157.00	12.10	11.84	11.89	11.76	169.00	13.14	12.98	13.03	12.51
12	157.00	12.21	11.90	11.95	11.78			Saturday		
13	156.00	12.20	11.90	11.95	11.81			Sunday		
14			Saturday			170.00	13.13	13.01	13.06	12.60
15			Sunday			170.00	13.26	12.81	12.86	12.67
16	155.00	12.15	11.78	11.83	11.84	168.00	13.10	13.06	13.08	12.73
17	153.00	11.85	11.47	11.52	11.85	172.00	13.44	13.17	13.22	12.77
18	150.00	11.71	11.48	11.53	11.86	172.00	13.39	13.14	13.19	12.80
19	148.00	11.53	11.78	11.58	11.83			Saturday		
20	151.00	11.71	11.88	11.76	11.84			Sunday		
21			Saturday			172.00	13.33	13.37	13.35	12.84
22			Sunday			170.00	13.26	13.69	13.31	12.88
23	153.00	11.92	11.68	11.73	11.84	176.00	13.80	13.52	13.57	12.95
24	151.00	11.83	11.81	11.82	11.83	176.00	13.80	13.56+	13.61	13.03
25	154.00	12.17	12.40	12.22	11.85			Holiday		
26	159.00	12.67	12.56+	12.61	11.89			Saturday		
27	159.00	12.78	12.71	12.75	11.94			Sunday		
28			Saturday			175.00+	13.72	13.60	13.65	13.11
29			Sunday			174.00	13.64	12.93	12.98	13.14
30	164.00	13.21	12.72	12.77	11.98	166.00	13.10	12.91	12.96	13.15
31	--	--	--	--	--	167.00	13.17	12.96	13.01	13.18
Average	155.33	12.11	11.99	11.97	—	167.00	13.12	12.99	12.98	--
Highest	164.00	13.21	12.72	12.77	11.98	176.00	13.80	13.69	13.65	13.18
Lowest	148.00	11.53	11.47	11.52	11.69	155.00	12.33	12.38	12.38	12.04

(a) London Daily Price (Raws) - c.i.f., f.o., United Kingdom in bulk.
(b) London Daily Price adjusted to f.o.b. & stowed Caribbean Port in bulk by deducting the cost of insurance and freight. Conversions of the L.D.P. are based on the closing spot rate of exchange for the relevant day of the Pound Sterling against the U.S. Dollar on the London market (Economic Rule 611-2).
(c) Spot Price for New York Contract No. 11 - f.o.b. and stowed Greater Caribbean Area in bulk.
(d) The 1977 International Sugar Agreement Daily Price (d.p.) is the arithmetical average of the New York No.11 Spot Price and the London Daily Price, after conversion as set out in (b), or, if the difference between these two f.o.b. prices is more than ten points, by adding five points to the lower price.
(e) The Prevailing Price (p.p.) is the 15 day average of the I.S.A. Daily Price calculated in accordance with Article 2, paragraph 21.
+ Average calculated in accordance with Economic Rule 611-3 for the day when the market was closed.

RAW SUGAR: DAILY SPOT PRICES

Day of Month	JANUARY 1982 London (a)	London (b)	New York (c)	I.S.A. d.p. (d)	I.S.A. p.p. (e)	FEBRUARY 1982 London (a)	London (b)	New York (c)	I.S.A. d.p. (d)	I.S.A. p.p. (e)
	£ per tonne	U.S. Cents per lb.				£ per tonne	U.S. Cents per lb.			
1	Holiday					171.00	13.34	13.28	13.31	13.06
2	Saturday					173.00	13.52	13.39	13.44	13.11
3	Sunday					171.00	13.33	13.07	13.12	13.13
4	163.00	12.93	12.52	12.57	13.16	* 168.00	13.15	13.17	13.16	13.14
5	159.00	12.49	12.45	12.47	13.13	170.00	13.24	13.22	13.23	13.17
6	157.00	12.39	12.74	12.44	13.08	Saturday				
7	161.00	12.72	12.68	12.70	13.07	Sunday				
8	160.00	12.67	12.84	12.72	13.05	170.00	13.26	13.08	13.13	13.20
9	Saturday					169.00	13.03	12.95	12.99	13.22
10	Sunday					168.00	12.99	13.03	13.01	13.23
11	160.00	12.45	12.75	12.50	13.00	168.00	13.09	13.23	13.14	13.26
12	163.00	12.63	12.86	12.68	12.97	168.00	13.02	13.22	13.07	13.26
13	166.00	12.84	12.97	12.89	12.94	Saturday				
14	167.00	12.89	12.88	12.89	12.91	Sunday				
15	166.00	12.84	12.92	12.88	12.86					
16	Saturday									
17	Sunday									
18	162.00	12.60	12.91	12.65	12.80					
19	162.00	12.68	12.90	12.73	12.74					
20	162.00	12.69	13.00	12.74	12.72					
21	162.00	12.67	13.20	12.72	12.71					
22	167.00	13.08	13.18	13.13	12.71					
23	Saturday									
24	Sunday									
25	174.00	13.54	13.39	13.44	12.77					
26	176.00	13.83	13.50	13.55	12.84					
27	176.00	13.81	13.60	13.65	12.92					
28	176.00	13.84	13.31	13.36	12.97					
29	172.00	13.57	13.23	13.28	13.01					
30	Saturday									
31	Sunday									
Average	165.55	12.96	12.99	12.90	—					
Highest	176.00	13.84	13.60	13.65	13.16					
Lowest	157.00	12.39	12.45	12.44	12.71					

(a) London Daily Price (Raws) - c.i.f., f.o., United Kingdom in bulk.
(b) London Daily Price adjusted to f.o.b. & stowed Caribbean Port in bulk by deducting the cost of insurance and freight. Conversions of the L.D.P. are based on the closing spot rate of exchange for the relevant day of the Pound Sterling against the U.S. Dollar on the London market (Economic Rule 611-2).
(c) Spot Price for New York Contract No. 11 - f.o.b. and stowed Greater Caribbean Area in bulk.
(d) The 1977 International Sugar Agreement Daily Price (d.p.) is the arithmetical average of the New York No.11 Spot Price and the London Daily Price, after conversion as set out in (b), or, if the difference between these two f.o.b. prices is more than ten points, by adding five points to the lower price.
(e) The Prevailing Price (p.p.) is the 15 day average of the I.S.A. Daily Price calculated in accordance with Article 2, paragraph 21.
* Average calculated in accordance with Economic Rule 611-3 for the day when the market was closed.

The growth rate would possible turn out to be lower as a consequence of the per capita consumption remaining static, with a low rise in the population in the high income countries, and due to the growing competition from substitutes.

5.3.3 Prospects

The changing situation of the world sugar market makes any projections on supply, demand or prices very risky, and often useless. The price crash from 1980 illustrates this situation perfectly.

In spite of all this, and through considering them to be of interest, here are some forecasts by persons or associations with a good knowledge of the matter, although some of them already appear to be mistaken.

This is the case of the "Projections of the Price of Sugar according to the Volume of World Production in 1980 "(1); as in the column for a production figure of 84.6 million tonnes, the prices for 1981 rose to 0.38 US$, when in reality they stayed at less than half that. Attached is the calculation in constant money prices and the international price index, projected until 1990, and also the estimates of production, consumption and trade by countries for 1985 and 1990. According to

(1) The World Sugar Economy: An Economic Analysis of Long Term Development (by Jos de Vries)
F.O.Licht's International Sugar Report nº 18 - 1980

this. world production should reach a volume of 105 million tonnes in 1985 and 115 in 1990, consumption 102 and 115, respectively, and foreign trade 27 and 30 million on the same dates. The greatest changes should happen in the developing countries, especially in Africa, which doubles its production by 1990 and in Asia, which doubles its consumption.

The changes happening in the last two years make it necessary to revise the forecasts made for 1985. From this point of view, A. Viton (2) establishes considerations on sugar consumption for 1985. According to his analysis, it is expected that the world consumption of sugar and HFCS will rise by 10-12 million tonnes, but the consumption of sugar will rise by 8 or 9 million tonnes, the rest being taken up by the HFCS.

The table of world consumption will have changed substantially by 1985. More than half will be effected in the developing countries, including China. In the free market countries the demand for sugar is expected to be maintained and the consumption of HFCS to increase.

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(2) Albert Viton. Consumption Outlook for 1985
F.O.Licht. International Sugar Economic Year Book and Directory,1981

PRODUCTION BASIC PROJECTIONS, SUGAR CONSUMPTION AND COMMERCE, BY COUNTRIES.

1985 - 1990

	Production			Consumption			Exports			Imports		
	1974/76	1985	1990	1974/76	1985	1990	1974/76	1985	1990	1974/76	1985	1990
	(in '000 metric tons)											
WORLD	82,345	105,183	115,249	79,814	101,516	114,696	21,638	27,193	30,276	21,459	27,292	30,276
Developed Countries	25,502	32,231	35,550	31,433	35,464	37,245	4,587	6,408	9,403	11,961	11,480	11,225
US	5,930	5,787	5,795	9,822	10,181	10,115	111	50	50	4,331	4,768	4,419
Canada	125	146	113	1,002	1,220	1,285	61	40	39	976	1,155	1,197
EEC	10,278	12,703	13,291	10,684	11,621	12,083	1,233	1,566	2,166	2,132	1,350	1,100
Other Western Europe	3,540	5,761	6,838	4,621	5,530	6,015	164	308	1,135	1,642	390	360
Japan	530	716	702	3,105	4,199	4,676	43	20	20	2,637	3,549	4,000
Oceania	3,087	4,223	5,484	900	1,182	1,274	2,142	3,188	4,491	204	268	299
South Africa	2,017	2,815	3,307	1,220	1,531	1,797	832	1,236	1,502	39	-	-
Centrally Planned Economies	16,598	19,509	20,736	20,862	25,422	27,835	649	850	850	4,662	7,461	8,055
USSR	8,409	8,984	9,117	11,518	12,797	13,370	85	100	100	2,951	4,250	4,403
Eastern Europe	4,222	4,768	4,527	4,614	5,399	5,699	501	700	700	904	1,578	1,910
Asia	3,967	5,757	7,092	4,730	7,226	8,766	63	50	50	807	1,633	1,742
Developing Countries	40,240	53,453	58,965	27,519	40,630	49,616	16,403	20,135	20,023	4,836	8,452	10,996
Africa	3,344	5,070	6,001	3,899	5,772	7,092	1,151	1,300	1,300	1,859	2,162	2,415
Asia	12,683	17,281	17,617	10,791	16,807	20,587	3,938	5,338	3,528	2,727	5,319	6,568
India	4,857	5,605	6,243	3,888	5,165	5,942	792	295	279	0	-	-
Indonesia	1,105	1,278	1,481	1,207	1,962	2,404	0	-	-	121	697	925
Philippines	2,771	2,749	2,804	881	1,403	1,753	1,395	1,227	1,033	0	-	-
Taiwan	803	943	761	304	463	560	491	464	199	0	-	-
Thailand	1,319	3,760	2,687	539	919	1,241	792	2,821	1,442	0	-	-
Other Asia	1,828	2,946	3,641	3,892	6,895	8,687	436	530	575	2,606	4,622	5,643
America	23,279	31,092	35,347	12,829	18,851	21,937	11,314	13,497	15,195	250	971	1,863
Argentina	1,486	1,552	1,542	1,059	1,218	1,321	383	267	211	0	-	-
Brazil	6,822	10,086	12,665	4,886	6,974	8,459	1,762	2,839	4,165	0	-	-
Colombia	933	1,514	1,848	708	1,232	1,580	142	270	268	0	-	-
Peru	962	849	817	550	717	872	389	117	-	0	-	57
Other South America	1,734	1,856	1,997	1,427	2,029	2,435	470	300	300	220	532	747
Cuba	6,168	7,795	8,386	518	689	781	5,666	7,055	7,597	0	-	-
Domi'can Republic	1,229	1,123	1,094	168	259	321	1,010	851	771	0	-	-
Mexico	2,728	3,322	3,660	2,540	3,714	4,674	242	-	-	0	399	1,015
Other Middle America	2,136	2,995	3,338	893	1,219	1,494	1,250	1,790	1,883	29	40	44

SUGAR PRICE PROJECTIONS UNDER DIFFERENT ASSUMPTIONS ABOUT THE SIZE OF THE 1980 WORLD SUGAR CROP.

	SUGAR PRICES ASSUMING A 1980 WORLD SUGAR CROP (IN MILLIONS OF METRIC TONS) OF :								
	98,60	95,20	93,60	92,20	90,60	89,10	87,60	86,10	84,60
	(1980 USc/1b)								
1980	12,88	13,93	15,10	16,41	17,88	19,60	21,60	24,00	27,00
1981	15,72	17,41	19,31	21,43	23,83	26,57	29,65	33,09	36,96
1982	25,10	25,51	25,84	26,07	26,14	26,05	25,78	25,26	24,44
1983	28,80	27,53	26,17	24,73	23,21	21,60	19,92	18,18	16,39
1984	24,14	22,66	21,18	19,69	18,21	16,71	15,24	13,76	12,27
1985	18,12	17,17	16,18	15,19	14,20	13,20	12,17	11,12	10,04
1986	14,31	13,81	13,21	12,76	12,20	11,62	10,98	10,30	9,57
1987	12,50	12,40	12,29	12,17	12,00	11,82	11,59	11,32	10,97
1988	12,15	12,38	12,62	12,87	13,09	13,32	13,52	13,69	13,81
1989	12,96	13,40	13,85	14,34	14,84	15,36	15,87	16,38	16,86
1990	14,39	14,86	15,33	15,84	16,36	16,88	17,41	17,94	18,44
Media (*) 1980-90	17,37	17,37	17,3[illegible]	17,41	17,45	17,52	17,61	17,73	17,89

(*) **Without ponderation.**

SUGAR PRICES IN CURRENT AND IN 1970 REAL US DOLLARS 1951-78 AND THE INTERNATIONAL PRICE INDEX, 1951-90.

YEAR	CURRENT SUGAR PRICE		REAL SUGAR PRICE		INTERNATIONAL PRICE INDEX (1970=100)
	US¢/lb	US¢/kg	US¢/lb	US¢/kg	
1951	5.70	12.57	6.91	15.24	82.5
1952	4.17	9.19	4.93	10.86	84.6
1953	3.41	7.52	4.22	9.31	80.8
1954	3.26	7.19	4.12	9.08	79.2
1955	3.24	7.14	4.03	8.89	80.3
1956	3.47	7.65	4.17	9.19	83.2
1957	5.16	11.38	5.99	13.20	86.2
1958	3.50	7.72	4.05	8.94	86.4
1959	2.97	6.55	3.43	7.55	86.7
1960	3.14	6.92	3.54	7.81	88.6
1961	2.70	5.95	3.02	6.66	89.4
1962	2.78	6.13	3.15	6.94	88.3
1963	8.34	18.39	9.40	20.73	88.7
1964	5.77	12.72	6.40	14.10	90.2
1965	2.02	4.45	2.18	4.80	92.8
1966	1.81	3.99	1.93	4.26	93.7
1967	1.92	4.23	2.02	4.44	95.2
1968	1.90	4.19	2.13	4.69	89.3
1969	3.20	7.06	3.55	7.83	90.2
1970	3.68	8.11	3.68	8.11	100.0
1971	4.50	9.92	4.15	9.14	108.5
1972	7.27	16.03	6.06	13.37	119.9
1973	9.45	20.83	6.53	14.41	144.6
1974	29.66	65.39	16.40	36.15	180.9
1975	20.37	44.91	9.76	21.52	208.7
1976	11.51	25.37	5.46	12.04	210.7
1977	8.10	17.86	3.50	7.73	231.1
1978	7.81	17.22	2.92	6.43	267.8
1979					303.2
1980					334.9
1981					365.1
1982					394.3
1983					422.0
1984					450.4
1985					479.8
1986					509.8
1987					541.2
1978					573.8
1979					607.3
1990					642.0

Source: Prices - International Sugar Organization; International Price Index - World Bank.

It is even possible that sugar consumption in the high-income developed countries may fall between 300.000 and 800.000 tonnes. which would be made up by HFCS. Everything will depend on the development levels of the prices of both products.

In Latin America important increases in demand and prices are expected due to the traditional policies of price freezes which can no longer be maintained for various reasons: devaluation of currency. increased production costs. etc.

Considerable changes are also expected in Asia, where growth will also affect the Middle Eastern countries.

In Africa it will depend on the encouragement of industrial development. which usually means an increase in the sugar demand.

The increase and maturation of the HFCS. has affected remarkably tne developed high income countries but will not have so much of an effect at world level

Below are included the forecasts for world consumption for 1985, also specified for the most important countries. Total consumption would reach 102-103 milliom tonnes, a figure which is not noticeably different from the figure set previously (105 million tonnes). One must note that the new estimate includes 4.8-5 million tonnes of HFCS, therefore it seems wise to estimate that the figure of sugar consumed in 1985 will be of the order of 100 million tonnes.

SUGAR CONSUMPTION 1980/81 AND ESTIMATED 1985

(million tonnes,raw value)

	1980 / 81	1985
EEC.	10,51	11,00
Spain	1,13	1,30
Other Western Europe.(1)	2,60	3,00
Canada	0,98	0,85
USA	8,93	8,30
Australia and New Zeeland	0,96	1,10
Japan	2,70	2,90
South Africa	1,32	1,35
USSR	12,40	13,00
Eastern European	4,68	5,20
T O T A L	46,21	48,00
DEVELOPING COUNTRIES		
Argentina	1,07	1,25
Brazil	6,55	7,00
Colombia	1,03	1,13
Mexico	3,23	3,60
Perú	0,61	0,58
Venezuela	0,70	0,85
India	5,60	7,0-7,5
Indonesia	1,73	2,20
Irán	0,90	1,00
Iraq	0,44	0,60
Korea	0,52	0,55
Malaysia	0,54	0,58
Pakistan	0,89	1,00
Philippines	1,26	1,40
Taiwan	0,45	0,50
Thailánd	0,65	0,78
Turkey	1,27	1,40
Egypt	1,33	1,50
Morocco	0,68	0,70
Sudán	0,41	0,55
Other developing Countries	8,82	10,0-10,2
T O T A L	38,68	44,2-45,0
China and Centrally planned Economics in Asia	4,30	5,00
WORLD TOTAL SUGAR	89,18	97,0-98,0
HFCS	2,90	4,8-5,0
TOTAL SUGAR & HFCS	92,09	102,0-103,0

SOURCE : F.O. LICHT, WORLD SUGAR BALANCES,
(1).- Excluding Turkey

5.4 THE CENTRAL AMERICAN MARKET

Central America has a 14.7% share in world sugar production, 5.5% in consumption, 3.6% in imports and 34.8% in exports (1980 figures). It is characterised, then, as basically an exporting region, even though it has lost part of its importance over the last ten years.

Within the region itself, production has remained practically stable between 1974 and 1980 (12.4 million tonnes in the latter year), with a minimum growth of 3.4% in the period. Consumption has grown almost by 70% although per capita consumption has only risen by 7.6% due to the corresponding population growth. The average level is 42.4 kg per inhabitant and year.

Imports show a completely anomalous behaviour, with a growth around 4.000%, but this is due to the radical change in Mexico, which from being a net exporter during the rest of the period, has gone to importing 761.000 tonnes in 1980, completely upsetting the values of the series. Exports have been maintained practically stable (8.1 million tonnes in 1980), as although they show growth in 1978 and 79, in 1980 they fall even below the 1974 level, with a decrease in the period of 1.5%.

In general, stocks of sugar have increased during the period, except in Jamaica and Guatemala. Domestic prices, in countries for which information is available, have been maintained or have risen slightly, both at wholesale and retail levels.

The three main sugar producing countries are Cuba (6,8 million tonnes) Mexico (2,4) and the Dominican Republic (1,0). Between the three they account for 82,5% of the total sugar production, and the three have seen this reduced in 1980 as against previous years. This trend is general in the region; only the Bahamas, Barbados, Bermuda, Guatemala, Haiti and Honduras have improved their production figures in 1980., but between all of them they do not account for 10% of regional production.

Consumption has been in general growing. The big consumer, which is Mexico, has made up for its lack of production with imports, and even made so it shows a slight decrease with respect to 1979. Per capita consumption has increased in nearly all countries, with the notable exception of the Dutch Antilles, where it has fallen from 48 to 26 Kg The lowest level of consumption is in Haiti, with 12,4 Kg per inhabitant and year and the maximum is Costa Rica (62,1) and Barbados (58,4).

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Only 6 countries appear as net sugar importers: Bahamas, Bermuda, Haiti, Mexico (for the first time in 1980) Dutch Antilles and the Panama Canal Zone, and remaining indetermined countries. The only figure of importance is that of Mexico (761.000 tonnes, out of a total of 801.000).

The main exporter is Cuba, which by itself exports 76,5% of the regional total. The Dominican Republic follows at a great distance.

The three big producers (Cuba, Dominican Republic and Mexico)are the only ones with stocks of any importance.

In this context. El Salvador apprears as a small producer and exporter, but with a minimal share in both activities.

CENTRAL AMERICA PRODUCTION OF CENTRIFUGAL SUGAR

(Tonnes-Raw Value)

COUNTRIES	1974	1975	1976	1977	1978	1979	1980
BAHAMAS							
BARBADOS	112.680	101.967	106.486	119.836	103.785	117.110	135.493
BELIZE	91.884	85.684	68.242	97.831	119.138	105.330	108.363
BERMUDA							
COSTA RICA	193.230	205.000	210.000	200.000	227.400	203.500	220.000
CUBA	5.925.850	6.427.382	6.150.797	6.953.284	7.661.546	7.799.968	6.805.255
DOMINICAN REP.	1.229.933	1.169.725	1.286.946	1.258.359	1.198.956	1.200.195	1.012.604
EL SALVADOR	260.760	244.009	261.099	317.739	278.911	273.779	217.045
GUATEMALA	365.948	384.146	517.312	486.894	445.931	414.802	450.000
HAITI	68.000	69.000	60.000	50.000	57.000	60.000	65.000
HONDURAS	67.000	75.000	80.813	115.000	131.346	164.386	191.124
JAMAICA	383.282	366.357	365.498	295.811	305.580	291.025	236.389
MEXICO	2.838.178	2.636.350	2.709.888	2.789.856	3.130.682	3.095.408	2.456.616
ANTILLAS HOLAND.........							
NICARAGUA	165.000	210.000	242.000	225.540	222.352	201.726	190.063
PANAMA	108.000	135.000	160.879	181.019	187.000	225.509	200.231
PANAMA ZONA CANAL							
ST. KITTS-NEVIS-ANGUILLA	26.732	25.855	36.460	42.794	40.89[illegible]	40.745	35.609
TRINIDAD & TOBAGO...	186.815	163.040	205.010	178.004	148.137	143.521	113.580
OTHER CENTR.AMERICA.	10.000	6.000	0	0	0	0	0
TOTAL	12.033.292	12.304.515	12.461.430	13.311.967	14.258.663	14.337.004	12.437.352

SOURCE : I.S.O. - Sugar Year Book 1980.

CENTRAL AMERICA CONSUMPTION OF CENTRIFUGAL SUGAR

(Tonnes-Raw Value)

PAISES	1974	1975	1976	1977	1978	1979	1980
BAHAMAS	7.250	7.500	7.600	7.700	7.300	7.000	7.500
BARBADOS	17.256	15.093	14.824	14.670	16.015	15.420	15.718
BELIZE	6.351	5.777	5.655	6.682	7.730	7.517	7.153
BERMUDA	2.700	2.500	2.500	1.800	2.000	2.000	2.300
COSTA RICA	104.326	110.000	123.000	125.000	130.000	140.000	139.000
CUBA	522.162	499.313	531.919	519.009	552.006	518.986	529.975
DOMINICAN REP.	171.972	166.030	166.490	176.533	182.056	190.844	208.536
EL SALVADOR	102.708	118.138	122.916	124.997	138.070	143.760	155.016
GUATEMALA	173.403	193.906	204.135	221.932	215.671	223.049	230.000
HAITI	53.000	54.000	55.000	60.000	62.000	60.000	62.000
HONDURAS	60.000	65.000	74.228	87.000	105.368	108.816	111.139
JAMAICA	101.908	105.000	106.619	113.275	115.000	101.190	117.233
MEXICO	2.343.632	2.525.500	2.675.411	2.677.316	2.993.940	3.059.538	3.012.624
NETHERLANDS ANTILLES	7.500	7.500	7.600	12.000	12.000	12.000	7.000
NICARAGUA	90.000	106.000	108.000	110.221	109.794	107.470	125.622
PANAMA	50.000	50.000	48.700	57.465	60.723	64.685	69.691
PANAMA ZONA CANAL	2.500	2.600	2.600	2.500	2.500	2.500	2.500
ST. KITTS-NEVIS-ANGUILLA	2.784	2.461	2.519	2.322	2.211	2.252	2.400
TRINIDAD & TOBAGO...	46.116	45.195	48.075	46.507	45.502	45.138	38.721
OTHER CENTR.AMERICA	13.666	14.039	12.674	17.000	18.000	18.500	18.000
TOTAL	3.879.234	4.095.552	4.320.465	4.383.929	4.717.896	4.830.665	4.862.128

SOURCE : I.S.O. - Sugar Year Book 1980

CENTRAL AMERICA-NET IMPORTS OF CENTRIFUGAL SUGAR

(Tonnes-Raw Value)

PAISES	1974	1975	1976	1977	1978	1979	1980
BAHAMAS	4.818	5.335	7.956	6.294	7.610	6.923	7.942
BARBADOS							
BELIZE							
BERMUDA	2.708	2.500	2.500	1.898	1.853	2.391	2.280
COSTA RICA							
CUBA							
DOMINICAN REP.							
EL SALVADOR							
GUATEMALA							
HAITI	n.e.	n.e.	n.e.	12.970	197	644	844
HONDURAS							
JAMAICA							
MEXICO	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.	760.743
NETHERLANDS ANTILLES	6.000	7.500	7.600	18.822	9.754	8.962	8.976
NICARAGUA							
PANAMA							
PANAMA CANAL ZONE...	2.500	2.600	2.600	2.500	2.500	2.500	2.500
ST.KITTS-NEVIS-ANGUILLA							
TRINIDAD & TOBAGO							
OTHER CENTR.AMERICA	3.763	2.496	11.761	17.500	18.367	19.138	17.266
TOTAL	19.789	20.431	32.417	59.984	40.281	40.558	800.551

SOURCE : I.S.O Sugar Year Book 1980.

CENTRAL AMERICA NET EXPORTS OF CENTRIFUGAL SUGAR

(Tonnes-Raw Value)

PAISES	1974	1975	1976	1977	1978	1979	1980
BAHAMAS							
BARBADOS	96.744	83.979	93.233	106.247	88.935	101.357	121.695
BELIZE	86.418	80.781	58.294	85.785	117.039	97.035	103.149
BERMUDA							
COSTA RICA	88.904	101.877	88.000	84.341	86.836	72.879	81.755
CUBA	5.491.247	5.743.711	5.763.652	6.238.162	7.231.219	7.269.429	6.191.074
DOMINICAN REP.	1.054.948	975.290	998.854	1.116.587	936.678	1.034.960	792.734
EL SALVADOR	146.162	139.805	129.839	168.818	133.114	164.312	35.273
GUATEMALA	143.890	203.872	321.475	293.610	152.542	195.486	255.535
HAITI	15.916	10.456	5.516	n.i.	n.i.	n.i.	n.i.
HONDURAS	8.153	10.841	7.256	25.069	22.596	53.890	81.325
JAMAICA	278.364	260.567	236.526	205.713	181.366	193.911	129.801
MEXICO	495.535	217.244	13.065	0	73.711	29.605	n.i.
ANTILLAS HOLAND.........							
NICARAGUA	65.853	88.982	153.285	102.103	103.651	104.667	58.170
PANAMA	59.270	85.092	92.911	119.129	126.196	151.829	145.369
PANAMA ZONA CANAL							
ST. KITTS-NEVIS-ANGUILLA	23.710	23.106	33.899	39.779	38.524	38.583	33.009
TRINIDAD & TOBAGO....	136.000	106.085	157.867	140.239	94.385	87.954	44.085
TOTAL	8.191.114	8.131.688	8.153.672	8.725.582	9.386.792	9.595.897	8.072.974

SOURCE : I.S.O. Sugar Year Book 1980

CENTRAL AMERICA STOCKS OF CENTRIFUGAL SUGAR

(Centrifugal Sugar)

PAISES	1974	1975	1976	1977	1978	1979	1980
BAHAMAS	-	-	-	-	-	-	-
BARBADOS	3.023	6.498	6.006	4.925	3.760	4.524	3.415
BELIZE	1.347	473	4.766	10.130	4.642	5.420	3.481
BERMUDA	-	-	-	-	-	-	-
COSTA RICA	-	-	-	-	-	-	-
CUBA	373.071	557.429	412.655	608.768	487.089	498.642	582.828
DOMINICAN REP.	36.881	66.862	188.016	153.257	233.498	204.142	203.346
EL SALVADOR	51.959	38.025	46.367	70.293	78.020	42.727	70.430
GUATEMALA	59.387	45.755	37.457	8.909	86.527	82.794	47.259
HAITI	-	-	-	-	-	-	-
HONDURAS	3.919	3.078	2.407	2.338	5.720	7.400	6.060
JAMAICA	8.395	9.185	31.988	8.811	18.025	13.949	3.304
MEXICO	206.286	99.849	121.261	233.801	356.832	363.097	505.543
ANTILLAS HOLAND.........	-	-	-	-	-	-	-
NICARAGUA	-	-	-	-	-	-	-
PANAMA	1.711	1.619	5.694	10.119	10.200	19.195	4.269
PANAMA ZONA CANAL	-	-	-	-	-	-	-
ST. KITTS-NEVIS-ANGUILLA	-	-	-	-	-	-	-
TRINIDAD & TOBAGO	4.965	16.725	15.793	7.051	15.301	8.831	19.551

SOURCE : I.S.O. Sugar Year Book 1980

CENTRAL AMERICA : SUGAR CONSUMPTION

(Kg.Raw Value)

	1974	1975	1976	1977
Bahamas	36,3	37,5	36,2	35,0
Barbados	54,5	61,8	59,3	58,7
Belize	39,1	42,8	40,4	47,7
Bermuda	45,0	41,7	41,7	30,0
Costa Rica	54,3	56,4	61,2	60,7
Cuba	56,8	53,5	56,2	53,9
Rep. Dominicana	37,7	35,3	32,7	36,4
El Salvador	26,0	28,9	28,0	28,5
Guatemala	32,9	35,6	36,5	38,2
Haiti	11,8	11,8	11,8	12,6
Honduras	22,4	23,6	26,6	29,9
Jamaica	53,6	52,5	51,3	53,9
México	40,3	42,0	42,9	41,5
Antillas Holand.	31,3	31,3	31.7	48,0
Nicaragua	43,3	49,1	48,4	47,9
Panama	30,7	29,9	28,3	32,5
Panama, zona canal	50,0	52,0	52,0	50,0
St. Kitts-Nevis-Anguilla	39,8	35,2	36,0	33,2
Trinidad y Tobago	43,4	42,0	44,5	45,0
Resto América Central	29,1	29,9	27,0	34,7
Media	39,4	40,4	41,2	40,7

SOURCE : I.S.O. Sugar Year Book 1980.

Cap. 5.1

PER CAPITA

1978	1979	1980
31,7	30,4	31,3
59,5	57,3	58,4
55,2	50,1	49,4
33,3	33,3	38,3
61,6	64,8	62,1
56,4	52,6	53,9
35,7	38,2	38,4
31,4	31,9	32,2
32,6	31,7	31,7
12,8	12,2	12,4
34,5	30,6	38,4
54,8	48,2	55,8
43,9	44,1	44,7
48,0	48,0	25,9
44,6	42,6	46,5
33,6	34,4	35,9
50,0	50,0	50,0
31,6	32,2	34,3
40,2	41,2	32,9
36,7	37,0	35,3
42,2	41,8	42,4

WHITE REFINED SUGAR PRICES IN CENTRAL AMERICA

COUNTRY	INFLUENCE (1980 Prices)	REPRESENTATIVE PRICES (U.S. cts. per pound). 1979 WHOLE SALE	1979 RETAIL	1980 WHOLESALE	1980 RETAIL
Barbados	Entire Country	18,6	20,5	21,9	24,0
Belize	Belize	7,0	7,9	7,0	8,4
Rep. Dominicana		14,0	17,0	14,2	17,0
El Salvador	Entire Country	17,6	20,0	--	--
Guatemala	Entire Country	13,3	15,0	--	--
Honduras	Entire Country	--	--	15,0	16,5
Jamaica	Entire Country	42,1	47,8	42,9	47,8
México	Entire Country	--	--	25,0	26,7
Panama		18,3	20,0	--	--
St. Kitts-Nevis	Entire Country	11,4	12,9	--	--
Trinidad y Tobago	Entire Country	8,5	8,8	8,5	8,8

SOURCE : I.S.O. Sugar Year Book 1980.

5.5 THE EL SALVADOR MARKET

The El Salvador sugar industry has had a notable increase since 1959, in which the first refinery in Central America was set up in the country. Since then, its production of refined sugar has increased by 300%, although interest in the production of raw sugar for export has not been lost. The redistribution of the Cuban sugar import quota by the United States, from 1960, has contributed to the development of the El Salvador sugar industry, and also the expansion of the domestic market, both due to the population increase and the preference for white refined sugar, and action by the government to diversify production, overcoming its dependence on coffee.

Over the last few years the economic activity of El Salvador has declined owing to the internal strife the country is going through. Naturally this has had repercussions on the sugar industry reducing its share in the regional cake, as shown by the following figures:

EL SALVADOR SHARE IN CENTRAL AMERICA TOTALS

	CENTRAL AMERICA		EL SALVADOR (Tm)		PERCENTAGE ON CENTRAL AMERICA	
	1974	1980	1974	1980	1974	1980
PRODUCTION	12.033.292	12.437.352	260.760	217.045	2,16	1,70
CONSUMPTION	3.879.234	4.862.128	102.708	155.016	2,60	3,20
IMPORTS	19.789	800.551	0	0	0,00	0,00
EXPORTS	8.191.114	8.072.974	146.162	35.273	1,80	0,40

SOURCE : Sugar Year Book and Source.

El Salvador's share in the regional cake has been reduced to 1.7% of production and 0.4% of exports. It is to be expected that, when the situation in the country has returned to normal, the expansion plans may be fulfilled and at least the average levels of production and exports of the last decade may be recovered.

The area sown with cane in El Salvador was 32,000 Ha. in 1980, with a yield of 69,000 kg/Ha. and production of 2,207,000 tonnes (FAO figures). Normally , the sugar cane is sown in spring and harvested, after over a year, between November and June. The most of the sugar cane harvest is between January and March. The increases in production taking place since 1960 are due to an increase in the area under cultivation, and also to improvements in the average yield and the sugar content of the cane. The sugar yield per hectare has increased from 5.7 tonnes in 1959/60 to 7.6 in 1970/71 and 8.5 in 1976/77. Anyway, agricultural mechanization is vary scarce and most of the operations are carried out by hand.

The El Salvador sugar industry is made up by 14 sugar factories, although one of them, Colimo, has not worked since the 1977/78 year, and one refinery. Most of them are owned by the State. The number of sugar factories was 21 in 1960/61, reducing to 12 in 1974/5. In

AREA UNDER SUGAR-CANE AND PRODUCTION OF SUGAR

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
Total Area harvested for Sugar (1000 ha.)	19,6	22,7	23,5	30,2	33,2	33,5	24,6	34,3		
Total Cane crushed (1000 tons)	1492,2	1849,2	1888,8	2398,4	2615,6	2598,8	2933,9	2944,0		
Sugar produced (1000 tons)	158,0	187,5	190,2	231,7	256,8	261,8	286,0	288,0	277,3	178,3
Yield of Cane per ha. (tons)	76,1	81,5	80,4	79,4	69,7	77,3	84,8	85,8		
Cane Sugar ratio	9,4	9,9	9,9	10,4	10,2	9,9	10,3			
Yield of Sugar per hectare. (tons)	7,6	8,1	8,0	7,9	7,9	7,7	8,5			
Panela produced	28,0	30,0	35,0	22,0	21,0	20,0				

SOURCE: International Sugar Organisation.

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SUGAR MILLS

SUGAR MILLS			OWNERS
1º)	EL ANGEL	GOVERNMENT	INAZUCAR
2º)	LA CABAÑA	GOVERNMENT	INAZUCAR
3º)	SAN FRANCISCO	GOVERNMENT	INAZUCAR
4º)	SAN ESTEBAN	GOVERNMENT	INAZUCAR
5º)	CHANMICO	GOVERNMENT	INAZUCAR
6º)	LA MAGDALENA	GOVERNMENT	INAZUCAR
7º)	SAN ISIDRO	GOVERNMENT	INAZUCAR
8º)	EL CARMEN	GOVERNMENT	INAZUCAR
9º)	TALCUALHUYA	GOVERNMENT	INAZUCAR
10º)	INJIBOA	GOVERNMENT	INAZUCAR
11º)	CENTRAL IZALCO	PRIVATE	CO.AZUCARERA SALVADOREÑA
12º)	AHUACHAPAN	PRIVATE	INGENIO AHUACHAPAN S.A
13º)	EL CASTAÑO	PRIVATE	EL CASTAÑO, S.A.

SOURCE : INAZUCAR

MILLED CANE, SUGAR PRODUCTION AND PERFORMANCE

SUGAR MILLS	1980/1981 (x) MILLED CANE (ST).	SUGAR PRODUCTION (QQ).	PERFORMANCE QQ/ST.
El Angel	281.344	517.178	1,84
San Esteban	110.199	183.643	1,67
La Cabaña	250.110	467.494	1,87
El Carmén	107.064	203.034	1,90
San Francisco	212.534	411.470	1,94
Talcualhuya	-	-	-
Ahuachapan	-	-	-
San Isidro	-	-	-
Ctral. Izalco	544.452	1.066.000	1,96
Chanmico	108.865	203.167	1,87
La Magdalena	68.744	136.800	1,98
El Castaño	-	-	-
Jiboa	300.108	595.055	1,98
Colimo	-	-	-
TOTAL	1.983.420	3.783.861	1,91

(x) SOURCE : Inazucar Official Figures.

MILLED CANE, SUGAR PRODUCTION AND PERFORMANCE

1979-1980 (x)

SUGAR MILLS	MILLED CANE (ST).	SUGAR PRODUCTION (QQ).	PERFORMANCE QQ/ST.
El Angel	270.188	449.369	1,66
San Esteban	121.318	235.513	1,94
La Cabaña	269.442	421.755	1,57
El Carmén	81.610	153.320	1,88
San Francisco	192.435	320.476	1,67
Talcualhuya	30.373	47.797	1,57
Ahuachapan	39.000	59.873	1,54
San Isidro	62.771	130.632	2,08
Ctral. Izalco	547.833	1.062.000	1,94
Chanmico	79.826	140.933	1,77
La Magdalena	99.188	211.979	2,14
El Castaño	53.982	94.643	1,75
Jiboa	294.838	558.863	1,90
Colimo	-	-	-
TOTAL	2.142.804	3.887.153	1,81

(x) SOURCE : Inazucar Official Figures

MILLED CANE, SUGAR PRODUCTION AND PERFORMANCE

1978-1979 (x)

SUGAR MILLS	MILLED CANE (ST)	SUGAR PRODUCTION (QQ)	PERFORMANCE QQ/ST.
El Angel	411.215	869.383	2,11
San Esteban	174.427	390.594	2,24
La Cabaña	443.922	887.630	2,00
El Carmén	130.420	251.901	1,93
San Francisco	342.032	730.421	2,14
Talcualhuya	47.996	67.158	1,40
Ahuachapan	58.062	94.172	1,62
San Isidro	63.562	138.402	2,18
Ctral. Izalco	646.738	1.208.855	1,98
Chanmico	111.106	222.639	2,00
La Magdalena	111.690	227.779	2,04
El Castaño	89.788	164.449	1,83
Jiboa	352.614	702.025	2,00
Colimo	-	-	
TOTAL	2.983.572	6.027.408	2,02

(x) SOURCE : Inazucar Official Figures.

MILLED CANE, SUGAR PRODUCTION AND PERFORMANCE

SUGAR MILLS	1.977/1.978 MILLED CANE (ST).	SUGAR PRODUCTION (QQ).	PERFORMANCE QQ/ST.
El Angel	448.999	847.989	1,89
San Esteban	93.891	208.262	2,22
La Cabaña	504.391	979.583	1,94
El Carmén	169.633	322.516	1,90
San Francisco	395.616	793.642	2,00
Talcualhuya	40.172	62.594	1,56
Ahuachapan	81.330	142.868	1,76
San Isidro	95.875	180.687	1,88
Ctral. Izalco	627.197	1.167.180	1,86
Chanmico	134.531	252.527	1,88
La Magdalena	128.251	234.608	1,83
El Castaño	95.609	181.287	1,90
Jiboa	437.622	806.486	1,84
Colimo	41.559	80.791	1,94
TOTAL	3.294.876	6.261.020	1,90

(x) SOURCE : Inazucar Official Figures.

1977 INJIBOA owned by INAZUCAR entered service,. with a molturation capacity of 3,500 tonnes per day and some 50,000 tonnes per year. But the total molturation capacity has increased up to some 20,000 tonnes/day.

Most of the production of the sugar factories is centrifugal sugar, although there is a small part of "sulphited" sugar for domestic use. Below is included a summary of their activity by year of harvest.

Parallel with this industry there is another activity of craftsman type constituted by the "trapiches" or sugar mills, producing non-centrifugal sugar known as "panela" or "pilón" for local consumption. Some of them still use animals for power, usually oxen. But this activity is in decline.

The refinery was set up, as stated, in 1959 and its production has been above all for the domestic market. Its annual production capacity is 230,000 tonnes. According to the figures of the United States Department of Agriculture, (3), the number and capacity of the refineries existing in Central America at the end of the last decade was:

COUNTRIES	ANNUAL CAPACITY TONNES
Belize	90,000
Costa Rica	200,000

El Salvador	230.000
Guatemala	320.000
Honduras	80.000
Nicaragua	200. 000
Panama	130.000
T O T A L	1.250.000

El Salvador has 18.4% of the refining capacity of the region.

The consumption of sugar in the country is mainly of refined sugar, although yellow sugar and panela also exist. Refined sugar is also used primarily for industrial uses: carbonated drinks alone in 1974 used an appreciable quantity of unrefined sugar. This industrial sector has had rapid growth and at present consumes half the sugar for industrial purposes. Other consuming sectors are the confectionery and cake industries, ice cream, etc.

Foreign trade is at present subject to control. All, trade operations are centralized in the Instituto Nacional del Azúcar (INAZUCAR) (National Sugar Institute). There have been no imports for several years and exports have been on the decrease.

(3) Report on World Sugar Supply and Demand

Exports of sugar have grown almost without interruption from 1960 to 1977. In that year its value was less than 2% of the total value of exports, whereas in 1975 it reached 16% falling again later both because of the fall in sugar prices and the reduction of the amounts exported, so that in 1979 is had been reduced to a bare 5% of the total value.

The entry into service of the refinery assumed that in the first years El Salvador supplied the other Central American countries with this product, also exporting some to the United States. The latter country is the main - and at present the only - customer for Salvadorean sugar.

El Salvador has been operating in the market independently from the Central American Consortium of Sugar Producers. As a member-country of the International Suga Agreement of 1977, it was assigned a basic export quota (BATT) of 145,000 tonnes, but it has received supplementary authorization from the Special Hardship Reserve Committee in following years.

Up to 1967, El Salvador only exported sugar to immediately adjacent countries; in 1968 the first exports to Canada and Europe were made; which, in the case of Europe went on until 1975; Japan was a customer

SUGAR YEARLY PRODUCTION

(46 Kg. QQ)

YEAR	PRODUCTION	VARIATION (*)	% VARIATION (*)
1970/71	3.433.987		
1971/72	4.075.497	641.510	18,7
1972/73	4.133.990	58.493	1,4
1973/74	5.037.439	903.449	21,8
1974/75	5.581.667	544.228	10,8
1975/76	5.691.246	109.579	2,0
1976/77	6.217.853	526.607	9,2
1977/78	6.261.020	43.167	0,7
1978/79	6.027.407	-233.613	-3,7
1979/80	3.887.153	-2.140.254	-35,5
1980/81	3.783.861	-103.292	-2,7
1981/82			

SOURCE : INAZUCAR.

(*) Regarding former year.

SUGAR YEARLY ACTUAL INTERNAL CONSUMPTION

Tel Quel (x) (46 Kg. QQ)

YEAR	CONSUMPTION	ABSOLUTE VARIATION (xx)	% VARIATION (xx)
1970	1.465.806		
1971	1.578.910	113.104	7,7
1972	1.783.711	204.801	13,0
1973	1.845.973	62.262	3,5
1974	1.977.388	131.415	7,1
1975	2.230.749	253.361	12,8
1976	2.565.008	337.259	15,0
1977	2.522.226	-42.782	-1,7
1978	2.792.327	270.101	10,7
1979	2.837.717	45.390	1,6
1980	3.093.727	256.010	9,0
1981	2.882.699	-211.028	-6,8
1982			

SOURCE : INAZUCAR

(x) As it is, sugar consumed in gross value is sold without premiums nor penalties, independently of polarization.

(xx) Regarding former year.

INDUSTRIAL USE BY INDUSTRY : 1961, 1971 and 1974 (Tm)

	1961			1971			1974		
	REFINED SUGAR	UNREFINED SUGAR	Total	REFINED SUGAR	UNREFINED SUGAR	Total	REFINED SUGAR	UNREFINED SUGAR	Total
Milk Products	3,9	-	3,9	1,3	-	1,3	0,8	-	0,8
Homogenized Milk	28,5	-	28,5	118,5	-	118,5	169,4	-	169,4
Milk Sorbets	519,4	2,1	521,5	246,8	3,7	246,8	(1)	(1)	(1)
Fruit Juices	97,6	-	97,6	29,4	-	29,4	(1)	(1)	(1)
Bakerry Products	2.467,8	45,3	2.513,1	2.441,1	873,7	3.314,8	2.852,6	-	2.852,6
Pickels	1,0	-	1,0	-	3,3	3,3	8,9	-	8,9
Tinned & dried fruits	-	-	-	8,2	-	8,2	20,9	-	20,9
Confectionary, etc.	1.393,7	47,6	1.441,3	2.967,1	-	2.967,1	4.084,2	-	4.084,2
Coffee roasting	22,8	-	22,8	-	6,4	6,4	15,1	-	15,1
Cocoa & Chocolate Prod.	(1)	(1)	(1)	211,5	-	211,5	232,8	-	232,8
Ice-cream	(1)	(1)	(1)	120,9	-	120,9	550,0	-	550,0
Syrups	132,7	127,0	259,7	450,3	-	450,3	-	80,2	80,2
Other food uses	9,6	0,2	9,8				13,6	129,0	142,6
Wine making	58,4	-	58,4	101,8	-	101,8	131,9	-	131,9
Carbonated drinks	1.449,8	-	1.449,8	3.912,6	-	3.912,6		6.125,2	6.125,2
Other drinks	14,9	-	14,9	123,9	-	123,9	135,6	-	135,6
Pharmaceutical	23,6	14,0	37,6	56,4	19,9	76,3	201,5	-	201,5
TOTAL	6.233,7	236,2	6.459,9	10.789,8	907,0	11.696,8	8.417,3	6.334,4	14.751,7

(1) Included if necessary in others alimentary products.

SOURCE : International Sugar Organization.

SUGAR INTERNAL PRICES

(Raw Sugar)

	1975	1976	1977	1978	1979	1980	1981
REFINED SUGAR							
Delivered at the Distributor Warehouse	22,75	35,50	35,50	35,50	44,50	44,50	44,50
To Consumer	25,00	40,00	40,00	40,00	50,00	50,00	50,00
SULFITED SUGAR							
At Sugar Mill	20,30	31,25	31,25	31,25	41,00	41,00	41,00
To Consumer	22,00	35,00	35,00	35,00	45,00	45,00	45,00
CENTRIFUGATED AND CRISTALLIZED SUGAR							
At Sugar Mill	20,30	31,25	31,25	31,25	40,00	40,00	40,00
To Consumer	22,00	35,00	35,00	35,00	43,00	43,00	43,00

SOURCE : Comisión de Defensa de la Industria azucarera.

between 1969 and 1974; the Soviet Union and some African countries received Salvadorean sugar in 1972 and 1973. The greatest diversification of exports appeared between 1968 and 1975. From the latter date, there are only exports to the United States, the cnly customer not to change since 1960.

The amount of exports has varied from 21,000 tonnes in 1964 to 168,000 in 1977, diminishing since then, and being reduced to 35,000 in 1980. The figures available for 1981 show a slight increase, which for the January--November period worked out at 18.4%. Stocks at the end of the period tend to reduce as against the previous year.

Sugar exports are channelled through the Asociación Azucarera del Salvador (El Salvador Sugar Association) and are subject to licencing from the Comisión de Defensa da la Industria Azucarera, which also looks after the planning of its development.

El Salvador participates in the assigning of quotas in the United States market, excluding the quotas of the International Sugar Agreement.

EXPORTS OF RAW SUGAR BY COUNTRIES OF DESTINATION (1964-73)

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
USA	18.588	8.125	44.255	27.848	62.744	39.868	47.975	45.350	48.207	53.839
CANADA	-	-	-	-	5.334	-	-	-	-	-
HONDURAS	1.589	2.560	3.845	2.660	2.284	932	-	-	-	-
NICARAGUA	445	439	513	614	918	403	31	34		
GUATEMALA	53	234	387	122	55	90	92	295	-	-
OTHER COUNTRIES	-	3	-	-	1.250	7	-	-	106	-
UNITED KINGDOM	-	-	-	-	-	-	-	-	11.843	-
OTHER COUNTRIES	-	-	-	-	8.038	-	-	-	-	-
FINLANDIA	-	-	-	-	-	12.692	-	5.867	-	-
PORTUGAL	-	-	-	-	-	-	-	-	-	-
SPAIN	-	-	-	-	-	-	-	-	-	-
JAPAN	-	-	-	-	-	10.160	6.402	6.401	22.002	-
MALASIA	-	-	-	-	-	-	-	14.396	-	11.600
SABAH	-	-	-	-	-	-	-	-	11.350	-
MOROCCO	-	-	-	-	-	-	-	-	10.500	9.814
OTHER COUNTRIES	-	-	-	-	-	-	-	-	-	-
U.S.S.R.	-	-	-	-	-	-	-	-	31.410	23.996
TOTAL	20.675	11.361	48.999	31.224	80.624	64.153	54.501	72.882	135.418	99.249

SOURCE : International Sugar Organization.

<u>**EXPORTS BY COUNTRIES OF DESTINATION**</u>

1974-80

(M.T. Raw Value)

DESTINATION COUNTRIES	1974	1975	1976	1977	1978	1979	1980
Algeria	2,599	0	0	0	0	0	0
Egypt	9,372	0	0	0	0	0	0
EEC.	0	26,775	0	0	0	0	0
Finland	3,142	0	0	0	0	0	0
Japan	63,225	0	0	0	0	0	0
Morocco	2,754	0	0	0	0	0	0
Portugal	0	10,256	0	0	0	0	0
Spain	0	3,648	0	0	0	0	0
U.S.A.	62,116	99,126	129,839	168,818	133,114	164,312	35,273
Venezuela	2,954	0	0	0	0	0	0
TOTAL	146,162	139,805	129,839	168,818	133,114	164,312	35,273

SOURCE : I.S.O Sugar Year Book. 1980

PRODUCTION, EXPORTS, CONSUMPTIONS AND STOCKS

(M.T. Raw Value)

YEAR	PRODUCTION	EXPORTS	CONSUMPTION	STOCKS AND END OF YEAR
1973	231.979	103.349	90.434	40.069
1974	260.760	146.162	102.708	51.959
1975	244.009	139.805	118.138	38.025
1976	261.099	129.839	122.916	46.367
1977	317.739	168.818	124.997	70.293
1978	278.911	133.114	138.070	78.020
1979	273.779	164.312	143.760	43.727
1980	217.045	35.273	155.016	70.430

Campaign : November-May

SOURCE : I.S.O. Sugar Year Book. 1980.

PRODUCTION, EXPORTS, CONSUMPTION AND STOCKS

(Monthly Detail for 1980 and 1981)

PERIOD	PRODUCTION	EXPORTS	CONSUMPTION	STOCKS & END OF PERIOD
1980				
January	50,475	0	15,273	78,876
February	62,440	0	17,063	124,253
March	44,255	12.065	12,196	144,247
April	1,568	13,880	10,540	121,395
May	0	7,487	11,661	102,247
June	0	1,841	10,393	90,013
July	0	0	14,656	75,357
August	0	0	12,207	63,150
September	0	0	13,051	50,099
October	0	0	11,631	38,468
November	10.441	0	13,059	35,850
December	47,866	0	13,286	70,430
1981				
Enero	52,389	0	10,955	111,864
Febrero	45,497	0	10,413	146,948
Marzo	23,450	15,545	10,826	144,027
Abril	853	14,424	11,502	118,954
Mayo	0	0	12,108	106,848
Junio	0	0	10,692	96,156
Julio	0	5,170	13,968	77,018
Agosto	0	0	10,763	66,255
Septiembre	0	0	11,550	54,705
Octubre	0	0	12,279	42,426
Noviembre	11,369	6,617	12,715	34,463
Enero/Noviembre 1981	133,558	41,756	127,771	34,463
Enero/Noviembre 1980	169,179	35,273	141,730	35,850

SOURCE : I.S.O. Statistical Bulletin. Febr. 1982

5.6 CONCLUSIONS

The international sugar market appears as a market subject to many conditioning factors, both climatic and economic and political, which give rise to unexpected and unforeseeable variations in supply and demand and above all in prices.

Competition between cane sugar and beet sugar is now aggravated by the appearance of a new product: HFCS, or High Fructose Corn Syrups. This product is already making remarkable competition in the United States and Japanese markets and is beginning to do so in the Canadian market. This competition is centred, for the present, in industrial uses of sugar.

In addition cane sugar has to face competition from beet sugar, which, even with greater present manufacturing costs, is increasing its profitablilty with greater use of technology.

It is important to perfect the mechanization of the cultivation and harvesting of sugar cane and also its yield, in order to improve its profitability also. The industrial use of by-products of bagasse may be a good way of achieving that improvement.

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Sugar prices affect its production late and little. This may continue provided the prices cover the variable costs.

The consumption of sugar will continue to rise, especially in developing countries, which are also making an effort to also increase their production.

El Salvador has a long way to go in the improvement and modernization of the methods of cultivation and extraction of sugar, and it is expected that the yield will increase and productivity improve in the future. It is in the leading exporting region in the world, but its share is very small. Lately it has lost all its markets, except the United States, which may be a problem when it needs to recover them when production is increased. This increase must happen rapidly, at least up to the levels reached in the middle of the last decade. The product exported would be raw sugar, as the other Central American countries have sufficient refining capacity.

The relaunching of the El Salvador sugar industry should be made thinking of the minimization of production costs, as a small differential cost advantage with respect to prices which move completely independently from it may be a substantial differential income for the country. The public sector, owning most of the factories, should do all in its power to reach these minimum production costs.

5.2 MARKET FOR ETHANOL FOR USE AS FUEL

CONTENTS

5.2 MARKET FOR ETHANOL FOR USE AS FUEL

1. Introduction

The possible setting up of a plant for the obtainment of anhydrous ethyl alcohol next to the Jiboa Sugar Factory has been planned. Its capacity would be 90,000 litres per day, using as raw materials the juice and molasses of the cane processed by the factory. The operating time planned would be 240 days a year, with which total production would reach 21,600,000 litres per year, equal to 5,706,116 gallons per year.

The purpose of the alcohol obtained would be its use as fuel in the domestic market, adding it to gasoline in a proportion of up to 20%. The export possibilities of the product are not envisaged. The aim of the installation would be to complement the domestic gasoline supply, at present monopolized by Refinería de Acajutla, S.A. (RASA), the production capacity of which will be exceeded in the coming years by domestic demand.The supply of anhydrous alcohol would thus complement the gasoline supply, incorporating a domestic produced energy source alcohol obtained from sugar cane molasses.

For all these reasons, the study is centered around the domestic market, and specially, the

the future gasoline demand, as the damand for ethanol is conditioned and limited by this, as the ppoportion of alcohol which may be mixed in the fuel is also limited.

2. Use of Ethanol as Fuel

The use of ethanol as an energy source dates from the first internal combustion engines. At the end of the last century alcohol produced from sugar beet was already being used as fuel in Europe. The application of this technique was later suspended in view of the high cost of the product in comparison with the low price of petroleum.

During the economic crisis and with the threat of war in the thirties, European countries began to experiment with various alternative fuel sources, in particular with methanol and ethanol. Priority was given to ethanol, produced from the fermentation of agricultural produce, such as potatoes, sugar beet, sugar cane and cereals.

The use of ethyl alcohol as fuel in Brazil dates from the twenties. The first attempt to adapt grain alcohol for internal combustion engines was begun in 1923 in an experimental fuel station, with mixtures of 65% ethanol.

At the end of 1927, the alcohol used as fuel for car engines was in a mixture of 75% alcohol and 25% ether. Later other alcohol mixtures were used, such as "azulina", "motorina", "alcoholina" and "nacionalina".

After these results, the Federal Government, by decree nº 19,717 of 20th February 1931, made compulsory the mixture of 5% alcohol in gasoline.

After the Second World War, the fuel mixture was at a disadvantage, for economic reasons, and this led to a loss of interest in the research which had been carried out earlier.

At present, and in face of the heavy and repeated increases in the price of petroleum, insistence has been made on research to adapt ethanol for use as fuel, normally mixed with gasoline. This mixture, in varying percentages, is used in numerous countries, such as:

Argentina
Germany
Austria
Brazil
Bulgaria
Cuba
Czechoslovakia
Chile
Denmark
Ecuador

Philippines
France
Hungary
Italy
Panamá
Sweden
Switzerland
Yugoslavia

The most advanced country at present in the use of alcohol as fuel is Brazil, where, at present 250,000 cars are operating only on alcohol (with the engine adapted for this), and it is aimed to reach a figure of 2 million vehicles in 1985. In Europe, France has a research programme to obtain in 1985 alcohol for fuel in a quantity equivalent to 1.23 million barrels of petroleum. Other European countries are also carrying out research on the same subject.

Research on the use of ethyl alcohol, mixed with gasoline, shows that with a mixture of up to 20% alcohol, approximately, no changes are needed in the gasoline engines normally used.

The limitation of 20% is due to the different fuel to air ratio for gasoline and ethanol, because if the percentage of alcohol in the gasoline is increased this ratio must be increased in the same proportion; otherwise, the mixture is diluted, leading to the waste of the added alcohol.

The present widespread nature of research on the use of ethanol as fuel is due to two basic causes:

- The increase in the prices of petroleum and the energy crisis deriving from this.

- The need to make the by-products and surpluses of the agricultural sector profitable.

The use of these two last mentioned for conversion to alcohol and the use of this as fuel would make possible the double benefit of simultaneously getting rid of surpluses (agricultural) and deficits (energy).

3. Present Day Gasoline Market

3.1. Supply

The domestic gasoline supply is made up by production plus the net balance of foreign trade.

Gasoline production in El Salvador is carried out in the Acajutla S.A. Refinery (RASA). Its annual refining capacity was 650,000 tonnes of petroleum between 1969 and 1974, 750,000 between 1975 and 1977 and 850,000 from 1978.

The refinery has prepared the following quantities of products over the last few years.

PRODUCTION OF THE REFINERY (1969-1978)

YEARS	TOTAL PRODUCTION 1000 tonnes	GASOLINE 1000 tonnes	% GASOLINE	GASOLINE (1000gal)
1969	324	68	20.99	24.275
1970	172	36	20.93	12.852
1971	451	92	20.40	32.843
1972	467	94	20.13	33.557
1973	598	108	18.06	38.555
1974	605	103	17.02	36.770
1975	630	115	18.25	41.054
1976	682	133	19.50	47.480
1977	715	142	19.86	50.692
1978	706	146	20.68	52.120

SOURCE: U.N,.Statistical Yearbook, 1979/80 and own preparation.

The gasoline obtained is of the order of 20% of total production. If we consider that the maximum capacity of the refinery is 850,000 tonnes per year, should the capacity not be altered, then the maximum gasoline production would be 170,000 tonnes per year. Taking for gasoline an average specific weight of 0.74 kg per litre, the above figure is equivalent to 229.7 million litres or 60.7 million gallons per year. But this would entail the use of the refinery at 100% capacity,which is not usual in reality.

Limiting the use of the installations to 90% of capacity, the results would be a maximum yearly production of 153,000 tonnes of gasoline, equivalent to 206.8 million litres or 54.6 million gallons.

Foreign trade in gasoline is slight. According to the figures of the National Energy Balance and taking as the average calorific value 1.23015 Tcal per 42 gallon barrel, the following results have been obtained for last decade.

FOREIGN TRADING IN GASOLINE (1970-80)

(thousands of gallons)

YEARS	IMPORTS	EXPORTS
1970	20,622	-
1971	2,014	-
1972	5,838	34
1973	3,619	-
1974	2,014	-
1975	2,083	-
1976	1,468	-
1977	1,810	922
1978	2,766	68
1979	2,151	34
1980	3,005	-

SOURCE: CEL. National Energy Balance

The exports are temporary and of slight significance. Imports, on the other hand, are permanent, and of varying amounts, and have an average between 1971 and 1980 of 2,677 thousands of gallons per year. The figures for 1970 have been eliminated as they are unusually high and would distort the resulting average. Imports are necessary both to complement the production of RASA, and to compensate for its variations, adjusting the total supply to the demand of the product.

From these figures the internal supply of gasoline in the country may be obtained. It should be borne in mind that the original figures have been converted by mean coefficients to make them comparable. Also, the variation in stocks for each period has not been included, which would also alter the final figures. Therefore the results obtained should be considered always as approximate, giving more importance to their order of magnitude than their exact quantity.

DOMESTIC SUPPLY OF GASOLINE (1970-78)

YEAR	PRODUCTION	IMPORTS	EXPORTS	DOMESTIC SUPPLY
1970	12,852	20,622	-	33,474
1971	32,843	2,014	-	34,857
1972	33,557	5,838	34	39,361
1973	38,555	3,619	-	42,174
1974	36,770	2,014	-	38,784
1975	41,054	2,083	-	43,137
1976	47,480	1,468	-	48,948
1977	50,692	1,810	922	51,850
1978	52,120	2,766	68	54,818

SOURCE: Own preparation.

The domestic supply of gasoline has increased in El Salvador from 33 million gallons in 1970 to 55 in 1978, which is an accumulative yearly average growth of 6.36%.

3.2 Demand

Domestic demand for gasoline is equivalent to the consumption of the automobile vehicle numbers of the country, plus another small amount destined for industrial and unspecified uses.

Figures are available for the total amount of gasoline consumed annually "for automobiles and other uses" from 1966 to 1980, which is equivalent to the total domestic demand of that fuel.

Comparing these figures with those we have just obtained for the domestic supply, we can observe quite an acceptable concordance between the two series, even though they may not agree fully for the reasons stated.

SUPPLY AND DEMAND OF GASOLINE (1970-78)

(thousands of gals)

Year	Supply	Demand	Difference
1970	33,471	33,081	393
1971	34,857	35,160	-303
1972	39,361	38,943	418
1973	42,174	40,821	1353
1974	38,874	39,564	-780
1975	43,137	43,150	-13
1976	48,948	46,033	2915
1977	51 850	50,717	1133
1978	54,818	55,687	-869

SOURCE: Ministry of Planning: Economic and Social Indicators 1980 and own preparation.

As may be seen, supply adapts to demand, mainly through imports. The differences correspond, approximately to variation in stocks. Practically all the gasoline is consumed by the transport sector. Only a minimal amount of 1 to 1.5 %, depending on the year, is consumed by industry and agriculture and other unspecified uses (2).

But is cannot be clearly established which class of vehicles are consumers of gasoline. The available source (3) classifies the vehicles existing in 1980

(2) National Energy Balance
(3) Ministry of Planning. Economic and Social Indicators 1980

according to "type of fuel" and "Use" but does not cross reference both classifications. In addition, these figures are only for 1980. Lastly, the sum of vehicles classified in both categories does not agree with the total of vehicles existing in that year.

For all these reasons, the vehicles under the heading "Cars, lorries and jeeps" destined to carry passengers have been taken as consumers of gasoline, although it is known that they are not all those consuming gasoline but approximately two thirds. For this reason, the average consumption per vehicle is too high, as it includes a part of the lorries, and the consumption of the latter must be greater than that of the cars.

The next two tables show the evolution in the number of cars, the motorization rate per thousand inhabitants, the total gasoline consumption and the average consumption per automobile, which should be interpreted with the restrictions already noted.

The number of cars has increased from 26,179 in 1965 to 72,547 in 1980, which supposes an overall increase of 177% and an accumulative annual mean growth of 7.03%. In 1981 there were 16 cars for every thousand inhabitants, which is quite a low rate,

CARS

YEAR	CARS	INHABITANTS (thousahds)	CARS/1000
1965	26.179		
1966	27.593		
1967	30.080		
1968	31.340		
1969	34.029		
1970	34.238	3.397,6	10,08
1971	39.129	3.496,4	11,19
1972	46.845	3.598,3	13,02
1973	47.885	3.703,4	12,93
1974	48.948	3.811,9	12,84
1975	50.034	3.924,1	12,75
1976	51.145	4.039,9	12,66
1977	57.265	4.159,4	13,77
1978	63.688	4.282,6	14,87
1979	71.066	4.409,4	16,12
1980	72.457	4.539,5	15,98

SOURCE: Ministerio de Planificación. Indicadores Económicos y Sociales 1980 and own source.

NOTE : Since data for 1973,74 and 75 do not appear in the above mentioned source. They have been estimated by Interpolation.

ANNUAL GASOLINE CONSUMPTION PER PRIVATE CAR

YEAR	GALLONS (thousand)	CAR (thousands)	GALLONS/CAR	AVERAGE PRICE OF GASOLINE
1966	25.367	27,6	919	
1967	27.150	30,1	902	
1968	28.450	31,3	909	
1969	30.454	34,0	896	
1970	33.081	34,2	967	
1971	35.160	39,2	897	
1972	38.943	46,8	832	1,35
1973	40.821	47,9	852	1,46
1974	39.564	48,9	809	2,06
1975	43.150	50,0	863	2,23
1976	46.033	51,1	901	2,23
1977	50.177	57,3	885	2,53
1978	55.687	63,7	874	2,53
1979	55.049	71,1	774	4,24
1980	47.077	72,5	649	4,98

SOURCE: Ministerio de Planificación. Indicadores Económicos y Sociales 1980 and our own calculations although since 1970 it has experienced growth of 4.72% accumulative.

The total consumption of gasoline has evolved at a rate of 4.52 % annually, less than that of the numbers of vehicles, which implies a decrease in the average consumption per vehicle, as may be seen in the table.For this and between the ends of the period under consideration the drop is 30% although the evolution is not homogeneous.

The downward trend of average consumption is shown more clearly from 1976, becoming acute in the lest two years. In them there is a strong increase in the average prices of gasoline, but they also coincide with the manifestation of the depressive effects on economic activity of the delicate situation through the country is passing. These prices had almost nearly doubled between 1972 and 1978 without decreasing average consumption. It is clear that the sharp increase of 1979 - 68% accumulated to the rest, ?? reinforcing their dissuasive effect. On the whole, between 1972 and 1980 the weighted average prices of gasoline have increased by 269%, whereas consumption has been reduced by 22%.

With these figures the average elasticity of demand for gasoline with regards to its price would be:

$$Eqp = 0.0818$$

i.e. almost nil. However, considering the variations between 1979 and 1980, the result changes remarkably, being:

$$Eqp = 0.9255$$

i.e. an elasticity of almost one, which implies that an increase of the price in a certain proportion produces a decrease in demand in an equivalent proportion.

Without rejecting the effects of the internal situation as has already been stated, there can be no doubt that the 1980 price of 5 colones a gallon gives an elasticity which is greater than at the previous prices and that any new rise in them will produce reductions in the average consumption of gasoline by the car, which is the most sensitive consumer to successive price rises starting from an already relatively high price. In spite of this, the total consumption should increase again, as the number of vehicles increases.

4. Prospects of the Gasoline Market

4.1 Supply Forecasts

Gasoline production is subject to certain rigidity, as from the distillation of petroleum its derived products are obtained in determined proportions which, although not fixed, have a limited margin of variation. Elasticity to adapt to annual consumption comes from imports and stock variation.

As seen in 1.3.1 the annual capacity of RASA would make possible a maximum output of gasoline of 55 to 60 million gallons each year, according to whether it was working at 90 or 100% capacity. Due to the practical impossibility of using the installations at 100% capacity, it seems wise tp assume a maximum production of the order of 55 million gallons a year. According to available figures, the utilization rate in 1978 was 83%, even when demand was higher, giving rise to imports of 2.8 million gallons.

The fact that from that year the consumption of gasoline begins a downward trend makes us assume that even when that trend changes signs shortly, returning to its usual growth trend, the installed capacity of RASA will be able to cover demand without any problems at least until 1985, depending on the vigour with which consumption recovers once the present situation has been overcome. The following section analyses these possible alternatives.

4.2 Demand Forecasts

The forecasting of future demand for gasoline poses certain difficulties. Apart from the usual ones in this type of forecasting, the fact that, from 1978 on, a heavy price increase has coincided with a worsening of the internal situation in the country., hinders an evaluation of the effect of price on demand, as it is not possible to isolate which part of the fall in consumption is due to which of these phenomena.

The effect of the internal situation is transitory and will disappear sooner or later when the situation returns to normal. But the effect of prices is permanentand will continue to depress demand, even more so if there are further rises. Because of all this, it is not possible to give a clear meaning to the reduction of demand for gasoline by 15.5% between 1978 and 1980.

In order to estimate the future demand, several extrapolations have been made of the series of historical figures 1966 to 1980. As a complement, the future evolution of the total number of cars has been projected and also the number of vehicles per thousand inhabitants. Applying the average consumption per vehicle another estimate is obtained of the gasoline demand in the future.

PROJECTIONS OF GASOLINE CONSUMPTION

(thousands of gallons)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1980	56.805	54.582	58.558	51.289	47.077	47.077	47.077	47.077
1981	59.150	56.696	61.152	52.801	46.925	49.058	48.768	43.283
1982	61.495	58.811	63.746	54.312	50.201	51.123	50.519	41.538
1983	63.840	60.925	66.341	55.823	52.604	53.274	52.333	44.350
1984	66.185	63.040	68.935	57.334	57.496	55.516	54.212	47.352
1985	68.530	65.154	71.529	58.845	59.577	57.852	56.159	50.558
1986	70.875	67.269	74.124	60.357	57.027	60.287	58.176	52.686
1987	73.220	69.383	76.718	61.868	61.520	62.824	60.265	54.904
1988	75.565	71.498	79.312	63.379	64.859	65.468	62.429	57.215
1989	77.910	73.612	81.906	64.890	70.878	68.223	64.671	59.624
1990	80.255	75.727	84.501	66.401	77.144	71.094	66.993	62.134

SOURCE: Our own calculations

The extrapolations of the historical series are summarized in the table on the following page. A tota of eight has been made and their results show a wide margin of variation. In 1990 the expected consumption varies from 62 to 84 million gallons.

Each of the series is headed by a number. The criteri applied for each of these are the following:

Series 1 Adjustment of a straight line (y=mx+b) to the figures from 1966 to 1978, eliminating the negative effect of the drop in demand from that year. Results too high: the figure for 1980 is 9.7 million higher than the actual figure. The adjustment is very good with a very high correlation coefficient (R= 0.9836) and a standard estimation error very small (S_e^2= 1,610.41). The parameters of the straight line are

b = -4,586,426; m = 2,345

Series 2 Adjustment of a straight line to the set of figures, until 1980, so that the drop in demand is included in the trend. Results also high, although less than in the preceding, especially in the target year. Very good adjustment with a very high coefficient of correlation (R = 0.9594) and highly acceptable standard estimate error (S_e^2= 2,686.26). The parameters are:

b = -4,132,114; m = 2,114.49

Series 3 Adjustment with double exponential smoothing taking the values between 1967 and 1978. This is the series which produces the highest values. The value obtained for 1980 differs greatly from the actual value, although the preceding values are a lot more similar. The value = 0.15 was used for both smoothing constants, obtaining for the coefficients the following values:

Level coefficient: $F_t = 53,369$

Trend coefficient: $T_t = 2,594.27$

Series 4 Adjustment with double exponential smoothing for the values of the series from 1969 to 1980, in order to include the reduction in demand of recent years. The value obtained for 1980 approximates to the actual, with a difference if under 10%. The forecast of the first years appears to be excessive as it does not reflect the trough in demand; that of the last years more correct. The same value is used for the constants of the smoothing, but the coefficients are:

Level: $F_t = 51,28\ 9$

Trend: $T_t = 1,511.18$

Series 5 Adjustment with triple exponential smoothing, considering the decreases in demand (1974, 1979 and 1980) with seasonal variations. Includes years 1968 to 1980. The same value alpha = 0.15 for the three constants of the smoothing, giving coefficients:

Level: F_t = 51,515

Trend: T_t = 1,522.25

Greater approximation in the initial values is obtained as the series starts from the actual value for 1980. The final value is close th that of series 2.

<u>Series 6</u> Projection atarting from the actual value of the series for 1980 and applying the average accumulative annual growth rate of the period 1966-.1980, which is 4.21%. Intermediate values are obtained between those already obtained for other series.

<u>Series 7</u> Like the preceding one, but using the rate of 3.59% between1970 and 1980. Results similar to those of series 4 although generally lower and especially at first, through starting out with the actual figure for 1980.

Series 8. Obtained using multiple criteria: starting out from the actual figure for 1980, it is assumed that in 1981 the trend will continue to be downward at the same average rate as that recorded in 1978-80 (-8.60%); for 1982 this rate will fall to half (-4.03%), in this year the internal reasons motivating the decrease in consumption finishing in this year. From 1983 consumption recovers, growing at the historical rate before the crisis (6.77% during the period 1966-1978) until in 1985 the figure of 50 million gallons is reached. for the last year of that period, growth smoothing out after 1986 and remaining at the average level of the whole period considered (4.21%)

(period 1966-1980). The consumption of the limiting year is 62 million gallons.

As a summary of all these estimates the consumption of gasoline in El Salvador in 1985, may be expected to reach a volume of 53 to 55 million gallons, and in 1990 it may reach a figure near 65 million gallons.

The projection of the number of cars has been made by adjusting a Gompertz curve to the figures of the numbers of vehicles from 1966 to 1980. Although the reconstruction of historical series obtains values very similar to those observed, from 1976 the curve gets out of step and especially does not respond to the sharp increase of 1979, giving for the end of the forecast period a figure as low as 77,110 automobiles (1980 stocks:72,547). It has been rejected.

In addition, the application of the accumulated annual average growth rate between 1966 and 1980 (7.15%) leads to the result of forecasting for 1990 a total number of 1[illegible]707 vehicles, a figure which is too high as it does not take into account the decrease in purchasing shown clearly in 1980 (2.08% growth as against 11.58% in 1979).

Assuming that this slower growth rate will remain until 1983, then recovering up to the historical level of 7.15%, the number of vehicles in 1985 would be 88,598 and in 1990, 125,137.

Applying these criteria in order to extrapolate the series of the number of vehicles per thousand inhabitants (which in 1980 was 15.98), with respective rates of -0.0087 and 4.72% the following results are obtained:

YEAR	AUTOMOBILES (per thou. inhab.)	POPULATION (thou. inhab.)	TOTAL AUTOMOBILES
1985	17.06	5,235.7	89,321
1990	21.48	5,997.0	128,816

Which are not noticeably different from those just obtained.

In contrast to the motorization rates obtained the table on the following page shows the levels of this rate in nine other Central American countries and also their per capita income levels. The rate anticipated for El Salvador in 1990 (21.48 per ..J0 inhabitants) is still low and is only slightly higher than that registered for Nicaragua in 1977.

As we saw, the average consumption of gasoline in 1980 was 649 gallons per automobile. Assuming that this figure is maintained in time or reduced to 550 gallons and applyinhg these figures to the estimated number of vehicles various estimated consumption figures are obtained:

PRIVATE VEHICLES

COUNTRIES	VEHICLES (thousands)	POPULATION (millions)	VEHICLES/1000 HABITANTS	INCOME
Costa Rica (1)	73,4	2,07	35,5	1.371
Dominican Republic	90,6	5,12	17,7	842
Guatemala	90,5	6,84	13,2	769
Haiti (1)	22,7	4,75	4,8	277
México	3021,1	66,94	45,1	1.230
Nicaragua (1)	46,4	2,32	20,0	896
Panamá (1)	71,0	1,70	41,8	1.076
Puerto Rico	806,8	3,36	240,1	2.748
Trinidad and Tobago	131,5	1,13	116,4	2.638
El Salvador	63,7	4,28	14,9	644

(1) Data for 1977

SOURCE: U.N.: Statistical Yearbook. 1979/80 and our own calculations.

YEAR	AUTOMOBILES (000's)	AV. CONSUMPTION (gals)	TOTAL CONSUMPTION (millionsgals)
1985	89	650	57.8
	89	600	53.4
	89	550	49.0
1990	126	650	81.9
	126	600	75.6
	126	550	69.3

These figures go to confirm those obtained as a summary of the extrapolations of gasoline consumption. Joining the results of both types of forecast (direct and indirect) and maintaining a weighted criterion, it may be stated that gasoline consumption in El Salvador in 1985 will be between 5C and 55 million gallons, and rising in 1990 to 65-70 million.

5. Conclusions: The Ethanol Market in El Salvador

The market for ethanol for use as automobile fuel derives directly from the gasoline market, with which it must be mixed to be used without any problems. Therefore its potential market exists wherever the market for gasoline exists. The decision to sell gasoline with a certain percentage of ethanol, transforming that potential market into a real one, is a political decision. The main problem is not the existence of the market, but the cost of obtaining the product, which may make the conversion of molasses to alcohol unprofitable.

The anhydrous alcohol distillery projected has a manufacturing capacity of 5.7 million gallons a year and the product is intended to be mixed with gasoline in a proportion of 20 to 80. Which means that we must add to gasoline 25% of its volume of alcohol, for the resulting mixture to contain 20% of this (25/125).

In these conditions and with a present (1980) consumption of 47 million gallons, there is already a potential market of 11.75 million gallons of ethanol. The problem is that the production of RASA at present exceeds gasoline consumption, thus producing a gasoline surplus of a similar volume as the production figure for alcohol, which would have to be exported.

It does not seem wise in the present circumstances to increase the supply of fuel, perhaps to the detriment of gasoline production. It would be quite a different matter to replace imports, when necessary, the mean annual volume of which is estimated at 2.6 million gallons.

The maximum gasoline production in the present RASA plant has been estimated at some 55 million gallons. According to the projections made, this volume of consumption will be reached from 1985 on. It is for that date that the entry into service of a plant for the obtainment of anhydrous alcohol of the characteristics established in the project would be suitable. With a consumption of 55-60 million gallons a year possible for 1986-87 a complementary production of 5.7 millions of alcohol would provide 10% of that consumption, obtaining a fuel mixture of 9% alcohol(10/110), which is easier for consumers to accept initially. This production would make it possible to eliminate imports of gasoline, leaving RASA with greater flexibility in production, which would be at maximum capacity.

The maximum potential demand for alcohol for 1990, considering a mixture with 20% would be from 16.3 to 17.5 million gallons, i.e. of the order of three times the capacity of the plant now under study.

5.3 MARKET STUDY OF BAGASSE PANELS

CONTENTS

5.3 MARKET STUDY OF BAGASSE PANELS

1. Introduction

Below is an analysis of the market for bagasse panels. The production capacity of these products, by the Jiboa Complex, has been put at 60,000 tonnes a year.

The resulting product that can be manufactured with various types and densities (from 400 kg/m^3 to 650 kg/m^3) would have applications similar to other particle boards and fibreboards.

The study carried out has been centred around the analysis of the market of panels in general and specifically particle boards. From the spatial point of view a preliminary analysis has been made of the main world trends, then centring both on El Salvador and the group of neighbouring countries (the geographical zone extending from Mexico to Panama, including the Caribbean) as this last area is considered to be the main potential market of the new factory.

2. The International Panel Market: Present Situation and Main Trends

Given the diversity of types of panels or boards which may be produced from a bagasse base, it has been decided to analyse the market of wooden panels as a whole, which, according to the FAO classification, includes all panels used as raw materials both wood and its residues and other lignocellulose matter. In the international statistics used, wooden panels include veneer, plywood, particle boards and fibreboards. Although each of these products may have different optimum applications, there is a wide range of uses in substitution, though bagasse panels enter direct competition with other particle boards and fibreboards; however, for certain applications it may replace plywood and even certain uses of sawnwood, especially in the furniture and construction industries.

The world supply of wooden panels has been experiencing very considerable increases since the end of the Second World War, representing growing quotas in the production of the whole group of forestry products used industrially.

WORLD WOODEN BOARD PRODUCTION (in thousands of cu. m)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
BOARD (TOTAL)	69.785	78.205	87.578	95.461	88.018	84.819	95.706	101.051	104.551	106.815
LAMINATED SHEETS	3.235	3.346	3.484	3.795	3.695	3.850	4.218	4.383	4.455	4.569
PLYWOOD	33.174	36.499	40.122	42.171	36.061	34.264	38.787	41.267	41.943	43.214
PARTICLE BOARD	19.170	22.780	27.393	31.946	31.702	30.825	34.966	37.511	40.199	41.039
FIBREBOARD	14.207	15.580	16.580	17.549	16.560	15.880	17.734	17.890	17.854	17.993
Compressed	6.410	6.635	7.157	8.056	8.060	7.582	8.376	8.627	8.749	8.741
Not compressed	8.067	8.945	9.423	9.493	8.501	8.298	9.358	9.263	9.205	9.252
INDEX FIGURES:										
BOARD (TOTAL)	100,00	112,07	125,50	136,79	126,13	121,54	137,14	144,80	149,82	153,06
LAMINATED SHEETS	100,00	103,43	107,70	117,31	114,22	119,01	130,39	135,49	137,71	141,24
PLYWOOD	100,00	110,02	120,94	127,12	108,70	103,29	116,92	124,40	126,43	130,25
PARTICLE BOARD	100,00	118,83	142,90	166,65	165,37	160,80	183,40	195,68	209,70	214,08
FIBREBOARD	100,00	109,66	116,70	123,52	116,56	111,78	124,83	125,92	126,37	126,65
Compressed	100,00	108,06	116,56	131,21	131,27	123,49	136,42	140,50	142,49	142,35
Not compressed	100,00	110,88	116,81	117,68	105,38	102,86	116,00	114,83	114,11	114,69

SOURCE: Foresty Products Yearbook F.A.O. 1979

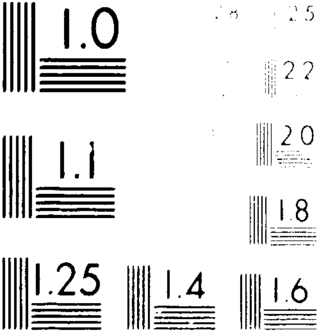
Thus, from a world production figure of the whole of panels of some 10.3 million m^3 at the beginning of the fifties (equivalent to 5.3 m^3 per inhabitant) it has reached 102.3 million m^3 in 1979 (equivalent to 25 m^3 per thousand inhabitants).

Centring ourselves more specifically in the seventies, the expansion undergone by the world production of panels was abruptly interrupted by the economic crisis of 1973 and although production levels were recovered in 1976, later growth has been slowed down considerably with respect to the high rates of increase before the crisis.

However, in spite of these changes in the recent trend, the world supply of panels was in 1979 53% higher than in 1970. For the same period the world production of sawnwood grew by only 12%. This unequal evolution implies that, in spite of the economic crisie of recent years, the trend already observed in previous decades - growing uses of panels in applications previously reserved for wood and the development of new applications - is still valid today.

Within the general group of wooden panels, the particle boards are those which have been experiencing the greatest increases since their appearance, representing growing shares of the total production of panels. In the attached table the various rates of growth may be observed, during the decade, among the various types of panels, which have determined that particle boards went from accounting for 27.5% of the total supply of panels in 1970 to 38.4% in 1979; this greater share of particle boards is based on their growing absorption of the market increase, replacing both plywood and fibreboards. In the years following the crisis of 1973 - after the production drop of 1974/75 - this process has continued, although less intensely than in earlier times.

The world supply of panels is rather concentrated in the most developed countries (market economy) controlling 71% of total production, as against 11% of the developing countries ((market economy) and 18% of countries with centralised economies. However, these two last groups of countries are presenting increases higher than those of world production, and for this reason the concentration is increasingly less marked.


1.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

It should be noted that it is precisely in the production of particle boards where the share of the developing countries (market economy) is less, as their share in the production of these products only accounted for, in 1979, 4.5% of the world total (as against 35% and 15% in veneer and plywood, respectively), This situation is explicable mainly because párticle board is a relatively recent product and required technical and economic conditioning factors rather greater than the manufacture of plywood, and also by the greater development of the industry using these products in the richest countries, many of which in addition have scant resources of suitable timber (especially in Europe).

The regional distribution of production reflects to a great extent the concentration noted earlier, as, for panels as a whole, the main producing areas are North America and Europe, closely followed by Asis (especially due to the influence of Japan). The share of South America is still very small, although growing.

It is interesting to analyse the regional distribution of production of the various types of panels as very divergent situations exist. in effect, the major plywood producing areas are North America (49% in 1979), and some way behind, though growing fast, Asis (34%). Europe is a poor producer of these panels (8%).

The position is completely different when we come to the production of particle board, as Europe makes up approximately 60% of world production, although with smaller growth rates than other regions. North America is the next producing region, but it only makes up 21% of the world total.

In the case of fibreboard, North America is the main producing region (45%), followed at a distance by Europe (25%).

The apparent consumption of wooden boards or panels per thousand population, on world scale, has continued to show important growth in the 1970-79 period, from 19.2 m^3 in 1970 to 25 m^3 in 1979. As happened with production, the most dynamic panel is the particle board, the level of consumption of which per inhabitant is approaching that of plywood.

The average consumption levels present very important distorsions according to the economic development of each country and the specific characteristics of each region. Thus, the most developed countries (with market economies) went from consuming 77.9 m^3 per thousand population in 1970 to 102.7 m^3 in 1979. On the other hand, the less developed countries (with market economies) are still situated at 4.4 m^3 of consumption of panels per thousand inhabitants in 1979, although this figure is twice the 1970 level.

At regional scale, the differences are also very important, with maximum consumption levels per thousand inhabitants in North and Central America (110.9 m^3/1000 inhavitants in 1979) and Europe (75.11 m^3) and a minimum level in Africa (2.6 m^3).

The distribution of these levels of consumption according to the types of panels is also very variable according to the regions: thus, whereas in Europe most of the consumption goes to particle boards, in North America the main panel consumed is plywood, although in both cases the particle board shows the greatest relative expansion.

PRODUCTION OF AND OVERSEAS TRADE IN BOARD (TOTAL) BY REGIONS (IN THOUSANDS OF CU.M)

REGIONS	MEAN 1970 -74			MEAN 1975 - 77		
	PRODUCTION	IMPORTS	EXPORTS	PRODUCTION	IMPORTS	EXPORTS
AFRICA	1.090	277	418	1.146	326	290
NORTH AND CENTRAL AMERICA	32.222	3.771	1.258	35.374	3.711	1.632
SOUTH AMERICA	1.894	33	217	2.799	39	345
ASIA	14.127	900	3.463	16.665	1.268	4.264
EUROPE	26.593	7.134	5.916	31.611	9.026	7.167
OCEANIA	876	110	92	1.057	129	74
U.S.S.R.	7.010	86	629	9.956	99	897

SOURCE: F.A.O.

PRODUCTION OF AND OVERSEAS TRADE IN PARTICLE BOARD BY REGIONS (IN THOUSANDS OF CU M)

REGIONS	MEAN 1970 - 74			MEAN 1975 - 77		
	PRODUCTION	IMPORTS	EXPORTS	PRODUCTION	IMPORTS	EXPORTS
AFRICA	249	30	8	319	39	5
NORTH AND CENTRAL AMERICA	5.156	188	115	7.292	424	165
SOUTH AMERICA	480	3	12	808	0	19
ASIA	844	56	61	1.503	92	75
EUROPE	16.367	2.804	2.834	21.905	4.282	4.271
OCEANIA	397	8	6	609	8	20
U.S.S.R.	3.269	-	167	4.472	-	288

SOURCE: FAO

The level of commercial exchange in the panel market is quite important, as shown by the fact that imports make up around 14% of world production, with slight variations according to product (except veneers, in which the ratio of imports and total production is somewhat higher). However, most of the international trade in these products has a marked intraregional character given the strong incidence of transport costs.

In spite of the deficiencies existing in the statistics, the volume of extraregional trade in panels may be estimated by comparing the estimates of apparent consumption with production, in each region; in this way the existing trade within these regions would in theory be eliminated. Making thes calculations for three different years of the decade 1970-1979 (end years, 1970 and 1979 and a year of production crisis:1975), the result obtained fully confirms the previous statement as the levels of self sufficiency for the main regions is usually situated in levels of 93-95% of self sufficiency, for the main consumer regions (Europe and America), and between 100% and 110% for the rest of the world regions, with the sole exception of Asia which is a net exporter of some size.

PRICES OF PLYWOOD AND PARTICLE BOARD

	1970	1971	1972	1973	1974	1975	1976	1977	1978	97
Average world export price ($/m^3)										
Plywood (1)	145	147	167	216	255	228	257	281	294	34
Particle-board (2)	67	66	75	90	106	112	108	120	134	16
Price ratio (1/2)	2,16	2,23	2,23	2,40	2,41	2,04	2,38	2,34	2,19	2,1
Price of imports to El Salvador										
Plywood (3)	213	252	217	217	229	293	322	364	364	36
Particle board (4)	-	-	-	-	-	-	225	228	228	22
Price ratio (3/4)	-	-	-	-	-	-	1,43	1,60	1,60	1,6

Source: F.A.O.

It should be noted that in the case of fibreboards and especially in the case of particle boards, trade between regions is virtually non-existant, as most of the main regions present an almost total degree of self sufficiency. This fact is determined to a large extent by the low cost of the particle board in relative terms, therefore international trade is very delimited to areas near the place of production, as otherwise it would present a disadvantage as against plywood, with much higher unit prices (and therefore much more able to absorb transport costs).

They are precisely the remarkable differences in prices existing between the particle boards and plywood panels which explain to a great extent the continuiung process, already remarked on, of substitution between these two products. Actually, although the proces of both products experience continuous growth (except in 1975 and 1976) - measured in dollars each year and based on the FOB export values - the relative level between the prices per m^3 of plywood as against particle board wood oscillates between 2.04 and 2.41 during the whole period of 1970-1979.

The forecasts made by the various international bodies (FAO and the World Bank) estimate important growth in the production of wood panels of the order of 5% per year and accumulative, until the year 2000. According to the FAO (New Delhi, 1976), the expected production growth of developing countries would be even higher (between 5.3% and 7.5%). Some opinions voiced in groups of experts mark that those estimates are rather optimistic.

In any case, there are well founded opinions to foresee an important increase in the future consumption of wooden panels and in particular, particle boards; also all the forecasts mark a greater growth in relation with the world production and consumption of these products, by the developing countries.

The non-existance of detailed statistical information makes it difficult to place the production and demand of panels produced using a raw material such as bagasse within the general context described above. In order to attempt to obviate this drawback, various specialised publications have been analysed, and interviews have been held with several research bodies, business associations and companies producing particle boards and bagasse panels.

Based on the information received, we deduce first the relative novelty of the production of the bagasse panel. Within this, the relatively new group of particle boards in particular, the industrial use of bagasse for boards or panels is even more recent and its beginning goes back to the end of the sixties, within the context of facing, with new raw materials, (flax, bagasse , etc) the growing development of the consumption of panels. This characteristic - new raw materials, new applications, new types of products- usually accompanies markets with a strong expansive dynamic.

In spite of this recent development, experts in the sector have remarked that at the end of the seventies an important U.S. factory had closed, after a remarkable development of its production of bagasse panels (especially directed to the fabrication of doors).

In Spain there also existed a factory of bagasse panels with a production capacity of 40,000 m^3 per year. This factory closed in 1981, basically due to difficulties in the conservation of the raw materials (spontaneous combustion, rapid deterioration of raw materials, necessity of high costs for conservation of bagasse , etc.) although the final product had been favourably received in the market, due mainly to the fact that it was a company which was well introduced into the market of particle boards.

At present, it is estimated that there are some 20-30 factories all over the world producing bagasse panels, with an overall production capacity of 600,000m^3. The greatest installed capacity is in Latin America, which represents approximately 70% of world production ; the rest of the production is located in South Africa (20%) and Asia.

The main producing countries in Latin America are the following (in brackets the estimated production at present, in m^3):

1. Cuba (200,000)
2. Venezuela (60,000)
3. Peru (40,000)
4. Ecuador (30,000)
5. Trinidad and Tobago (25,000)

In El Salvador there is one factory (Proagro, in San Francisco) producing bagasse panels with an estimated production of 9,000 m^3 and which at present is experiencing difficulties in placing this production, both in the d.mestic and foreign markets.

According to several experts interviewed, the introduction of bagasse panels into the international market as a substitute for other particle boards is not free of difficulties; especially in the low density types (around 400 kg/m^3) due to heavy competitiion from other panels; the high density type (650 kg/m^3 or over) has more possibilities and may have better applications than other similar panels.

The prices of bagasse panels on the market are estimated to be - at least in the introduction phase of the new product - around 20-30% lower than particle boards (1).

As for the main uses of this product, they vary remarkably both according to the specific type being manufactured and the characteristics of the consuming country. In general the most widespread uses of this product are those similar to other particle boards;

(1) At present Cuban bagasse panels are being sold on the London market at prices 30% below particle boards, despite the effect of transport costs from the place of production to place of sale.

in dwellings and other buildings (interior compartmentalisation, doors, false ceilings, sound insulation,...) and in the furniture industry, where they have had their most generalised use, the importance of these uses varying according to country. So, for example, in the Northern European countries the construction industry (including kitchen furniture of dwellings) usually take up over 50% of the production of particle boards, whereas in Spain the main consumer sector is the furniture industry (around 80% of production).

Other less generalised applications have been tried: in the production of packing ; prefabricated dwellings, using only bagasse panels, etc. From the technical point of view there do not appear to be great limitations on these possible uses, if the final product is suitably treated (improving its resistance to damp and self extinguishing properties, especially).

3. The Panel Market in the American Area

With the aim of knowing in more detail the differentiating characteristics of the potential buyers and competitors of El Salvador, below the main trends in the production and consumption of panels in the American Continent are analysed, distinguishing the following zones: USA and Canada; other countries of Central and North America (including the Caribbean); South America. Later this overall analysis will be completed with another, more detailed analysis at the level of each of the countries geographically nearest El Salvador.

The main characteristics of the evolution of the production of wood panels on the American continent over the period 1970-1979 are the following:

First, note the heavy concentration in the USA and Canada of the American production of wooden panels, the joint supply of these two countries accounting for over 90% of the American production of these products (in 1979). That share is somewhat lower both in the production of particle boards and fibreboards.

Nevertheless, during the period 1970-1979 the production of the other areas in America has grown at faster rates than those of the USA and Canada, so the degree of concentration of production is gradually diminishing.

In South America, the most notable thing is the sharp drop in the variation rates of the period 1976/1979 compared with those of 1970-73, more intensely than at world level. Only in fibreboard does this area maintain a remarkable growth.

The Central America area (including Mexico and the Caribbean) is that which presents the lowest level of production, being only 2% of production on the continent (with higher relative shares in particle boards and especially veneers).

The composition of the American production of wooden boards is different from that stated for the world as a whole. Actually, the production of plywood and especially fibreboard has in the American area an importance rather greater than that existing at world level and differs notably from the European production structure, much more centred around the production of particle board.

INDICATORS OF PRODUCTION AND REGIONAL DISTRIBUTION TRENDS

IN PREPARED TIMBER AND PARTICLE BOARD

(1970-1979)

	VOLUME OF PRODUCTION		PERCENTAGE OF WORLD PRODUCTION		COMPOUNED ANNUAL GROWTH RATE	
	1970	1979	1970	1979	1970-73	1976-79
PREPARED TIMBER						
World production ($10^6 m^3$)	404,8	443,8	100,0	100,0	2,7	1,2
Production USA and Canada	107,5	132,0	26,6	29,7	5,8	2,4
Rest of North and Central America	2,9	2,4	0,9	0,5	-0,9	-12,9
South America	12,6	20,3	3,1	4,6	-	0,1
WOODEN BOARD						
World Production ($10^3 m^3$)	69.785	106.815	100,0	100,0	11,0	3,7
Production USA and Canada	26.314	37.760	37,7	35,3	11,3	3,7
Rest of North and Central America	310	627	0,4	0,6	7,9	12,3
South America	1.349	3.060	1,9	2,9	17,5	3,9
PARTICLE BOARD						
World production ($10^3 m^3$)	19.170	41.039	100,0	100,0	18,6	5,5
Production USA and Canada	3.410	8.500	17,8	20,7	26,6	11,6
Rest of North and Central America	72	239	0,4	0,4	11,9	24,1
South America	311	866	1,6	2,1	23,5	3,0
FIBREBOARD						
World Production ($10^3 m^3$)	14.207	17.993	100,0	100,0	7,3	0,5
Production USA and Canada	6.755	8.049	47,5	44,7	8,6	-0,2
Rest of North and Central America	87	92	0,7	0,6	1,5	0,4
South America	331	895	2,3	5,0	10,3	7,5

INDICATORS OF PRODUCTION AND REGIONAL DISTRIBUTION TRENDS IN PREPARED TIMBER AND PARTICLE BOARD

(1970-1979)

	VOLUME OF PRODUCTION		PERCENTAGE OF WORLD PRODUCTION		COMPOUNDED ANNUAL GROWTH RATE	
	1970	1979	1970	1979	1970-73	1976-79
LAMINATED SHEETS						
World production	3.235	4.569	100,0	100,0	5,5	2,7
Production USA and Canada	220	500	6,8	10,9	-3,4	1,8
Resto of North and Central America	4	23	0,4	0,5	14,5	21,0
South America	129	240	3,9	5,2	17,3	5,7
PLYWOOD						
World production	33.174	43.214	100,0	100,0	8,3	3,7
Production USA and Canada	15.929	20.711	48,0	47,9	8,8	2,6
Rest of North and Central America	147	273	0,4	0,6	10,3	8,5
South America	579	1.053	1,7	2,5	18,0	1,4

SOURCE: F.A.O.

As can be seen from the attached table, the evolution between 1970-1979 of the continental production of panels (total and by types) follows, in general lines, the trends remarked on at world level, with important increase rates, especially in areas with low initial volumes of production and a greater relative growth of particle boards (with the exception of South America, which presents very intense increases in fibreboards).

It is interesting to note especially the evolution during the period analysed of the production of panels in the group of countries in which El Salvador figures (rest of North and Central America), which in addition corresponds with the possible area of maximum influence of the new factory, due to the fact that it groups the countries which are near to each other geographically. The scant impact of this area on continental production (and world production) is obvious, not only in panels, but also in sawn wood.

The recent evolution of this area presents, however, notable differences, both with regards to world production and for America as a whole. In order to analyse this evolution the annual accumulative rates of the period 1970-73 have been calculated, before

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PRODUCTION AND CONSUMPTION OF WOODEN BOARD IN CENTRAL AMERICA AND THE CARIBBEAN

PRODUCTION BY GROUPS OF COUNTRIES	PRODUCTION (thousand of cu.m) 1970	1979	APPARENT CONSUMPTION (Tousends of cu.m) 1970	1979	APPARENT CONSUMPTION PER 1000 inhabitants (cu.m) 1970	1979	PERCENTAGE OF SELF-SUPPLY (% 1/2) 1970	1979
Total wooden board								
C.A.C.M.	52	97	50	95	3,3	4,8	104	102
Mexico and Panama	178	455	188	460	3,6	6,5	95	99
Caribbean	80	75	149	204	7,0	8,2	54	37
out of which:								
1) Particle board								
C.A.C.M.	4	35	3	34	0,2	1,7	133	103
Mexico Panama	56	196	56	210	1,1	3,0	100	93
Caribbean	12	8	21	48	1,0	1,9	57	17
2) Fibreboard								
C.A.C.M.	-	-	-	-	-	-	-	
Mexico and Panama	21	26	24	26	0,5	0,4	88	100
Caribbean	66	66	71	72	3,4	2,9	93	92

SENER

PRODUCTION AND CONSUPTION OF PREPARED TIMBER IN CENTRAL AMERICA AND THE CARIBBEAN

GROUPS OF COUNTRIES	PRODUCTION (1) (thousands of cu. m)		APPARENT CONSUMPTION (thousand cu.m)		APPARENT CONSUMPTION PER 1000 INHABITANTS (cu.m)		PERCENTAGE OF SELF-SUPPLY (%1/2)	
	1970	1979	1970	1979	1970	1979	1970	1979
Prepared timber:								
C.A.C.M.	1.218	1.238	845	786	81,2	62,3	144	158
Mexico and Panama	1.462	1.005	1.593	1.045	28,1	14,1	92	97
Caribbean	178	141	916	1.414	8,4	5,7	19	10

SOURCE: F.A.O.

the crisis, and those of 1976-1979, in which the production of panels had already recovered. As can be seen in the attached table, the growth rates of the production of panels in this sub-region have been greater in the more recent period than before the crisis, the reverse of the world trend and other American sub-regions.

These remarkable growths have been basically due to the sharp growth of the production of particle board and to a lesser extent the veneers (and plywood). Although the weak levels of starting condition the evaluation of these high rates, the existing figures seem to imply a growing introduction of panels in general - and more specifically particle board - into the consumption of forestry products, taking into account the stagnation of production of sawn wood. This would mean that the sub-region would already be entering - with a certain delay and with still low levels - into the process followed by other areas and countries of thepártial substitution of wood by panels.

In order to analyse the importance of this process in the area next to El Salvador the sub-region has been broken down into three different areas: countries of the Central American Common Market (Guatemala, Honduras, Nicaragua, El Salvador and Costa Rica), Mexico and Panama and the rest of the countries of the above mentioned sub-region, grouped together under the name of the Caribbean. In the following table there figure the production, apparent consumption and degree of self sufficiency in sawn wood, total panels, fibreboards and particle board, for each of these areas,for the years 1970 and 1979. Taking no notice of the poor quality of some of these figures,deriving from the quality of the statistical information available and the non consideration of stock variations, the growth in per capita consumption of panels is evident in all and each of these geographical areas, from 1970 to 1979.

It is interesting to note that this increase in apparent consumption of panels has been accomplished by using increasingly particle boards and less plywood; on the contrary, the apparent consumption of fibreboard has remained stagnant between 1970 and 1979, although the Caribbean still presented in 1979 relatively high levels of consumption of these panels.

However, we should also note the very low consumption per inhabitant of panels existing in all these areas, with figures much lower than the world and regional averages (except those for the African continent). Also the main panel consumed in all areas is still plywood; only Mexico and Panama presents levels somewhat similar in the per capita consumption of plywood and particle boards.

On the basis of the figures used, then, it cannot be said that in all these areas the consumption of panels is ousting that of wood, as at least in the Central Americal Common Market and the Caribbean the apparent co nsumption of sawn wood is still relatively high and continues to be maintained in both areas a ratio of consumption of sawn wood to consumption of panels of 6.9 and 8.2 in the Caribbean and the Central American Common Market respectively, and for 1979; at world level the ratio is 4.

Foreign trade in wood panels in the whole continent of America is structured largely around a basic buyer (USA) which takes over 80% of American imports of panels. Far behind is Canada, the next importer; the remaining countries make imports of scant quantity in absolute terms (between 1,000 and 50,000 m^3). Traditionally the most part of the imports of panels into the USA and Canada corresponds to plywood, although in recent years the imports of fibreboard and particle board reach remarkable volumes in both countries (around 530,000 m^3 of fibreboard and the same am(for particle board, as against 2 million of plywood, for USA and Canada in 1979).

In the exportation of panels, in addition to the two abovementioned countries, Brazil has a certain position, especially as an exporter of fibreboard and to a lesser extent, of plywood. During the period 1970-1979 no American country was an important exporter of particle board (perhaps with the execption of the USA).

Due to the relatively scant volume of foreign trade in existence in the area, the prices of importation and exportation of boards vary remarkably both with respect to the world averages and between countries. This is why the average prices by country are in these cases not very significant, as they refer to low volumes of exchange and therefore highly conditioned by the type and characteristics of the imported or exported panels. In the attached table these price inequalities may be observed (deduced from the FAO export statistics), taking the world average values, regional values and the main exporters of the various types of panels in the area;

it should be emphasized that the price trends are also different - between the two years here - according to the area or country concerned.

For the geographical area nearest to El Salvador - grouped in the three areas of the Central American Common Market, Mexico and Panama and the Caribbean - one may talk of a high level of self sufficiency and therefore of a low extra zonal trade exchange for the panels as a whole; the exception to this is the Caribbean which presented a low degree of self sufficiency in 1979, both in panels as a whole and particle board (and sawn wood).

PRICES OF PLYWOOD, PARTICLE-BOARD AND FIBREBOARD

	1970	1979
AVERAGE PRICE OF PLYWOOD (export)		
World	145	342
North and Central America	126	284
South America	153	353
U.S.A.	146	420
Canadá	117	217
Brasil	139	350
AVERAGE PRICES OF PARTICLE BOARD (export)		
World	67	161
U.S.A.	75	110
AVERAGE PRICES OF FIBREBOARD (export)		
World	67	167
North and Central America	91	124
South America	92	223
U.S.A.	108	142
Brasil	91	249

SOURCE: F.A.O.

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4. The El Salvador Panel Market

Before analysing the domestic market for panels in El Salvador, it is convenient to examine the general characteristics of the country, as regards the sectors which are the most closely linked with wooden panels, either through producing possible substitutes or potential buying sectors

One first relevant characteristic which El Salvador presents is its scarcity of timber resources, which contrasts markedly with the important potential offered by other Central American countries. In effect, a FAO study (1) noted the scarcity of land for potential forestry use in this country, which was put at 9% of its already small territorial area, compared with levels usually over 30% in other countries of Central America, with absolute dimensions which are also larger. In the same study it was also stated that the country has few forestry resources of economic significance, contrasting with the high potential of the other countries in the area, with the possible exception of Costa Rica.

(1) FAO: Potential Land Use. Rome 1968.

Consequently with this lesser availability of own forestry resources, El Salvador presented at the end of the sixties a weak sawmill industry and no plywood industry, when these already existed in neighbouring countries.

At present, the activities of production and first conversion of wood are still poorly represented in the country (2), as indicated by the fact that (according to the FAO Forestry Products Yearbook) the domestic production of sawn wood is situated between 20,000 and 30,000 m^3 in the period 1974-1979, which, though doubling the figures at the beginning of the seventies, does not present a definite and continuing upward trend. Imports of sawn wood are greater than domestic production, and although generally in decline, they are still at 37,000 m^3 at the end of the decade. The apparent consumption also presents marked oscillations in the period 1970-1979 reaching in 1979 the figure of 67,000 m^3, the highest of the whole ten year period (except the 1975 figure). This implies a low consumption of sawn wood per thousand inhabitants

(2) Silviculture in 1979 generated an added value of some 32 million colones (less than 1% of the agricultural income).

(15.2 m^3), both with regards to the world average (104 m^3) and in relation with the whole of the Central American Common Market (52.1 m^3).

As regards sectors which are potential users of wooden panels, it is also necessary to point out the low development of these. Thus, the timber and furniture industries only contributed to the G.D.P. in overall and for 1979 some 33 million colones which is equivalent to less than 0.4% of the GTP (Gross Territorial Product at market prices), and 2.5% of the added value of the manufacturing industry. Both production sectors, despite their small size, followed a wavering trend, although growing (in constant terms) until 1978. Both in that year and in the following the trend breaks completely, and the revenue of the sectors analysed decreases in an even greater proportion than the whole of Salvadorean industry.

This relative weakness of the timber processing industry constitutes, in principle, an important limitation on the introduction and development of new products, as these sectors are usually important consumers of panels, both in direct construction of furniture and the preparation of intermediate products used in construction. As there

PRODUCTION AND APPARENT CONSUMPTION OF TIMBER IN EL SALVADOR

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
LUMBER(in thousands of cu. m.)										
Production	2374	2446	2516	2586	2657	2730	2805	2891	2974	3073
Imports	-	-	2	2	2	-	-	-	-	-
Exports	-	-	-	-	-	-	-	-	-	-
Apparent consumption	2374	2446	2518	2588	2659	2730	2805	2891	2974	3073
Net imports	-	-	2	2	2	-	-	-	-	-
PREPARED TIMBER AND SLEEPERS (thousands of cu. m.)										
Production	20	20	20	20	30	38	31	34	33	37
Imports	35	30	45	45	45	37	34	37	37	37
Exports	-	-	-	-	-	-	-	-	-	-
Apparent consumption	55	50	65	65	75	75	65	71	70	74
Net imports	35	30	45	45	45	37	34	37	37	37

SOURCE: F.A.O.

is no existing manufacturing tradition in these it is to be expected that any new product will have greater difficulties in introducing itself or may require the limitation of producing not very diversified articles, at least for the domestic market. In this connection it must be remembered that the use of particle boards in the furniture and construction industries usually entails a series of changes in the preparation of auxiliary materials and its installation (assembly, fixing, etc.) which necessitate a certain changeover period for the user industries; if this were not so the panel factory itself would have to take on some of the potential uses of the product, with the difficulties and complexity entailed by this.

The foreign trade of the timber processing and furniture industries are overall deficit producing for El Salvador, with a negative balance of 24 million colones in 1978, due above all to the import needs of the sector of the first conversion of timber industries, because of the already mentioned lack of own forest resources. The specific furniture industry presents, on the other hand, an almost balanced balance, although with a trend towards a negative balance in the last few years; both

PRIVATE SECTOR BUILDING COMPLETIONS: EL SALVADOR

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Total number of units	2.510	2.598	2.426	2.776	2.155	2.730	2.272	4.131	2.925	5.022	2.999
of 1 story	2.249	2.298	2.242	2.554	1.922	2.477	1.934	3.824	2.633	4.773	2.924
Total area in sq.m	741628	753076	678977	766948	606583	554188	395390	799268	615967	815433	399319
of 1 story	243808	266456	228405	243295	223396	224453	155610	317594	246439	318023	163139
Average built area sq. m per diwelling	92,0	115,9	101,9	95,3	116,2	90,6	80,5	83,1	93,6	66,6	55,8
Average value (in colones) per square metre built area	115,85	124,93	117,52	137,69	168,03	119,12	205,81	252,88	319,05	298,32	353,5[illegible]

SOURCE: Ministerio de Planificación: Indicadores Económicos y Sociales (Julio-Diciembre 1980) the imports and exports of this subsector are calculated at around 15% of the gross value of domestic production and represent percentages of between 0.1 and 0.5% of the total imports or exports of the country.

The construction sector does have a more relevant amount, as it represents more than 50 % of the gross Domestic Investment and 9% of the Gross Domestic Product, figures which are quite a lot higher than those of other countries in the area.

An indicator of the activity in this sector, and more specifically of the construction of dwellings, is given by the figures for dwellings completed in the private sector. According to this information, the number of dwellings completed in the period 1970 -1979 varies remarkably according to year, although with a certain upward trend and situated towards the end of the period at between 2,300 and 5,000 units Most of the construction of dwellings by the private sector, both by area and especially the number of units, is materialised in one storey dwellings with an average area of 70-80 m^2 per dwelling, with an average cost per m^2 constructed of 141$ (in 1980) and an average number of rooms per dwelling of around 4.

Certainly the number of dwellings actually built must be higher, even though it must be the building of dwellings by their owners or irregular workers; an estimate of the building needs for housing would put it at around 20,000 constructions/year, at least.

Going now into the panel market, the FAO statistics (Forest Products Year Book, 1979) does not show any volume of domestic production (3), at least until the last year for which these figures are published (1979). According to this information there is only foreign trade of a certain size (over 1000 m^3) in plywood, during the period 1968-1979. The volume of imports - and therefore the apparent consumption - of these products is placed, from 1976 to 1979, at 9000 m^3, with a relatively important jump - but within those low levels - as against previous years, in which betwen 5,000 and 6,000 m^3 was imported.

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(3) Therefore the production of bagasse panels does not show, estimated at around 9,000 m^3 at present.

PRODUCTION AND APPARENT CONSUMPTION OF WOODEN BOARD AND PLYWOOD IN EL SALVADOR

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
WOODEN BOARD (thousands of cu.m.)										
Production	-	-	-	-	-	-	-	-	-	-
Imports	5	5	6	6	6	6	9	9	9	9
Exports	-	-	-	-	-	-	-	-	-	-
Apparent consumption	5	5	6	6	6	6	9	9	9	9
Net imports	5	5	6	6	6	6	9	9	9	9
PLYWOOD (thousands of cu: m.)										
Production	-	-	-	-	-	-	-	-	-	-
Imports	5	5	6	6	6	6	8	9	9	9
Exports	-	-	-	-	-	-	-	-	-	-
Apparent consumption	5	5	6	6	6	6	8	9	9	9
Net imports	5	5	6	6	6	6	8	9	9	9

SOURCE: F.A.O.

In the other types of panels relevant amounts are neither produced or imported until 1979, as only in particle boards a figure of around 1,000 m^3 was imported in 1976; in other years the imports of these products or veneer sheets and fibreboard were less than 1,000 m^3, taken together.

According to these figures, given in the attached table, the consumption of panels overall per thousand inhabitants is situated in El Salvador at 2 m^3 in 1979. This figure is less than the half of the consumption of the group of developing countries and the average consumption of the Central American Common Market (4.8, m^3)

The information available on the new bagasse panel factory, installed in San Franciscp state that the fact of counting on a larger domestic supply of panels does not appear to have stimulated as yet the domestic consumption of these products much; this would explain the difficulties of placing its relatively small production, which aims to send mainly to foreign markets.

Certainly there is also a present demand for substitutes, which after a certain period of introduction of the panels could be partially covered with the domestic manufacture of panels. Anyway, this process of the substitution of products is usually relatively long, as it requires a certain dynamism in demand and a strong implantation and notable diversification of the sectors using those products; both circumstances seem to be lacking at the moment - on the basis of the information mentioned above - in the economy of El Salvador.

As an indication and in order to simulate the present possibilities of this process of substitution, it has been calculated what would be the theoretical potential of the Salvadorean market in bagasse panels in 1979 (3'), on the assumption that the structure of consumption was that at present existing as a world average (4). For this, the same

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(3') In the Preliminary Study both sawn wood and plywood are included as imports of El Salvador (possible substitution by cane trash panel). Apart from the fact that both products have different densities and so cannot be added together directly, the assumption of the complete interchangeability between them is made, which we consider to be mistaken.

(4) A clearly maximalist assumption, given the remarkable influence in these average data of the developed countries, with a powerful and diversified industry using panels. The different equivalence rates to homogeneise the various products have not been taken into account.

relative participation in the total consumption of El Salvador (in 1979 and in m^3 per thousand inhabitants) has been maintained as that existing at world scale between sawn wood - veneer sheets and plywood - particle boards and fibreboards.

From the results of these calculations, the maximum theoretical potential of domestic consumption of bagasse panels (with the additional hypothesis that this product would be equivalent to the consumption of all particle and fibreboards), would be around 8,000 m^3 for 1979. In addition, if this product replaced totally plywood calculated according to this method, the total consumption of bagasse panels in El Salvador would not exceed 15,000 m^3 in 1979.

The low level of the domestic market existing at present for this product is evident, also taking into consid·ration that there already exists a factory making these products in El Salvador, with an estimated capacity of some 9,000 m^3 and in which difficulties are already being encountered in domestic and foreign demand,according to the information available.

BOARD PRICES IN EL SALVADOR

	1977	1978	1979	1980	1982
AVERAGE IMPORT PRICE (1) (plywood+blockboard) (CIF)					
World average	287	307	375	s.d.	s.d.
Average for North and Central America	227	263	313	s.d.	s.d.
El Salvador	364	364	364	s.d.	s.d.
AVERAGE IMPORT PRICE OF PARTICLE-BOARD (1)					
El Salvador	228	228	228		
WHOLE SALE PRICE OF PLYWOOD					
El Salvador (2) (based on sheets 4 mm x 4 x 8 ft)	528	548	694	848	s.d.
EXPORT PRICES (fob) OF BAGASSE BOARD					
El Salvador (3): (based on a board size of 3/16" x 4' x 8')					
Fibrex					262
Fibrolux (Single thickness)					763
Fibrotablex (Double thickness)					1.148

(1) Anuario FAO Forestry Products Yearbook

(2) Mº de Planificación de El Salvador: Indicadores Economicos y Sociales Julio-Diciembre 1980
The conversion from colones to dollars has been made at an exchange rate of 2.5 colones=1$

(3) Current Proago export prices.

With the limitations entailed by operating with figures of little magnitude in absolute terms, the evolution of the import prices of sawn wood and particle board in El Salvador may be established. The evolution of the import price of plywood (derived from the CIF price) in the period 1970-1979 is, in the case of El Salvador rather different from that observed for the world average import prices and of the North and Central America Area (see attached graph). Neither does there appear to be much of a relationship between the average world prices and those of El Salvador, in absolute terms, although the prices of that country are usually higher than the average for North and Central America. However, these inequalities may be derived both from the low import levels of El Salvador and from the specific type of panels imported, with the consequent difficulty of being able to make significant comparisons with prices in wider areas.

The Ministry of Planning in its publication Economic and Social Indicators (July-December 1980) points out the wholesale domestic prices of a plywood board (4 mm x 4 x 8 ft). This information is given in the attached table, stated in dollars, together with the average import prices for plywood and the present prices of bagasse panels of equivalent dimensions, produced nationally.

As can be seen from these figures, there is no clear relationship between the average import prices and the domestic wholesale prices of plywood, both as regards absolute values (explicable comparing average import prices of a specific type of panel) and especially, in the trend. Thus,whereas the El Salvador average import prices were kept stable between 1977 and 1979, both the average world prices and the domestic wholesale prices (of the specific product analysed) rose considerably.

One fact to note on the import prices in El Salvador, is the low relationship existing between the average import price of the plywood board and that of the particle board (1.6 in the period 1977-79); this ratio is rather less than that calculated for the same period at world level (between 1.96 and 2,24) (5). This situation implies relative prices of the particle board which are very high and therefore uncompetitive with plywood, doubtless due to the proximity of El Salvador to the net exporters of plywood (Central America). Should these price ratios be maintained, the possible introduction of the particle board into the country will be quite conditioned.

At the level of domestic prices, it seems that therelative competitiveness of the new nationally produced bagasse panels must also be very conditioned by the prices of this board. In effect, if the trends of the period 1977-1980 continue, the domestic prices of plywood would be in 1982 at a par with the prices of Fibrotablex and at a ratio of 1.5 with those of Fibrolux; in those conditions it is difficult to expect great changes in the domestic consumption of panels, making the use of particle board more generalised than plywood.

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(5) For North and Central America this ratio varies from 1.68 to 2.5 for the same period (price per m3 of plywood/ price per m3 of particle board; in US$ and derived from CIF values and amounts imported).

5. Market Prospects

5.1 World Market

From the analysis carried out above of the present situation and recent trends in the international panel market, one may deduce a remarkable expansion in supply and demand of these products at world level. Although the recent trends indicate a strong slowing down of the growth rates before the crisis of 1973, most of the studies carried out continue to consider that there are favourable prospects in the panel market, especially in the less developed countries.

As background factors influencing these prospects are the increasing world reduction in forest resources for industrial use together with rising demand, derived both from theincrease in income and of population. In that context, the production of panels (based on low quality wood, using the sawdust from the sawmill or other alternative raw materials) has shown its capability to face the growth of demand, expecially in high income countries.

Also mentioned earlier was the greater dynamism presented by the specific production of particle boards, within boards and panels as a whole.

Those products are ousting - at world level - both fibreboard, and also, to a lesser extent, plywood. This substitution should be understood, for the present, more in the way that a great part of the new demand is covered with particle boards rather than as a reduction in the consumption in the volume of plywood in absolute terms. Complete substitution, both of wood by panels in general, and internally among different types of boards is not to be glimpsed yet, at least whole, with a persistance of the expansion of the demand, there is no greater rigidities in supply; that would imply that each type of these products still has a more or less defined field, and surely variable in time, of optimum applications.

Linked to the expansive character of the market in panels there appears a characteristic which is usually coexisting with all very dynamic markets: the continuous appearance (and, in some cases, fall) of new raw materials, products variants and applications for panels. In this general frame the growing generalisation of production of bagasse panels may be included, especially in Latin America and more specifically in the Caribbean. Also in this line I should note the recent development of medium density fibreboard.

This factor of rapid innovation in boards should be taken into account when establishing future prospects of this market, as it implies important risks for any investment, especially if it is intended to destine an important part of production to the international market, which is highly competitive.

Within the previous general lines we should place the prospects of the FAO and World Bank, which estimate growth in demand for boards overall, until the year 2,000 at around 5% p.a. accumulative. Within these increases so important, the growth estimated for the group of countries in development is higher still, with growth prospects (according to FAO) between 5.3% and 7.5% up to the end of the century.

However, the trends observed during the period 1976-79 are well below these forecasts, as they are at 3.7% for the world production of panels.

In the medium term, the difficult consitions in which a large part of the world ecpnomy moves do not appear to change - and specifically in the case of the set of the most developed countries - so that these forecasts seem, in general lines, somewhat optimistic, in view of the stagnation pf the main sectors making up the demand for panels (mainly construction and furniture industries).

The opinions obtained from representative companies in the sector confirm these appraisals. Also the prices of particle boards have not been experiencing fluctuations in the main markets recently, which reflects less dynamism in demand and increasing international competition.

The present price levels in the London market is at around 130$/m^3 for low density, uncoated 15 mm thick particle board. In this same market recently offers of Cuban bagasse board were made at prices of 100$/m^3.

5.2 Regional Market

Referring more specifically to the geographical ares includinf El Salvador, from Mexico to Panama, including the Caribbean, the present situation indicates a scant introduction of the panels in this market, withvery low levels of consumption per inhabitant. Besides, most of this small consumption of panels is still concentrated on plywood.
The forestry resources of the ares are rather diverse according to the country, although they appear to be of a reasonable size in Central

America and sparse in the Caribbean.

On the basis of these facts, recent trends in the production and consumption of the area open up, in principle, hopes favourable to the development of the market in panels, which may constitute a valid alternative to cover the demand generated by the increase in economic activity (especially the construction of dwellings and furniture sectors) and of the population. This alternative ,may exist as much in countries with sparse forestry resources (the Caribbean, for example) as in countries with important resources of this type, substituting part of the present domestic consumption of timber of quality for panels, in order to encourage the export of the former.

The intensity with which these changes happen in the area is - with the data available at the moment - difficult to judge, although in the medium term there are limiting factors to wait for radical changes, as the substitution of usual products used by sectors of the demand of each country - especially when as happens here, the demand is not quantitatively important - requires a rather long time to be assimilated.

Another aspect to consider in the area next to El Salvador is the suitable capacity of response which own production has shown when faced with the greater demand for panels, both in general and in the case of particle board. Only in the Caribbean there is a relatively important deficit (of so 128,000 m^3 in 1979 for panels as a whole, of which only 37,000 m^3 are particle board).

Nevertheless, the most recent estimates state that that deficit is theoretically covered at present, based on the installed capacity of cane bagasse (in Cuba and Trinidad, especially), which are already having difficulties selling in the area. These facts, linked to the generalised stocks of this and other raw materials for the manufacture of panels, make one think that the prospects for exporting, to other countries in the area, an important part of the production of a new factory in El Salvador are - in principle - slight. With these possibilities existing (due to the weight of limitations of a political nature on trade exchange with Cuba, for example) they would be reduced to the markets of small countries, in which the weak domestic demand does not justify the setting up of factories of a suitable size. In the attached table there is a list of the countries of Central America (including the Caribbean and Mexico) with an indication of their present levels of consumption and volumes of imports

As can be observed, the foreign demand for pa ··icle board is of slight magnitude in this area and in the unlikely event of it being satisfied by Salvadorean production, this would entail marked competition with other countries producing bagasse panels (Cuba, Trinidad, Venezuela) and of other substitute products and a certain diversification in the types of boards produced, adjusting themselves th the characteristics of each market (supposedly different, based on the inequalities of price observed.).

1979

	Apparent Consumption (thousands of cu. m.)	Net Imports (thousands of cu. m)	Consumption per 1000 inhabitants (cu.m)
CENTRAL AMERICAN COMMON MARKET	95	-2	4,8
Costa Rica	61	-7	28,11
El Salvador	9	9	2,03
Guatemala	15	4	2,13
Honduras	5	-3	1,40
Nicaragua	5	-5	1,89
MEXICO	444	3	6,40
PANAMA	16	2	8,94
CARIBBEAN	204	128	8,2
Bahamas	7	7	31,82
Barbados	18	18	72,00
Belize	1	1	6,25
Cuba	94	22	9,62
Dominican Republic	37	37	7,01
Guadeloupe	4	4	12,50
Haiti	-	-	-
Jamaica	19	15	8,80
Martinique	4	4	12,50
Netherlands Antilles	7	7	26,92
Trinidad-Tobago	13	13	11,50

SOURCE: F.A.O.

PLYWOOD

1979

	Apparent consumption (thousands of cu. m.)	Net imports (thousands of cu.m.)	Average import price ($/m^3)
CENTRAL AMERICAN COMMON MARKET:	53	-12	
Costa Rica	4	--7	323 (b
El Salvador	9	9	364
Guatemala	10	-6	209 (b
Honduras	5	-3	339 (b
Nicaragua	5	-5	214 (b
MEXICO	197	-9	136 (b
PANAMA	12	-	
CARIBBEAN	88	86	
Bahamas	7	7	176
Barbados	16	15	70
Belize	(a)	(a)	1.070
Cuba	24	22	94
Dominican Republic	5	5	157
Guadeloupe	3	3	588
Haiti	-	-	-
Jamaica	13	13	90
Martinique	3	3	483
Netherlands Antilles	5	5	174
Trinidad-Tobago	12	12	332

(a) Less than 1,000 m^3

(b) Average export prices (c.i.f.)

SOURCE: F.A.O.

1979

	Apparent consumption (thousands of cu. m)	Net imports (thousands of cu. m)	Consumption per 1000 inhabitants (cu.m)	Average import price ($/cu.m.)
CENTRAL AMERICAN COMMUN MARKET:	34	-1	1,70	
Costa Rica	31	-	14,28	
El Salvador	(a)	(a)	-	228
Guatemala	3	-1	0,43	364
Honduras	-	-	-	-
Nicaragua	-	-	-	-
MEXICO	208	14	3,00	180
PANAMA	2	-	1,12	-
CARIBBEAN:	45	37	1,90	-
Bahamas	-	-	-	-
Barbados	1	1	4,00	379
Belize	-	-	-	-
Cuba	4	-	0,41	-
Dominican Rep.	32	32	6,06	193
Guadeloupe	1	1	3,12	294
Haiti	-	-	-	-
Jamaica	4	(a)	1,85	903
Martinique	2	2	6,25	201
Netherlands Antilles	1	1	3,85	277
Trinidad-Tobago	-	-	-	-

(a) Less than 1000 m^3

SOURCE: FAO

1979

	APPARENT CONSUMPTION (Thousands of cu. m)	NET IMPORTS (Thousands of cu. m.)
CENTRAL AMERICAN COMMON MARKET	-	-
Costa Rica	-	-
El Salvador	-	-
Guatemala	-	-
Honduras	-	-
Nicaragua	-	-
MEXICO	24	-2
PANAMA	2	2
CARIBBEAN	72	6
Bahamas	-	-
Barbados	1	1
Belize	1	1
Cuba	66	-
Dominican Republic	-	-
Guadeloupe	-	-
Haiti	-	-
Jamaica	1	1
Martinique	-	-
Netherlands Antilles	2	2
Trinidad-Tobago	1	1

SOURCE: F.A.O.

5.3 El Salvador Market

From the things already said, it can be deduced that the basic market to consider for the new factory of cane trash panels would be the domestic market of El Salvador.

However, present levels of consumption of panels per inhabitant in the country are very reduced, and in them, particle board is practically never used in El Salvador. Recent trends do not make it possible to establigh optimistic prosp[illegible]s of growth.

Anyway, the marked lack of other timber resources in the country makes it possible to sketch the changes needed in the present situation, with the gradual implantation of panels, partially replacing wood, especially in construction and the furniture industry.

In order to estimate the consumption of particle boards in the construction of housing the following initial hypotheses were established.

First, assume that the marked lack of suitable timber in the country (and also plywood produced nationally) would imply a rapid implantation of particle board in the construction of party walls, doors, floors, etc., until reaching in 1990 a figure similar to that existing in other more developed countries and which present also a shortage of suitable forestry resources. Ths standards used for this hypothesis are the following, according to the destination of the panels (in m^2 of panels and m^2 of dwelling completed):

DESTINATION	M2 PARTICLE BOARDS
Distribution and separation of interiors	2
Floors	0.8
Ceilings	0.2
Roofs	0.1
TOTAL	3.1 m^2.

Applying these modulus to the average dimension of dwellings at present constructed in El Salvador (1) we get a need of particle board per dwelling of 3.3 m^2.

(1) The real dimensions of dwellings varies a lot; according to years: between 1976 and 1980 this figure was between 56 m^2 and 94 m2 (according to the publication Economic and Social Indicators) The figure adopted here as a dimension is 70 m2.

In order to calculate the number of dwellings built by 1990, it is estimated that then there will be the same ratio between annual construction of houses per 1000 inhabitants .(2), which would give 6,850 dwellings a year.

Based on this hypothesis the consumption of the particle board would be 22,600 m^3 for that year.

To this consumption one would have to add that of the furniture industry. The slight magnitude of this sector united with its marked annual fluctuations does not make it possible to make forecasts based on present trends. The practicallv nil use made of particle boards by this sector makes iteven more difficult to issue a forecast.

Within optimistic assumptions it is possible to suppose that the furniture industry may in 1990 have become converted into a buyer of panels of the same value as the construction industry, which would mean an important development of this industry in El Salvador and a relative sector consumption similar to that at present existing in the OECD (in

(2) This index for 1979 has been taken in which the pace of construction was the highest in the whole decade (5,022 dwellings) which is equivalent to 1.14 dwellings / 1000 inhabitants). Possibly public built dwellings or those built outside the market have not been considered the latter difficult to evaluate (and possibly with less prospectd of using panels).

which this sector makes up around 50%, on average, of the national consumption of particle board).

With these assumptions, which must be seen as very optimistic, the total consumption of particle boards in El Salvador in 1990 would amount to 45,000 m^3.

This figure would mean a consumption of particle boards of 7.5 m^3 per thousand inhabitants, which is almost four times the present consumption of El Salvador of all types of boards together.

Another method used to forecast the potential consumption of all boards together in El Salvador in 1990 is to apply the maximum growth rate annually calculated by the FAO up to the year 2000 for developing countries (7.5% annual accumulative) to the present level of consumption..

Applying this rate to the 9,000 m^3 consumed in 1979 (apparent consumption) in El Salvador, we obtain a consumption-for all boards - of some 20,000 m^3 in 1990.

In order to estimate what participation in this total consumption the particle boards would have, we have started out from the assumption that these products would account for around 60% of the total (3).

With these hypotheses the foreseeable consumption of particle boards in El Salvador for 1990, would be 12,000 m^3. This figure would be equivalent to 2 m^3 per thousand inhabitants (3.3 m^3 per 1000 inhabitants, for all boards).

A large part of the studies existing on markets in panels indicate the close correlation existing between the consumption of these products and income. For this, several forecasting methods have been used using these variables. as a preliminary stage, first the per capita income for El Salvador in 1990 has been estimated. The starting out assumption used has been to apply a growth rate to the GDP of 6.5% annual and accumulative (4); the estimated

(3) The participation of particle boards in the total consumption of panels is very variable according to the country: So, in 1979, in Spain it accounted for 77%; in Italy, 64%, in Costa Rica 60%; in Barbados 6%, in Mexico 47%. The assumption adopted here corresponds to the present day structure of consumption of Costa Rica.

(4) During 1972-1979, the growth rates of the GTP (at constant prices) of El Salvador were the following: 5.1%; 6.4%; 5.6%; 4%; 6.4%; 3.6%; and 1.1%. The rate applied is somewhat higher than the maximum reached in the period.

population for 1990 is 6 million inhabitants (according to the Ministry of PLanning). The GTP per inhabitant will therefore be 2,500 colones, at 1979 prices (US$1,000 at the official exchange rate).

The adjustment between income (per inhabitant, in dollars) and consumption (in m^3 per thousand inhab.)* has been applied initially only to a series of American countries (15 in all) with levels below US$2000 per inhabitant, in order to record as best as possible the consumption habits of the area and the level of income in which El Salvador is situated (5); the adjusted line - for 1979 and the total of panels - has the following expression:

$$C = 6.48 + 0.01413\ r$$

C being the consumption of panels (total) in m^3 per thousand inhabitants; r = per capita income, in 1979 dollars.

(5) The countries selected, by availability of data, were the following: Belize, Costa Rica, Dominican Republic, El Salvador Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Brazil, Colombia, Ecuador, Surinam and Peru. *the correlation coefficient is 0.75; there is fair dispersion of theoretical data with respect to actual consumprion.

The consumption of the total of panels in El Salvador based on this adjustment would be 45,900 m^3 (7.65 m^3/hx1000) in 1990 which in accordance with the hypothesis applied in the preceding forecast would give a consumption of particle board of 27,540 m^3 (4.6 m^3 per thousand inhabitants).

Another adjustment used between income and consumption per inhabitant, refers only to particle board. This second adjustment has been applied to a broad range of countries in different regions of the world (27 in all) which are characterised by having a relative lack of their own forestry resources, and have to resort to the importation of great amounts of timber in order to satisfy their consumption needs In this way an adjustment straight line is obtained between the consumption of particle boards (m^3 per thousand inhabitants) and the per capita income (in dollars)for a broad range of countries, with very diverse incomes, which could be similar to El Salvador from the point of view of relative dearth of own timber resources.

The straight line has the following expression for 1979:

$$C' = 4.85 + 0.0069\ r$$

C' being = consumption of particle boards in m^3 per thousand inhabitants; r = income per inhabitant, dollars, 1979.

Based on this adjustment, the estimated consumption of particle boards in El Salvador would be some 12,600 m^3 for 1990 (2.1 m^3 per thousand inhabitants).

As can be seen from the summary table, the estimates of the consumption of particle boards for El Salvador in 1990 are rather different according to the method used. The scant level of the present consumption of these panels in the country does not make it possible for us to evaluate future demand with greater precision.

The consumption figures estimated for 1990 of particle boards could be indicative of the potential consumption of bagasse panels, and the domestic demand capacity of the new factory, deducing production from the existing factory (valued at 9,000 m^3) For this the prices of this new product should be - at least in the initial introdtory phase, between 20% and 30% below the other particle boards and between 40% and 50% of plywood..

With these conditions, the domestic potential demand for the Jiboa Factory does not appear to be able to exceed - even in the most favourable case - of the generalised use of these products in industry of construction and furniture, 36,000 m^3 in 1990 (equivalent to 23.400 tonnes with an average density of 650 kg/m^3)

FORCASTS OF PARTICLE-BOARD CONSUMPTION IN EL SALVADOR

(Timescale up to 1990)

METHOD USED	FORECAST CONSUMPTION Total m^3	Per capita (m^3/1000)
a) Project development construction and furniture industry	45.000	7,5
b) FAO indices for developing countries	12.000	2,0
c) Income-consumption ratio (all board products) for American countries	27.540	4,6
d) Income-consumption ratio for particle board in countries poor in timber resources	12.600	2,1

6. Conclusions

From the preceding market study one may deduce that the new bagasse panel factory, of annual production capacity of 60,000 tonnes, would not find a market potential sufficient enough to place this volume of production.

Actually, the foreign demand of the countries which are physically nearest present at this moment a scant consumption of panels in general, and more specifically of particle boards, as most of their demand is materialised in either sawn wood or plywood.

The only area near in which there was an imbalance between demand and supply was the Caribbean, generating a high level of imports of panels. However, both the weak unit value by country of these exports and especially the fact that recently a factory has been set up in the area with an important production capacity of bagasse panels, which makes it clear that the demand for this type of products may be satisfactorily covered by the supply existing in the area.

Therefore the new factory should concentrate basically on the domestic Salvadorean market. This market is, after all, a very poor consumer of panels and the industries using them have until noe used plywood only; a situation which is explained by the poor development of the panel in the country and also the relative production specialisation of the rest of Central America in the production of plywood.

The lack of suitable timber resources in a country constitutes, in any case, an important aspect to take into consideration and makes it foreseeable that the present-day habits of production and consumption of wood in El Salvador may change in the medium term. Any way, even at the most optimistic hypothesis the domestic demand for the new factory is not expected to exceed 23,400 tonnes/year for 1990, a figure rather below the bagasse panel production capacity of the Jiboa Complex (60,000 t).

ANEXO

DEFINICIONES, EQUIVALENCIAS Y AGRUPACIONES DE PAISES

[illegible] los traviesas.

248 MADERA ASERRADA Y TRAV

MADERA ASERRADA (C)
248.2 MADERA ASERRADA (C)
MADERA ASERRADA (NC)
248.3 MADERA ASERRADA (NC)

Madera aserrada, sin cepillar, cepillada, machihembrada, etc. aserrada al hilo o producida por medio de un proceso de labrado (por ejemplo, tablones, vigas, viguetas, tablas, tablijes, cabrios, cuartones, listones, listones de cielo raso, tablas para cajones, etc.) y madera cepillada, machihembrada, ranurada, rebajada, moldurada, ensamblada en V, rebordeada, etc. Se excluyen las tablas para pisos. Salvo escasas excepciones, la madera aserrada tiene más de 5 mm de espesor.

TRAVIESAS
248.1 TRAVIESAS

Piezas de madera de sección más o menos rectangular que se colocan transversalmente sobre el balasto para sostener los rieles. Los durmientes pueden ser aserrados o labrados.

TABLEROS DE MADERA

Las cifras corresponden al volumen sólido

TABLEROS DE MADERA
634/641 TABLEROS DE MADERA

Los siguientes productos se incluyen en el total: hojas de chapa, madera terciada, tableros de partículas y de fibra, prensados o no.

HOJAS DE CHAPA
[illegible] HOJAS DE CHAPA

Hojas delgadas de madera de espesor uniforme, obtenidas por desenrollado, guillotinado o por aserrío, que se emplean en la fabricación de madera terciada, tableros laminados, muebles, envases de chapas, etc. En producción, no se incluyen las hojas de chapas utilizadas en la fabricación de madera terciada dentro del país.

MADERA TERCIADA
EX634 MADERA TERCIADA
(Plywood)
(Contrachapado)

Madera terciada, madera terciada de chapas, tableros con alma, incluso madera enchapada, placas para carpintero, tableros enlistonados y tableros de ripia. Otras maderas terciadas como tableros celulares, y madera terciada compuesta. La madera terciada de chapas es la que se fabrica encolando dos o más chapas. Las chapas suelen colocarse con el hilo atravesado generalmente en ángulo recto. Los tableros con alma son aquellos que tienen un alma, o sea, una capa central generalmente más gruesa que las otras, resistente, compuesta de tablas angostas, bloques o listones de madera yuxtapuestos, encolados o no. (Este rubro comprende chapas o tableros de madera en los que la chapa se pega sobre une base que suele ser de madera de calidad inferior con cola y a presión). Los tableros celulares son los que tienen un alma de construcción cellular y los compuestos los que tienen un alma o algunas capas de un material que no consiste ni en chapas ni en madera maciza.

TABLEROS DE PARTICULAS
634.32 TABLEROS DE PARTICULAS

Material en lámina fabricado con partículas de madera u otras materias lignocelulósicas (por ejemplo, astillas, hojuelas, virutas, etc.) aglomerados por medio de un aglutinante orgánico y uno o más de los agentes que se mencionan a continuación calor, presión, humedad, catalizador, etc. Tableros de lino inclusive (se excluyen los tableros de lana de madera u otros tipos de madera aglomerada, con aglutinantes inorgánicos).

TABLEROS DE FIBRA
641.6 TABLEROS DE FIBRA

El agregado abarca los tableros de fibra, prensados o no.

TABLEROS FIBRA, PRENSADOS
641.61 TABLEROS FIBRA, PRENS
TABLEROS FIBRA, NO PRENS
641.62 TABLEROS FIBRA, NO PRENS

Tableros de fibra (tableros de fibra para construcción)
Tablero fabricado con fibras de madera u otros elementos lignocelulósicos utilizándose como ligazón primaria las fibras afieltradas y sus propiedades de cohesión inherentes. Se pueden emplear materiales aglutinantes y/o aditivos. Suele aprensarse con prensa lisa pero también se pueden moldear. Los no prensados abarcan aquellos tableros aislantes cuya densidad no es superior a 0,40 g/cm³. Los prensados abarcan aquellos tableros duros cuya densidad es superior a 0,40 g/cm³. (Se excluyen otros productos similares fabricados con partículas de madera u otros materiales lignocelulósicos, o con polvo de madera y aglutinante, así como los tableros de yeso o de cualquiera otra materia prima de origen mineral).

STANDARD CONVERSION FACTORS USED IN PREPARING TABLES OF PRODUCTION AND TRADE

COEFFICIENTS DE CONVERSION TYPES UTILISES POUR LA PREPARATION DES TABLEAUX DE LA PRODUCTION ET DU COMMERCE

COEFICIENTES DE CONVERSION CORRIENTES EMPLEADOS PARA PREPARAR LOS CUADROS DE PRODUCCION Y COMERCIO

A) METRIC EQUIVALENTS
EQUIVALENTS EN UNITES METRIQUES
EQUIVALENTES EN UNIDADES METRICAS

1 inch - pouce - pulgada	=	25.4 millimetres - millimètres - milímetros
1 square foot - pied carré - pie cuadrado	=	0.0929 square metre - mètre carré - metro cuadrado
1 cubic foot - pied cube - pie cúbico	=	0.02832 cubic metre - mètre cubique - metro cúbico
1 short ton - tonne courte - tonelada corta	=	0.9072 metric ton - tonne métrique - tonelada mét[illegible]
1 long ton - tonne longue - tonelada larga	=	1.016 metric ton - tonne métrique - tonelada métri[illegible]

etc

B) FOREST PRODUCTS MEASURES
MESURES POUR LES PRODUITS FORESTIERS
MEDIDAS DE PRODUCTOS FORESTALES

Product and unit Produits et unités Productos y unidades	Cubic metres Mètres cubes Metros cúbicos	Cubic feet Pieds cubes Pies cúbicos	1 000 board feet Pies madereros	Standar[d] (Petrogr[ad])
ROUNDWOOD - BOIS ROND - MADERA EN ROLLO				
1 Hoppus cubic foot - 1 pied cube hoppus - 1 pie cúbico hoppus	0.03605	1.273		
1 ton of 50 hoppus cubic feet - 1 tonne de 50 pieds cubes hoppus - 1 tonelada de 50 pies cúbicos hoppus	1.8027	63.66		
1 cunit	2.83.16	100		
1 cord 1/ - 1 corde 1/ - 1 cuerda 1/	3.625	128		
1 stere 1/ - 1 stère 1/ - 1 estéreo 1/	1	35.315		
1 fathom 1/	6.1164	216		
SAWNWOOD - SCIAGES - MADERA ASERRADA				
1 standard (Petrograd)	4.672	165	1.98	1
*1 000 board super feet -*1 000 board feet/pieds superficiels -*1 000 pies madereros/superf.	2.36	83.33	1	0.505
1 ton of 50 cubic feet - 1 tonne de 50 pieds cubes - 1 tonelada de 50 pies cúbicos	1.416	50	0.6	0.303
PANELS - PANNEAUX - TABLEROS				
1 000 square metres (1 millimetre thickness) 1 000 mètres carrés (1 millimètre d'épaisseur) 1 000 metros cuadrados (1 milímetro de espesor)	1	35.315	0.4238	
1 000 square feet (1/8 inch thickness) 1 000 pieds carrés (1/8 de pouce d'épaisseur) 1 000 pies cuadrados (1/8 de pulgada de espesor)	0.295	10.417	0.125	

1/ Stacked volume - volume empilé - volumen hacinado
* See notes on the tables - Voir les notes sur les tableaux - Véase las observaciones a los cuad[ros]

WEIGHT AND VOLUME

D) POIDS ET VOLUME

PESO Y VOLUMEN

Product Produits Productos	Kilogrammes per cubic metre Kilogrammes per mètre cube Kilogramos por metro cúbico			Cubic metre per metric ton Mètres cubes par tonne métr. Metros cúbicos por ton. métr.		
	General Général General	Coniferous Conifères Coníferas	No-coniferous Non-conifères No-coníferas	General Général General	Coniferous Conifères Coníferas	No-coniferous Non-conifères No-coníferas
FUELWOOD - BOIS DE CHAUFFAGE - LEÑA	725	625	750	1.38	1.60	1.33
CHARCOAL-CHARBON DE BOIS-CARBON VEG	167					
SAWLOGS+VENEER LOGS - GRUMES, SCIAGE+PLACAGES - TROZAS, ASERRAR+CHAPAS						
Tropical - Tropicales			730			1.37
Other - Autres - Otras		700	800		1.43	1.25
PITPROPS - BOIS DE MINE - MADERA PARA MINAS	725	700	800	1.36	1.43	1.25
PULPWOOD - BOIS DE TRITURATION - MADERA PARA PULPA	675	650	750	1.48	1.54	1.33
OTHER INDUST ROUNDWOOD - AUTRE BOIS ROND INDUST - OTRAS MADERA EN ROL INDUSTRIAL	750	700	800	1.33	1.43	1.25
SAWNWOOD - SCIAGES - MADERA ASERRADA		550	700		1.82	1.43
SLEEPERS - TRAVERSES - TRAVIESAS	780			1.[illegible]		
VENEER SHEETS - FEUILLES DE PLACAGES - HOJAS DE CHAPA	750			1.33		
PLYWOOD - CONTREPLAQUES - MADERA TERCIADA	650			1.54		
PARTICLE BOARD - PANNEAUX DE PARTICULES TABLEROS DE PARTICULAS	650			1.54		
FIBREBOARD COMPRESSED - PANNEAUX FIBRE, DURS - TABLEROS FIBRA, PRENSADOS	950			1.053		
FIBREBOARD, N. COMPRESSED - PANNEAUX FIBR ISOLANTS - TABLEROS FIBRA, NO PRENSADOS	250			4		

LISTA DE LOS PAISES INCLUIDOS EN LAS CLASES ECONOMICAS Y LAS REGIONES

ECONOMIAS DE MERCADO DESARROLLADAS

AMERICA DEL NORTE:

Canadá, Estados Unidos.

EUROPA OCCIDENTAL:

Alemania (República Federal), Austria, Bélgica-Lux, Dinamarca, España, Finlandia, Francia, Grecia, Irlanda, Islandia, Italia, Malta, Noruega, Países Bajos, Portugal, Reino Unido, Suecia, Suiza, Yugoslavia.

OCEANIA:

Australia, Nueva Zelandia

OTRAS ECONOMIAS DE MERCADO DESARROLLADAS:

Israel, Japón, Sudáfrica.

ECONOMIAS DE MERCADO EN DESARROLLO

AFRICA:

Alto Volta, Angola, Argelia, Benin, Botswana, Burundí, Camerún, Chad, Congo, Costa de Marfil, Djibouti, Etiopia, Gabón, Gambia, Ghana, Guinea, Guinea Ecuatorial, Guinea Bissau, Cabo Verde, Kenia, República centroafricana, Liberia, Madagascar, Malawi, Mali, Marruecos, Mauricio, Mauritania, Mozambique, Niger, Nigeria, Reunión, Rwanda, Santo Tomé y Principe, Senegal, Sierra Leone, Somalia, Swazilandia, Tanzania, Togo, Túnez, Uganda, Zaire, Zambia, Zimbabwe.

AMERICA LATINA

Antillas Neerlandesas, Argentina, Bahamas, Barbados, Belize, Bolivia, Brasil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guadalupe, Guatemala, Guayana francesa, Guyana, Haiti, Honduras, Jamaica, Martinica, México, Nicaragua, Panamá, Paraguay, Perú, República Dominicana, Suriname, Trinidad y Tobago, Uruguay, Venezuela.

CERCANO ORIENTE:

AFRICA: Egipto, Libia, Sudán.

ASIA: Afghanistán, Bahrein, Chipre, Irak, Irán, Jordania, Kuwait, Líbano, Qatar, Reino de Arabia Saudita, Siria, Turquía, Yemen democrático.

LEJANO ORIENTE:

Bangladesh, Birmania, Brunei, Filipinas, Hong Kong, India, Indonesia, Laos, Macao, Malasia Nepal, Paquistán, República de Corea, Singapur, Sri Lanka, Tailandia, Timor oriental.

OTRAS ECONOMIAS DE MERCADO EN DESARROLLO:

Islas Salomón, Nueva Caledonia, Papua Neuva Guinea, Polinesia francesa, Samoa Occidental, Vanúatu, Viti.

ECONOMIAS DE PLANIFICACION CENTRALIZADA

China, Kampuchea Democrática, Mongolia, Vietnam, República Popular Democrática de Corea.

EUROPA ORIENTALE Y U.R.S.S.

Albania, Bulgaria, Checoslovaquia, Hungría, Polonia, República Democrática Alemana, Rumania, U.R.S.S.

North and Central America

Canadá, U.S.A.

C.A.C.M.

Méjico, Panamá

Mercado Común Centro Americano:

- Costa Rica
- El Salvador
- Guatemala
- Honduras
- Nicaragua

Caribbean

- Netherlands Antilles
- Bahamas
- Barbados
- Belize
- Cuba
- Guadeloupe
- Haití
- Jamaica
- Martinique
- Dominican Republic
- Trinidad and Tobágo

5.4 MARKET STUDY OF POTASSIUM SULPHATE

CONTENTS

5.4 MARKET STUDY OF POTASSIUM SULPHATE

1. Introduction

One of the by-products that may be obtained from the Jiboa Complex is potassium sulphate, with an estimated annual production of 24,816 tonnes of this product.

Potassium sulphate is one of the main simple potassium fertilisers, especially suitable to deliver the nutrients potassium and sulphur to the soil, easily soluble and rapidly assimilated by crops. The normal content of potassium sulphate in nutrients, varies between 48% and 52% of (K_2O) and around 18% of sulphur (S), attimes also having smll amounts of other nutrients (calcium and magnesium).

The production capacity stated earlier is equivalent, in nutrient units, to 12,500 tonnes of potash (K_2O) yearly.

2. The International Market in Potassium Fertilisers: Present Situation and Main Trends

Potassium (K) is one of the nutrients essential for most crops, together with nitrogen and phosphate. Its use as a fertiliser is very generalised all over the world, both in its simple forms in which only potassium is present, of the three basic nutrients, and in binary combination with other basic nutrients (nitrogen or phosphorus) or participating in complex or compound fertilisers in which both nitrogen and phosphorus are present in varying proportions and also potassium and other possible elements.

The basic raw material for the obtainment of potassium is potash, world reserves of which are estimated to be around 155,000 million tonnes, basically located in North America and the USSR. With all at the present prices the recuperable reserves are estimated at some 9,000 million tonnes. Other sources of potash of lesser importance are the by-products of cane and beet molasses, cement dust, vegetable ash, etc.

Most of the fertilisers commercially produced on a potassium base are derived from water soluble

POTASH FERTILISER PRODUCTION

(in tonnes of K_2O)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
CANADA + USA	5.437.800	6.127.000	6.261.000	7.435.800	7.697.700	6.940.700	7.999.400	8.181.500	8.673.000	9.160.000
REST OF NORTH AND CENTRAL AMERICA	-	-	-	-	-	-	-	-	-	-
SOUTH AMERICA	16.442	20.931	16.056	19.327	13.516	9.534	16.240	11.200	11.213	24.094
WORLD	17.828.203	19.446.929	20.185,213	22.230.090	23.698.444	23.476.791	24.958.979	25.509.892	26.237.373	25.681.585

SOURCE: F.A.O.

minerals, especially from silvinite, which is a chloride of potassium and sodium.

World production of potassium fertilisers in 1979/80 reached 25.7 million tonnes (measured in K_2O), whcih showed a 44% increase over the amount produced at the beginning of the decade.

In the last few years, world production of these fertilisers is experiencing growth rates lower than those of the rest of the basic fertilisers (phosphates, and especially nitrates); in some years the rates have even been negative..

One characteristic of the production of potassium fertilisers which differentiates them from other basic fertilisers is the marked concentration existing insome countries, deriving from the concentration of mineral reserves of potash. In 1979/80 practically the whole world supply came from twelve countries and the four main producers Canada, USSR and the two Germanies) were producing around 80% of the world total.

This situation implies an important trade current in these fertilisers, as shown by the fact that the sum of the imports of the various countries represent around 65% of the world consumption, as against 18-22% in phosphates and nitrates.

The growth of the world consumption of fertilisers of potash is, apart from the annual variations, rather notable. An indicator of this evolution is given by the ratio:

$$\frac{\text{Consumption of potassium fertilisers (in kilos of } K_2O)}{\text{Area in permanent tilled land (Ha.)}}$$

For the world as a whole, the above ratio was around 16.2 kg/Ha in 1878, as against 11.5 kg/Ha of 1969/71. The differences between countries in the use of agricultural fertilisers are, however, considerable not only according to the different soil types, climates and crops, but also based on the general level of development of each country,with all it implies in the predominance of modern agriculture over traditional methods.

So, for 1979/80 the previous indicator reached the value of 29.8 kg/Ha. for the developed countries, as against 4.5 kg/Ha. of the developing countries as a whole.

Regional differences in the consumption of these products are rather marked, and it should be noted especially that Latin America presents a rapidly growing development in the use of potassium fertilisers, as shown by the fact that the previous indicator of consumption reached 9.9 kg/Ha. in 1979, as against 4,2 kg/Ha. in 1969/71.

Another aspect which backs the growing use of potassium in Latin America is the high ratio of this component in the whole of basic fertilisers used in the region (0.6 parts of K_2O to 1 of N in 1979), which is the highest of all the developing regions and even higher than that existing for the developed regions of Europe and North America.

In the whole American continent there are only three producers of potassium fertilisers (USA, Chile, and especially Canada), although other countries import these products or their semi processed forms in order to incorporate them into their own production of complex fertilisers and later consume them domestically and export them (1).

(1) According to the FAO Fertilisers Year Book (1980) both Costa Rica and El Salvador re-export potassium fertilisers in the form of complex fertilisers, in the last years.

SENER

POTASH FERTILISER EXPORTS

(in tonnes of K_2O)

CANADA + USA.	3.479.300	4.426.000	4.646.000	5.605.900	5.741.300	5.088.700	6.264.000	6.737.000	7.163.000	7.383.20[illegible]
REST OF NORTH AND CENTRAL AMERICA	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
SOUTH AMERICA	10.859	12.728	12.199	9.842	7.728	10.220	11.000	8.000	12.905	17.34[illegible]
WORLD	9.450.900	10.351.198	11.219.581	12.384.443	12.974.680	11.884.826	13.744.493	14.955.259	15.835.158	15.660.19[illegible]

SOURCE: FAO

(a) : Re-export of potash fertilisers in form of compound fertilisers (in thousands of tonnes K_2O)

Costa Rica	2,7	3,2	7,9	5,3	1,1	4,5	13,8	5,1	6,0	4,0
El Salvador	4,8	5,1	7,5	5,5	2,8	0,6	1,9	4,4	1,6	1,8
Jamaica	2,0	1,8	2,2	1,5	-	-	-	-	-	-
Mexico	0,2	0,1	-	-	-	-	-	-	-	-

SENER

IMPORTS OF POTASH FERTILISERS

(in tonnes of K_2O)

CANADA + USA	2.314.600	2.849.232	2.917.000	3.758.280	3.529.800	3.589.800	4.519.289	4.508.500	4.643.000	4.927.900
REST OF NORTH AND CENTRAL AMERICA	-	-	-	-	-	-	-	-	-	-
SOUTH AMERICA	270.457	239.702	215.057	251.903	270.529	312.956	316.355	272.680	359.531	324.133
WORLD	9.227.827	10.133.723	10.876.379	12.870.078	12.955.495	12.181.668	13.703.694	14.901.088	15.231.890	15.376.082

SOURCE: FAO

IMPORTS OF POTASH FERTILISERS

(Tm K_2O)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
BAHAMAS					[illegible]	300	500	600	400	40
BARBADOS	2.500	2.000	2.200	2.840	[illegible]	2.600	1.671	1.124	3.000	3.00
BELIZE	500	381	19	382				218		
CUBA	160.056	105.800	78.000	96.600	106.800	155.200	127.300	133.800	166.800	133.60
DOMINICA							2.300	2.600	2.000	80
GUADELOUPE	4.400	5.300	3.000	3.000	3.500	3.263	3.175	4.000	2.558	70
HAITI	90	100	493	500	434	300	100	800	1.000	80
JAMAICA	15.000	10.000	8.000	8.500	9.400	7.800	5.700	6.000	7.400	5.02
MARTINIQUE	7.000	6.600	4.000	4.400	4.200	2.720	2.472	2.163	3.711	2.80
DOMINICAN REP.	14.207	16.617	18.412	21.333	26.197	20.400	19.400	12.476	17.300	27.20
SAINTS KITTS	1.500	1.500	3.000	3.200	3.200	2.000	1.200	1.200	1.200	1.20
SANTA LUCIA	1.000	1.000	3.000	3.000	3.000	1.500	1.200	1.200	1.200	1.30
TRINIDAD AND TOBAGO	2.500	3.000	3.000	2.921	2.935	2.372	2.691	1.255	2.800	2.10
TOTAL CARIBBEAN	208.753	152.298	123.124	146.676	165.255	198.455	167.709	167.436	209.369	178.92
MEJICO	20.693	34.193	37.519	34.080	34.012	63.851	67.332	34.255	72.208	73.38
PANAMA	3.000	4.000	4.934	5.783	8.516	7.008	7.500	7.500	5.900	11.200
TOTAL	23.693	38.193	42.453	39.863	42.528	70.859	74.832	41.755	78.108	84.582
COSTA RICA	14.500	19.700	21.000	25.280	27.708	24.490	29.000	21.134	32.000	30.700
EL SALVADOR	7.687	13.400	11.680	13.507	10.800	9.252	10.555	8.169	9.055	[illegible]
GUATEMALA	5.775	2.841	3.500	11.077	13.838	4.600	17.907	24.628	20.000	20.200
HONDURAS	7.500	9.500	7.900	8.000	7.000	4.900	5.400	7.200	6.500	6.000
NICARAGUA	2.549	3.770	5.400	7.500	3.400	400	10.952	2.358	4.499	300
TOTAL C.A.C.M.	38.011	49.211	49.480	65.364	62.746	43.642	73.814	63.489	72.054	60.622

SOURCE: F.A.O.

The only country in the continent which is a net exporter of potassium fertilisers is Canada, which is also the greatest exporting country in the world, controlling over 40% of the international trade in these products. The remaining American countries are net importers of potassium fertilisers.

Within this general characterization of the American continent as an importer of these products (except Canada) the main consumer markets are the USA and Brazil, with volumes of net imports around 4 and 1 million tonnes of potassium fertilisers (in K_2O) respectively and for 1979/80.

In the area nearest El Salvador, from Mexico to Panama, including the Caribbean the total volume of imports of potassium fertilisers amounted to some 325,000 tonnes in 1979.

Levels of consumption of these fertilisers are very variable according to the country and the year in question, as can be seen in the attached table; these variations in the consumption per Ha. cannot

POTASH FERTILISER CONSUMPTION PER HECTARE

(tilled or permanently cultivated land) Kg/Ha

	AVERAGE 1969-71	AVERAGE 1977-79
BAHAMAS	18,1	29,3
BARBADOS	70,2	72,0
CUBA	57,6	46,2
DOMINICA	n.d.	105,9
GUADELOUPE	93,1	48,4
HAITI	0,1	1,0
JAMAICA	37,4	23,2
MARTINIQUE	209,2	111,2
DOMINICAN REPUBLIC	11,0	11,8
SAINT KITTS	104,7	85,7
ST. LUCIA	59,2	72,5
TRINIDAD AND TOBAGO	19,0	12,9
TOTAL CARIBBEAN	39,00	31,6
MEXICO	1,0	2,5
PANAMA	6,1	14,5
TOTAL	1,05	2,75
COSTA RICA	15,9	48,3
EL SALVADOR	11,5	7,6
GUATEMALA	2,5	12,0
HONDURAS	5,2	4,4
NICARAGUA	2,0	1,2
TOTAL C.A.C.M.	5,29	9,96

SOURCE: F.A.O.

be attributed to only one variable, as they depend both on fairly permanent conditions such as the soil, climate and structure of crops of each country and on other less structural factors: the relative importance of the modern sector of their agriculture; varieties of crops used; average dimensions of farming land; extension of knowledge of the advantages of chemical fertilisers among farmers; the availability of these fertilisers in the country; prices of agricultural fertilisers and the products obtained; income levels, etc.

In any case, it appears that a clear distinction may be established between the Caribbean area with relatively high consumption of potassium fertilisers as against Mexico with a very low use of these products; the countries of the Central American Common Market would be in an intermediate position on this scale of consumption of potassium fertilisers per Hectare under cultivation.

In addition, it should be stated that most of the studies carried out on the use of fertiliser both in Latin America and in other regions, show remarkable variations in consumption inside one country. So, for example, let it suffice to quote the case of Brazil in which the consumption of all fertilisers per Hectare in the coffee growing area of São Paulo was two hundred times the national average (2). Within the same country and for the same crop the differences are also important according to the characteristics, type and yield of the development (3).

During the ten year period from 1970 to 1979 one cannot observe a clear upward trend in the consumption of potassium fertilisers in the area. Specifically, in the Caribbean the decrease in consumption per hectare of these products has been the almost general keynote; in the other two areas under consideration the variations are also very irregular, with increases of relative importance of consumption per hectare in Mexico, Guatemala, Costa Rica and Panama and remarkable decreases in other countries.

Both at the world and regional levels there is little information on specific types of fertilisers produced or used, or on prices. Any way, from the

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(2) Quoted by W. Wieser and J.C.Abbott in "Fertiliser Markets" FAO-1978

(3) In El Salvador and for coffee the range of use for fertilisers as a whole went from 0.76 kg/Ha to 230 kg/HA (mineral fertilisers, varying coffee yield from under 200 kg/Ha to over 1,200 kg/Ha, respectively (CEPAL: Coffee in Colombia and El Salvador, 1958).

statistics available for some countries, and other qualitative information, it may be deduced that a great part of the production and consumption of potassium fertilisers is carried increasingly in the form of complex fertilisers which have the advantage of delivering at the same time the main nutrients required for each soil and crop. The existence of a wide range of commercially available products of this type, with very different combinations of the various nutrients, has made this expansion easier; anyway simple fertilisers still have a vast field of use especially in intensive farming as they permit more exact applications, and generally at less cost of the most suitable nutrients for each soil and each type and phase of cultivation.

From among the simple potassium fertilisers the most widely used worldwide is muriate (potassium chloride), with a content usually over 45% of K_2O (between 48% and 62%) due to the fact that most potassium fertilisers are obtained from silvinite (potassium and sodium double chloride). Anyway, in many intensive crops (fruit, vegetables, tobacco...) this product presents problems and potassium sulphate is usually used more. This last mentioned fertiliser is also preferred for coffee.

Potassium sulphate is the next simple potassium fertiliser with generalised use, although, for the reasons set forth above, relatively less used than muriate.

The attached table shows the distribution of the consumption of potassium fertilisers between potassium sulphate, potassium chloride and complex fertilisers, for come countries in which this information is available. In view of these figures, there seem to be very different habits of consumption in each country; these habits of consumption are in turn greatly conditioned both by the greater or lesser availability of each product in each country and the price relationships between each type of fertilisers as, except for specific conditioning factors of certain soils or crops, there is a high degree of interchangeability between the different commercially available simple fertilisers.

The prices paid by the farmers for the potassium suplhate are usually between 1.5 and 2.2 times the price of muriate (with a K_2O content cf over 45%). This price differential is one of the factors explaining the greater relative use of chloride as against sulphate of potash, in spite of the better quality possessed by the latter as a fertiliser, o most of the soils and crops requiring potassium nutrients as it also provides sulphur and does not cause negative effects.(as happens with chlorine for some products).

In complex fertilisers sulphate may be used equally well as potassium chloride.

DISTRIBUTION OF POTASH FERTILISER CONSUMPTION BY PRODUCT AND COUNTRY

(In %)

	POTASSIUM SULPHATE	POTASSIUM CHLORIDE	COMPOUND FERTILISERS
BELGIUM & LUXEMBURG	4	9	68
DENMARK	1	3	96
FINLAND	-	3	97
GERMANY (FED.REP.)	1	..	70
ITALY+	8	16	72
NETHERLANDS	1	28	38
SPAIN	8	5	86
GUADELOUPE	-	52	48
HAITI	-	-	100
JAMAICA	-	60	40
MARTINIQUE	5	4	91
MEXICO	9	18	73
U.S.A.	1	49	-

SOURCE: F.A.O.
(Most recent year for which information available)

RATIOS BETWEEN PRICES PAID BY AGRICULTURAL PRODUCERS FOR POTASSIUM CHLORIDE AND FOR POTASSIUM SULPHATE

	Potassium sulphate / muriate 45 %
CANADA (1977)	2,04
MARTINIQUE (1976)	1,53
MEXICO (1979)	1,76
BRAZIL (1978)	2,23
ECUADOR (1977)	1,72
PERU (1979)	1,96
VENEZUELA (1979)	1,55

SOURCE: F.A.O.

3. El Salvador Market: Present Situation and Main Trends

Before going into the analysis of the supply and demandof potassium fertilisers in El Salvador, it is advisable to note some basic characteristics of the agriculture of the country.

El Salvador presents characteristics which clearly differentiate it from other Central American countries, as it has a very small surface area and a high population density, the reverse of the situation in other countries of the isthmus. Both factors together with a soil rather well suited to agricultural activity explain in part the high relative volume of the total area under cultivation and the intensive application of labour in the agricultural sector. In the table below the different combination in El Salvador of the various productive factors of land, work and capital with respect to the situation in other countries surrounding it is evident.

Most of the cultivated surface is used for the

INDICATORS OF EMPLOYMENT OF FACTORS OF PRODUCTION IN AGRICULTURE

	LABOUR	CAPITAL		LAND
	Persons employed per 100 Ha (1)	Tractors per 100 Ha (2).	Chemical fertilisers per 100 Ha(3).	Percentage of toal area under cultivation(4)
Netherlands Antilles	n.d	1,5		
Bahamas	n.d	3,4	75	8,3
Barbados	54	1,6	173	1,6
Belize	16	1,6	23	76,7
Cuba	23	2,7	156	3,9
Dominica	n.d	1,3	100	27,7
Guadeloupe	41	2,1	65	22,7
Haiti	218	0,1	4	29,0
Jamaica	59	1,3	50	32,1
Martinique	69	12,1	308	24,5
Dominican Republic	70	0,3	59	25,4
Saits Kitts	n.d	2,7	150	38,9
Santa Lucia	n.d	0,8	282	27,9
Trinidad and Tobago	45	3,2	54	30,8
Mexico	31	0,7	49	12,1
Panamá	40	0,9	52	7,4
Costa Rica	53	2,1	161	9,7
El Salvador	109	0,6	105	32,8
Guatemala	66	0,3	59	16,7
Honduras	38	0,2	11	15,7
Nicaragua	23	0,1	15	12,7
WORLD AVERAGE	58	1,5	77	10,8

SOURCE : F.A.O.

NOTES :
(1) Active agrarian population (1979) x 100/area tilled permanently cultivated (1978)
(2) Number of tractors in use (1978) x 100/area tilled (1978)
(3) Kilograms of basic fertilisers consumed ($N;P_2O_5;K_2O$ -1979)/ area tilled or permanently cultivated
(4) Area tilled or permanently cultivated/total land area (1978)

production of a few basic products, around which a greatpart of the country's economy revolves. So, and in this order between maize, coffee, sorghum, cotton, beans and sugar cane, they occupy nearly all the cultivated surface of the country.

Of these six basic products coffee has traditionally been the main product exported fromEl salvador: also important amounts of cane sugar and cotton are destined for export. The preferred destination of the remaining agricultural produce is usually the domestic market.

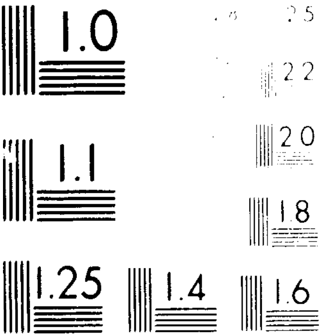
In the last ten years there have been many annual variations in the surface areas cultivated with these products, which indicates a relatively high adaptation by the agriculturalsector to the characteristics of the market and/or the stimuli of agricultural policy. Specifically, the main increases in area have taken place in maize and coffee, with increases of over 40% between 1970 and 1980; although with greater annual variations, the increases in the area dedicated to sugar cane, rice and beans are also important. Another indicator of the capacity of assimilation of new techniques and products by Salvadorean agriculture is the importance of the hybrid varieties of maize in the whole of the area destined to this product (over 70%

of the total in 1980)

The agricultural yields obtained in these basic products are quite high in relation with those of other neighbouring countries, although in some cases not as high as could be expected, given the labour intensive nature of Salvadorean agriculture.

Going now into the consumption of fertilisers in El Salvador one must point out the relatively high consumption of fertilisers per Hectare under cultivation in the case of basic fertilisers, which is rather higher than the world and American average, almost exceeding almost every year the rest of the Central American countries and many Caribbean countries.

The consumption of basic fertilisers, overall, has experienced in El Salvador a generally growing evolution until 1973;after a fall in 1974 and 1975, again the trend appeared to be upward until 1978 in which the maximum consumption of the period was reached (112,000 tonnes). However in 1979 consumption was drastically reduced, returning to 1970-71 levels. This marked step backwards was due not only to the fall the previous year of the coffee


1.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

PRINCIPAL CROPS AND AGRICULTURAL LAND-USES IN EL SALVADOR
1980 / 81

PRODUCT	AREA (HA.)
Maize	291.608
Coffee (a)	180.000
Sorghum	119.321
Cotton	58.182
Beans	52.448
Sugar cane	27.972
Reeds	2.098
Rice	16.793
Sesame	13.077
"Herrenquen"	10.210
Oranges	4.895
Coconuts	3.986

SOURCE: Ministerio de Agricultura y Ganaderia. Anuario de Estadisticas Agropecuarias (1980-81)

(a) FAO 1979 Yearbook

AVERAGE AREAS DEVOTED TO THE PRINCIPAL CROPS AND AGRICULTURAL LAND-USES IN EL SALVADOR AND THEIR YIELDS (Kg/ha)

PRODUCT	AVERAGE AREA (1969-71)	YIELD IN Kg/Ha (1969-71)	AVERAGE AREA (1977-79)	YIELD IN Kg/Ha (1977-79)
MAIZE	203	1.670	262	1.804
SORGHUM	121	1.186	138	1.188
DRY BEANS	36	833	52	765
UNGINNED COTTON	56	2.362	93	2.141
SUGAR CANE	31	53.224	41	85.516
RAW COFFEE	124	1.122	158	957

prices but also to the difficult sociopolitical conditions of the country.

Traditionally El Salvador has been using a combination of basic fertilisers centred around the use of nitrates. In effect whereas the ratio of consumption of nitrate, phosphate and potassium fertilisers (for N = 1) is around 0.9 (for P_2O_5) and 0.6 (for K_2O) in Latin America, the levels inEl Salvador, in addition to varying greatly from one year to the next, are between 0.2 and 0.5 (for phosphates) and 0.1 and 0.2 for potassium. The low relative use of phosphates and potassium in El Salvador is obvious and does not appear to be due to specific characteristics of the soil or crops (4)

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(4) So, at least part of the soils of El Salvador need in principle important doses of potassium (meteorised soils). Also the ratios of nutrients absorbed by some basic Salvadorean crops are more favourable to phosphate and potassium fertilisers than those derived from present consumption: Maize (between 0.4 and0.5 of P_2O_5; between 0.75 and 1 of K_2O. for N=1 and different yields); sugar cane (0.8 of P_2O_5 and 2.5-3 of K_2O); cotton (0.4 of P_2O_5 and 0.7 of K_2O). FAO figures (Fertilisers and Their Use).

COMPARATIVE YIELDS OF THE PRINCIPAL AGRICULTURAL PRODUCTS OF EL SALVADOR

period 1977 a 1979 - Kg./ Ha.

	MAIZE		COFFEE		SORGHUM		COTTON		DRY BEAN		SUGAR CANE	
	Mínim	Máxim	Mínim	Máxim	Mínim	Máxim	Mínim	Máxim	Mínim	Máxim	Mínim	Máxim
Netherlands Antilles					706	722						
Bahamas											31.429	31.429
Barbados	2.614	2.614									56.453	69.243
Belize	1.545	1.557							664	714	45.269	48.962
Cuba	1.250	1.250	510	540	1.100	1.100	968	968	714	714	45.968	53.291
Dominica	1.333	1.467									19.524	20.000
Guadeloupe	1.200	2.000	950	950							45.917	52.000
Haiti	1.040	1.218	1.060	1.131	1.084	1.145	500	500	313	396	34.467	38.667
Jamaica	1.148	1.260	267	336							61.777	65.237
Martinique			1.200	1.200							49.864	60.387
Dominican Republic	1.440	2.000	301	312	2.000	3.612	968	980	702	924	64.141	68.014
Saint Kitts							783	1.205			70.289	82.562
Santa Lucia	700	700										
Trinidad and Tobago	4.092	4.545	267	354							50.000	59.094
Mexico	1.295	1.519	467	661	2.680	3.060	2.323	2.852	472	666	64.368	71.625
Panama	956	1.042	220	238					212	312	59.408	67.046
Costa Rica	1.726	1.772	1.066	1.171	1.641	2.248	757	1.530	480	579	79.102	83.513
El Salvador	1.551	1.918	894	1.000	1.143	1.233	1.983	2.300	642	829	81.013	89.395
Guatemala	1.245	1.308	598	680	1.362	1.509	3.221	3.306	532	596	67.797	82.540
Honduras	935	1.051	436	577	667	750	1.772	1.835	385	500	31.507	34.667
Nicaragua	842	1.146	621	628	986	1.247	1.788	1.982	668	781	60.790	62.128
World Average	2.914	3.271	472	521	1.310	1.329	1.171	1.251	549	580	55.474	57.128

SOURCE : F.A.O. Yearbook

One cause of this predominance of nitrate fertilisers in Salvadorean agriculture appears to be the greater availability of this type of fertiliser. Actually, El Salvador presents a relatively high production capacity of nitrates, which in 1978 materialised in the national production of nearly 25,000 tonnes (in N) of these fertilisers (around 30% of the domestic consumption of these products).

Also since 1968 phosphated fertilisers have been produced in the country, although with a consumption coverage level lower than the nitrates (around 20%) and with a maximum production volume of some 4,500 tonnes (in P_2O_5 for 1977).

On the other hand, there is no domestic production of potassium fertilisers, which must be imported, either for domestic consumption or for re-export, in the form of complex fertilisers.

The Salvadorean consumption of potassium fertilisers is, as can be seen from the figures, rather low in comparison with the other basic nutrients and very irregular over the years. The maximum consumption during the period 1970-79 was reached in 1973 (10,000 tonnes of K_2O) although in general it varies between 6,000 and 8,000 tonnes. Imports are usually higher because the country re-exports part of these amounts, in the form of complex fertilisers.

EL SALVADOR: FERTILISER PRODUCTION FOREIGN TRADE AND CONSUMPTION

(IN tons)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
NITROGENOUS FERTILISERS										
Production	8.000	7.000	2.000	7.000	7.000	5.300	4.445	12.400	24.449	15.000
Imports	48.411	60.700	67.269	66.629	57.500	64.100	79.067	70.744	68.898	41.596
Exports	5.000	5.000	7.000	5.000	2.159	4.495	7.047	12.646	9.520	6.000
Consumption	45.000	63.000	65.000	68.000	62.500	65.000	77.106	77.118	84.192	50.600
PHOSPHATE FERTILISERS										
Production	2.000	2.200	3.700	4.000	1.600	2.400	3.872	4.521	3.956	2.000
Imports	10.534	13.347	26.525	35.800	34.500	21.491	21.200	26.800	26.200	22.400
Exports		5.400	7.700	8.000	8.000	3.731	8.700	7.100	5.087	6.300
Consumption	12.300	11.800	22.500	31.800	28.100	20.200	16.400	22.400	23.314	18.100
POTASH FERTILISERS										
Production	7.687	13.400	11.680	13.507	10.800	9.252	10.555	8.169	9.055	3.422
Imports	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Exports	7.687	6.000	7.000	10.000	8.000	8.700	8.690	6.018	4.024	6.000
Consumption										
ALL FERTILISERS										
Production	10.000	9.000	6.000	11.000	9.000	8.000	8.000	17.000	28.000	17.000
Imports	72.000	89.000	106.000	116.000	103.000	95.000	111.000	106.000	104.000	67.000
Exports	5.000	10.000	15.000	13.000	10.000	8.000	16.000	20.000	15.000	12.000
Consumption	65.000	81.000	95.000	110.000	99.000	94.000	102.000	106.000	112.000	75.000

SOURCE: F.A.O. Fertilisers Yearbook
(a) Reexports of potash fertilisers in the form of componed fertilisers

(10^3 Tm K_2O)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
	4,8	5,1	7,5	5,5	2,8	0,6	1,9	4,4	1,6	1,8

4. Market Prospects

4.1 International and Regional Markets

The prospects for the consumption of fertilisers and in particular of potassium fertilisers are; difficult to quantify dur to the number of variables influencing their development. However, in the long term, one may presume that consumption will grow, as the knowledge of the advantages derived from the use of fertilisers in agriculture spreads, in the medium term there are important annual variations, derived, among other causes, from the purchasing power of the farmers, the characteristics of soils and changes in cultivation of each country and relative variations of the prices paid and received by farmers.

So, during the period 1970-79, although there is a trend towards consolidating in easingly larger volumes of consumption of potassium fertilisers in the world, also annual unequal rates of consumption are also presented.

At regional level, similar problems are presented. Thus, for the area from Mexico to Panama including the Caribbean, there is a remarkable variety in the consumption of potassium fertilisers, with strong annual variations according to the country and the year and also with very unequal situations in the consumption per hectare according to the country.

The main consuming country of these fertilisers is Cuba, remarkably different from the rest in absolute terms, although this country is exceeded by others in consumption per hectare. Within the Central American Common market iself the differences are also important with a high potash consumption per hectare in Costa Rica and very low levels in Honduras and Nicaragua.

For the area overall, the rates (yearly) are also very variable, although a continuous growth in total consumption is evident since 1973.

In order to have a figure for guidance of the demand for potassium fertilisers in the area near El Salvador, which might serve as an indicator of the foreign market potential for the new Jiboa factory, it has been assumed that the demand of this area can grow until 1990, considered as the last year of the forecast at an accumulative annual rate equal to the average of the annual rates observed netween 1970 and 1979, for the area overall. This assumption seems to be valid, in view of the great differences in consumption per hectare of the various countries included in the area, as in this way the smaller rates foreseeable of growth of countries starting froma high level of consumption can be compensated, with the most intensive rates we may expect from countries with low consumption.

The rate adopted is 3.4% and the resulting level of potash consumption of the area overall, for 1990, would be some 460,000 tonnes (of K_2O). This figure implies levels of use of potassium fertilisers per hectare of 13 kg/Ha. a figure lower than the present world average. Until 1979 at least, all the consumption of the area had to be imported, as there was no own production in any country.

4.2 El Salvador Market

The estimate of the prospects of the potential market in potassium fertilisers in El Salvador is highly conditioned by the relatively low use of this basic nutrient by the farmers of the country, at present. It has already been stated that Salvadorean agriculture presents, together with a high level of consumption of fertilisers generally per hectare (compared to neighbouring countries), a relatively scant use of phosphates and potashes.

This fact, independently of whether it may be explained in part by the specific characteristics of the soils of the country, may be conditioned to a certain extent by a pressure from the national production of fertilisers, which are dominated by nitrates. Alongside this there seems to be a rather irrational use of the fertilisers, centring exclusively on nitrates without taking into account the close interrelations existing between the various nutrients, which must maintain a certain relationship between themselves, for the use of chemical fertilisers to cause a positive effect on agricultural output.

This lack of compensation between the various types of basic fertilisers may be one of the factors determining the relative stagnation of the output of most of the main crops of El Salvador. In effect, output of the six main crops of the country present marked annual variations and as can be seen in the previous table they are in 1977/79 at lower levels than in 1969/71 with the sole exceptions of sugar cane and to a lesser extent, of maize based on a greater use of hybrid varieties.

With this starting out situation, any forecast of the consumption of potassium fertilisers in El Salvador is very conditioned both by the availability of a suitable domestic supply at competitive prices for these products, and the carrying out of campaigns to spread a better knowledge of a more rational use of various chemical fertilisers among farmers.

In any case, and in order to have a forecast estimating possible demand of potassium fertilisers in the country, the following estimates for the year 1990 have been made:

a) Estimate based on the structure of the main crops

The initial assumption for this estimate consists in accepting as valid for 1990 the present day structure of the main crops in El Salvador, which implies that the six basic crops of the country will be cultivated in 1990 on land and areas similar to those used in 1980/81.

For each of these uses coefficients of the use of potassium fertilisers per Hectare have been employed, obtained from different sources but attempting tomake them as close as possible to to the geographical situation, land, climate and output of these crops in El Salvador. (1)

(1) The coefficients employed have been obtained from the following publications, for each crop: The Efficient Use of Fertilisers. FAO W- Ignatieff a . H.J. Page (1969 edition): Coffee (recommendations for 5-10 yrs plantation); Cotton (dose podzol red yellow and alluvial Usa soils);

ESTIMATE OF POTENTIAL DEMAND FOR POTASH FERTILISERS IN EL SALVADOR IN 1990 ON THE BASIS OF CROP STRUCTURE

Principal land-uses	Area (10^3 Ha.)	Potash fertiliser consumption factors per ha. (minimum levels)	Total demand per potash fertilisers (in tonnes of K_2O)
Maize	300	15	4.500
Sorghum	120	15	1.800
Coffee	180	50	9.000
Cotton	60	25	1.500
Beans	50	16	800
Sugar cane	30	45	1.350
TOTAL			18.950

For these estimates to be as realistic as possible and given the notable variations between the recommended dose for each crop, and also the differences according to the types of soils really used and the diverse use of chemical fertilisers according to the country, the minimum fertiliser coefficients have been used in all cases. on the basis of these assumptions, the foreseeable consumption of potassium fertilisers should situate itself in El Salvador at around 19,000 tonnes of K_2O a figure which can ne considered as a minimum, within the assumption of a more suitable combination of basic fertilisers to present day crops.

b) Estimate based on the Recent Trend towards the Consumption of Total Fertilisers.

This method starts out fromestimating, first the demand for all basic fertilisers in El Salvador, for 1980. The trend observed between 1970-79 in the total consumption of basic fertilisers presents however, two clear breaks in the last ten year period: one in 1974 and 1975, in which due

sugar cane - alluvial terraces of Missippi:recommended doses) Beans (recommended doses in USA) // Fertilisers Market. FAO. K.Wieser and J.C.Abbott, 1978: Maize and Sorghum (fertilisers used in Ecuador with maize, with output of 2,200 kg/Ha.

to the effects of the world crisis there was an important fall in the consumption of fertilisers, thus breaking the growth trend although with some ups and downs of the preceding years. From 1975 onwards consumption again recovers its upward trend, although at rates lower than those of the period before the crisis. In 1979, and as much due to purely economic elements (fall in coffee prices, especially) as to the internal problems of the country, there is again a sharp fall in the total consumption of basic fertilizer.

Due to these remarkable oscillations in the most recent period, the hypothesis has been adopted thatthe total consumption of fertilisers will grow from 1979 to 1990 at an accumulative annual rate similar to the average rate of the period 1975-78, in which there is a certain recovery from the world crisis, but still the influence of sociopolitical factors is not felt, which still continue in part in El Salvador.

This assumption imples rather moderate (6.03%) but acceptable consumption growth rates for basic fertilisers, given the high consumption per hectare of fertilisers which already exists in the country (until 1978) and also the existing internal difficulties.

With these assumptions the total comsuption basic fertilisers would rise to some 143,000 tonnes in 1990, which implies a consumption of 210 kg/Ha of permanent tilled land (2).

In order to estimate the share of potassium fertilisers in this total consumption of basic fertilisers, we must first start out from the low consumption ratio of these products in El Salvador, especially with nitrates. So, whereas in El Salvador the consumption of potassium fertilisers usually made up for 8% of all the bas[illegible] trients, this ratio was around 30% in mo[illegible] Caribbean countries and the rest of Central America. Specifically in the countries of the Central American isthmus only Nicaragua showed shares similar to those of El Salvador, whereas in Costa Rica, Guatemala, Honduras and Panama potassium fertilisers make up between 2[illegible]% and 40% of the total consumption of basic fertilisers.

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(2) At present the only places in the American Continent to surpass this level are Martinica, Guadalupe, San Vincent and Santa Lucia.

ESTIMATE OF POTENTIAL DEMAND FOR POTASH FERTILISERS IN EL SALVADOR IN 1990 ON THE BASIS OF RECENT TRENDS IN TOTAL FERTILISER CONSUMPTION

	TOTAL CONSUMPTION						CONSUMPTION IN 1990	
	Absolute values		Annual rates of growth (%)					
	Average 1970/73	Average 1975/78	1976/75	1977/76	1978/77	Average	Total	Per Ha.
Total consumption of basic fertilisers (N, P_2O_5, K_2O)	87.800 Tm.	103.500 Tm.	8.51	3.92	5.66	6.03	143.000	210.3
Consumption of potash fertilisers (as % of the total)	8.7% (7.670Tm.)	6.6.% (6.860Tm.)					20% (28.600Tm.)	42.0

SEMEER

Pag. 41

Despite the fact that the conditions of soils and crops in El Salvador can explain part of these differences, it was remarked upon before that a greater increase in potassium fertilisers is foreseable in the agriculture of the country, in order to achieve a better balance between the various nutrients employed.

For this reason, the assumption has been adopted that for 1990 the ratio of potassium consumption to total consumption in El Salvador may be at a level similar to the present average for the Latin American countries as a whole in the isthmus (including the country under analysis), which would give a participation of potassium in the total consumption of the order of 20%.

In accordance with the hypotheses indicated, the consumption of potassium fertilisers in El Salvador, for 1990, would be some 28,600 tonnes of K_2O.

In this way the consumption per hectare (permanent cultivated land) would be 42 kg/Ha for these products, a figure similar to the present figure for Costa Rica.

5. Conclusions

The estimated production of potassium sulphate in the Jiboa Complex, put at 24,816 tonnes/year, equivalent to 12,500 tonnes of potash (K_2O), does not present market problems, if we bear in mind that the Salvadorean market alone could have a demand for potassium fertilisers to be estimated between 19,000 and 28,600 tonnes for 1990.

The foreign demand for these fertilisers, both in their simple form and in the form of complexes, does not present limitations of any importance, owing to the important volume of these products consumed in the Central American Common Market and the Caribbean which should be important now.

The fact that there has existed for several years a production of nitrated, phosphated and complex fertilisers in El Salvador, part of which is already being exported, also favours the possibility of suitably commercialising this new product making it possible to place abroad any possible surpluses which may be produced, especially initially and while a guidance campaign is being carried out about the convenience and desirability of a relatively greater use of potassium fertilisers in the country. All this provided that the ratio of prices of the new product is maintained within the normal limits with regards to other substitutes (1.5 - 2 times that of muriate).

UNITED NATIONS NACIONES UNIDAS

UNITED NATIONS DEVELOPMENT PROGRAM

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

FEASIBILITY STUDY FOR "JIBOA" SUGAR FACTORY EXPANSION (SAN VICENTE) EL SALVADOR

VOLUME II

PROJECT No. DP/ELS/78/001. Industrial Promotion

SENER Reference: PQ-3040

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1196-E
(2 of 3)

6. ALTERNATIVES PROPOSED

SENER

6. ALTERNATIVES PROPOSED TO THE PRELIMINARY STUDY

SENER

CONTENTS

SENER

6. ALTERNATIVES PROPOSED TO THE PRELIMINARY STUDY

6.1 General Data

Below we are going to put forward three alternatives, which, according to our calculations, it is advisable to consider for possible application to the Jiboa Sugar Factory..

Alternative A: To study the extension of the work capacity of the sugar factory from 3,840 t cut cane per day to 5,000 t cut cane per day.

Alternative B: To study the extension of work capacity from 3,840 t of cut cane per day to 6,400 t of cut cane per day.

Alternative C: To study the extension of the work capacity of the factory from 3,840 t of cut cane per day to 6,400 t cut cane, but with the following characteristics:

The extension from 3,840 t to 6,400 t cut cane would be accomplished in a complete manner, from the intake of cane to the purification of juice inclusive; from the purification of juice up to the end of the production process of sugar the extension up to 5,000 t cut cane / day is studied.

The purified juice from the 1,400 t cut cane/day being the difference between the amount of cane that can be worked up to purification, and that which would be worked up to the end of the process of obtainment of sugar would be destined to an alcohol plant of 90,000 l/day, which would

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also convert the molasse produced by the factory.

Before embarking on a study of the three alternatives, let us set forth the summaries of the average data obtained in Jiboa, since the harvest of 1977/78; and also a balance of the various intermediate products generated by the process.

As the real parameters of these products of the process are not available, we shall make the balance in two parts, in the first we shall assume all the molasses have a B_x of 60 and a distribution we consider normal;in the second part we will do it with B_x 'es which, according to our experience, work out as closest to reality.

Should we be able to obtain, during our work on this study, the operational parameters of the factory, a corrected balance will be made up in accordance with those data.

As the amounts of white and raw sugar set per harvest are not constant, let us take those set forth in our balance.

AVERAGE DATA JIBOA SUGAR FACTORY

	Harvest 81/82	Harvest 80/81	Harvest 79/80	Harvest 78/79	Harvest 77/78	%mean yield of cane	Mean B_x
Tonnes cut cane: worked	338 059	300 107	294 838	352 613	434 752		
Mean polarization of cane	12.69	13.14	12.12	13.04	12.32	12.66	
Weight of syrup as percentage of cane	25.62	25.65	22.80	26.55	24	24.92	
Weight of final molasse as percentage of cane	5.65	6.60	5.12	6.17	5.03	5.68	
Mean brix syrup	61.66	60.53	60.27	58.42	61.10		60.42
Mean brix molasse	85.85	84.62	82.52	85.99	86.38		85.23
Raw sugar	6 416 215 Tc	128 200.20qq	173 748qq			2.34	
White crystal sugar:	25 239.60Tc	466 855 qq	370 570qq			7.29	

6.2 Alternative "A" - Extension of Work Capacity of Sugar Factory to 4,500 tonnes/day (5,000 Tc/day)

6.2.1 Technical Description

In the 1981/1982 harvest, the work capacity reached by the Jiboa sugar factory was 160 tonnes cut cane per hour, which is 3,840 tonnes per day.

In accordance with the talks held in San Salvador with Messrs Bayardo, Romero and Schult, it was considered advisable to study the extension of the work capacity of the sugar factory, from 3,840 tonnes cut cane per day to 5,000 tonnes cut cane per day.

The aim of this study is to find the greatest profitability to be obtained from the factory, with this extension to the daily work capacity, and, if it were advisable, attempt to approach in stages the final planned extension to 6,400 tonnes of cut cane per day, in order to obatin the greatest financial profits, in the phase of expansion of the cultivation of sugar cane, which according to a realistic assessment will happen progressively in the zone of influence of the factory.

According to impressions received, with which we agree, the extension we are about to study would be advisable to have it ready for when a harvest of over 450,000 tonnes of cut cane is anticipated.

In the 1981/1982 harvest, 338,000 tonnes of cut cane were harvested, and if the circumstances through which El Salvador is passing had been slightly more favourable, it is considered that

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the quantity of 450,000 short tons would have been reached.

Analysis of Extension to Equipment

We shall carry out this analysis following the various departments of the factory.

Reception and Grinding

With the equipment installed in the cane reception bay and in the mills 5,000 short tons of cane can be worked a day.

Purification

For the washing of cake and the separation of cake, , we consider that a new rotary vacuum filter should be fitted. The present capacity of the two filters in use is 3,800 short tons a day.

Evaporation

At present there is a quadruple effect evaporation installed with a heating surface of 3,470 m^3 formed in the following manner: first effect of 1,100 m^2; second, third and fourth effect of 790 m^2 heating area each.

We consider that this heating is undersized for the present work capacity, of 3,840 short tons; in this connection we have been told that in the last harvest deficiencies were noticed.

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Hugot recommends that the minimum evaporation area should be set at 25.2 m^2 per short ton of cane worked per hour; in the Jiboa sugar factory we have 21.69 m^2/short ton of cane worked per hout; our experience tells us that this area should be greater.

Consequently the evaporation area should be expanded to some 3,500 m^2, distributed in three or four units, for the new capacity of the expanded factory..

We consider that it is very important that the present evaporation and the expansion form one whole, so that the juice may function in series, through the boxes of the same effect, and for the vapours of the various effects to run parallel.

Besides, if the evaporation were one whole, the condensate water collection system would be a lot easier and more economical.

Sugar Boiling

The sugar output obtained in the Jiboa sugar factory, in the last harvests, has been the following:

White crystal sugar 7.29% of the cane by weight.
Raw sugar 2.34% of the cane by weight.

Now we shall proceed to detail our criteria with regards to the existing sugar boiling: we believe it will be clearer if we compare on the one hand the existing theoretical capacity contrasting it with the theoretical necessary capacity. In this way it will be simpler to understand the expansion we are proposing for the sugar boiling.

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The process used in sugar boiling is based on the production of three classes of massacuite A, B and C; making only one type of molasse on centrifuging massacuites A,B and with sugar C prepare the magma, which is used at the bottoms of the pans A and B.

The characteristics of the massacuites, are assumed to be thus:

Massacuite A	Purity = 87 Bx = 91	d= 1.49
Massacuite B	Purity = 76 Bx = 94	d= 1.51
Massacuite C	Purity = 62 Bx = 96	d= 1.52

The pans in the factory are the following:
Four of 45.4 m^3 and one of 25 m^3.

According to our experience, the way of working with these pans is the following: For massacuite A, the 25 m^3 pan and one of 45.4 m^3; for massacuite B one of 45.4 m^3; for massacuite C, two of 45.4 m^3.

As we can see in the balance of materials included below on page , the quantities of massacuites formed as a percentage of cane we can set in the following manner:

Massacuite A: 20kg/100 kg cane
Massacuite B: 10 kg/100 kg cane
Massacuite C: 8 kg/100 kg cane

Using the type of pans there are in the factory forced circulation type, with an adequate volume to heating area ratio, and using vapour from the first box; the times we will need for the various strikes, including the washing of the pans will

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be the following:

Massacuite A: 3 hours 30 minutes
Massacuite B: 5 hours
Massacuite C: 9 hours

The quantities of massacuite we can work will be the following:

Massacuite A: (45,400+25,000): 3.5=20,114 l/h = 29,969 kg/h
Massacuite B: 45,400 ÷ 5 = 9,080 l/h = 13,710 kg/h
Massacuite C: 45,400 x 2 ÷ 9 = 10,088 l/h = 15,335 kg/h

The quantities of massacuite we shall obtain working 3,840 short tons of cane per day (144 tonnes/h) will be the following:

Massacuite A: 28,800 kg/h
Massacuite B: 14,400 kg/h
Massacuite C: 11,520 kg/h

The quantities of massacuite we shall obtain by working 5,000 short tons of cane per day (187.5 tonnes/h) will be:

Massacuite A: 37,500 kg/h
Massacuite B: 18,750 kg/h
Massacuite C: 15,000 kg/h

Taking into account these results, it is deduced that two pans of 45.4 m^3 each should be installed, one for massacuite A and the other for massacuite B,with which the working capacity of the department will be:

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Massacuite A:	(2x45,4+25.0)÷ 3.5	= 33,085 l/h	= 49,269 kg/h
Massacuite B:	2 x 45.4 ÷ 5	= 18,160 l/h	= 27,421 kg/h
Massacuite C:	45.4 x 2 ÷ 9	= 10,088 l/h	= 15,335 kg/h

Although by installing these two pans, the department is oversized, on the other hand there is the possibility of obtaining all the sugar in the form of white crystal sugar.

If only one pan were installed for massacuite A, we would have to produce more raw sugar.

Centrifugals

The working capacity of this department is sufficient for the expansion to 5,000 short tons a day.

The quantities of massacuite we can work using the present centrifugals are:

Massacuite A :	4 x 550 x 17	= 37,400 kg/h
Massacuite B :	3 x 550 x 13	= 21,450 kg/h
Massacuite C :	3 x 5,000	= 15,000 kg/h

The criteria we have followed to reach these quantities, will be set forth in the analysis of alternative B, expansion of the factory to 6,400 short tons of cane per working day.

Boiling

According to our criterion, and as this department is rather at full capacity at present, for the expansion to 5,000 short tons of cane per day, another boiler should be installed identical to the existing ones of 45 T/h.

Electric Power Generator

It is not necessary to expand this.

Crystallisers

In order to continue with local exhaustion similar to that used at present, for massacuite C, which we consider very good, we are in favour of installing two new crystallisers similar to those already installed.

This achieves great economiv advantages.

Balance and Consumptions

The balances included in section 6.1 are made for 100 tons cane input as a basis.

Therefore applying the corresponding coefficient the concrete balances and consumptions of alternative "A" are obtained.

These consumptions and productions are those we have taken into account for the evaluation in the profitability study of this alternative.

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6.2.2 Valuation of Investment Alternative "A"

Production Capacity 5000 short tons a day (104 days harvest)

Investment Costs

	Foreign Currency $	Local Currency $	Total $
Main equipment	750,000	210,000	960,000
Service equipment	550,000	140,000	690,000
Misc. Materials	–	385,000	385,000
Freight & Insurance	–	143,000	143,000
Interning equipment	–	65,000	65,000
Install. equipment	–	606,000	606,000
Install. misc. mat.	–	275,000	275,000
Preparation of land	–	–	–
Civil Engineering woek	–	380,000	380,000
Licences and royalties	–	–	–
Engineering	–	260,000	260,000
Management & owners expenses		210,000	210,000
Utilities & eventualities	130,000	268,000	398,000
Total	1,430,000	2,942,000	4,372,000

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6.2.3 Sugar Factory Alternative "A"

Annual Production Costs as percentage of capacity	Annual Amount	Cost/U US $	Foreign Currency	Local Currency
Days of harvest = 104				
1. Raw materials:				
Sugar Cane tonnes	468,000	22.22	-	10 399,000
Additives	-	-	-89,000	-
2. Services:				
Electricity (CLES)kWh	435,000	-	-	-
Water m^3	110,000	--	-	-
3. Other Costs	-	-	-	20,000
4. Materials maintenance & repairs	-	-	34,000	100,000
5. Labour:				
Direct	-	-	-	1 135,000
Indirect	-	-	-	178,000
6. Finance Costs (Interest)	ACCORDING TO TYPE OF CREDIT			
7. Depreciation	10% annual			
			123,000	

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6.3 Alternative "B" Exoansion of the Work Capacity of the Sugar Factory to 5760 Tonnes/day (6,400 short tons/day)

Technical Description

In the terms of reference of the United Nations Industrial Development Organization, it is anticipated that the Jiboa sugar factory will have to convert 900,000 tonnes of sugar cane in the near future; it is indicated that the work capacity of the factory is 3,000 tonnes of cane per day.

As we have stated on criticising the study made by Señor Lazarevich, according to our criterion we do not consider technically the expansion of the work capacity o the sugar factory, based on installing 6 Tilby machines with a work capacity of 40 tonnes/hour each.

Now we are going to develop how we propose making the the expansion of the sugar factory, setting forth first a number of remarks to justify the expansion of the Jiboa sugar factory to 6,400 short tons of cane per day.

in the 1981/82 harvest, the work capacity reached by the sugar factory was 160 short tons per hour, which makes 3,840 short tons per day; a total of 338,000 shotr tons were worked.

The production of sugar cane in El Salvador has fallen over the four last years. In the 1981/2 harvest it was expected to collect 2,100,000 short tons of cane; the harvest in 1977/78 was 3,294,876 short tons; according to the impressions received, it is expected that this crop will increase considerably in future years, until a harvest is achieved double the size of the last one, over 4,000,000 short tons.

Cane production in the area of influence of Jiboa has a tendency to increase, with yields which are above the national average, and there is the impression that they are beginning to reap the fruit sown years ago in the work carried out by the agronomical department of the sugar factory, spreading among the croppers' cooperative, and also among independent farmers, the rational techniques of cane cropping, , and the selection of the most suitable types of cane for the area; tested in the centre the Government has near San Miguel.

On the Government Programme for the expansion of the cultivation of cane in the west of El Salvador, amny hopes have been pinned, to the extent that if this objective were attained, it is intended to move the existing sugar factories in the East side to the West.

The 1981/82 sugar cane harvest began on 23rd November 1981 and finished on 20th March 1982.

The polarization of the cane at the beginning of the harvest was 11%, and until the neginning of January it did not rise above 11.50%. The purity of the juic at the beginning of the harvest was 74.

At the end of the harvest, from the last days of February, the polarization of cane was 12.50% and over and a purity in the juice of 76, in spite of the drawbacks associated with the irregularity in the delivery of cane to the factory and not being able to work the cane shortly after cutting.

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Working the cane with one or the other polarization, it is easy to see the amount of economic resources that are not used.

In view of the importanve of the matter, we shall go into this in certain detail.

If we assume that these figures of difference in the polarization of 12.50% at the end with 11% at the beginning have repercussions in the development of the harvest in 1% of sugar; the amount of sugar which is not stored in a harvest of 338,000 short tons will be 3,338 short tons of sugar, equivalent to 6,706,497 lb which at the present sugar price on the domestic market of 51c/lb make 3,420,313 colones (1,368,125$)

In addition, if we bear in mind the difference in purities in the juice, which at the beginning was 74, and at the end 76, it is logical to think that with higher purity the losses in the fabrication process are less.

Taking these criteria into consideration, we consider that the expansion of the Jiboa complex to 6,400 short tons per day should be made when the harvest is near 600,000 metric tonnes of cane.. In our study we envisage this probability for the 1986/87 harvest.

The expansion of the work capacity of the Jiboa sugar factory to 6,400 chort tons of cane per day was envisaged in the project drawn up by the English firm of Fletcher and Stewart Ltd, around 1975. With this project the factory was built entering service in 1977; with the data obtained from the project, and also those supplied by Señor Romero, Manager of the

SENER

Factory, and taking into account our experience and present day trends in this type of expansions we are going to set forth our approach to this.

As in the previous case the necessities to be covered in each department of the factory will be described.

Unloading of Cane

At present there are two hydraulic tips for lorries and two weighbridges.

Assumin that the cane is unloaded six days a week, and that all the cane is transported in lorries, that unloading takes place for ten hours, and that each lorry takes 5 minutes to unload; each bay can unload 200 short tons of cane per hour, if the lorries take an average of 15 short tons each.

As 750 short tons per hour are going to be unloaded, we shall have to install two new tips.

We also consider it convenient to istall a new gross scale, like the existing ones, so we can have two gross scales and one net scale.

Milling and Preparation of Cane

At resent there are installed four cane mills; designed to have a maximum speed of 17.37 m/min .

The four mills installed, using cane with 14% fibre and at 9.3 m/min, can work 3,500 short tons of cane a day; as the cane has a lower fibre content and they can work faster, for the work they are doing now they have plenty of capacity; but for the expansion to 6,400 short tons of cane per day, two more mills would have to be installed.

In the Fletcher project it is anticipated that the six mills can work 6.400 short tons per day, if the cane has a maximum fibre content of 14%, with a speed around 13.71 m/min.

Together with the installation of these new mills, we hall consider in our valuation the arrangement of the equipment necessary, such as the steam turbines for each mill, the force feed rollers, intermediate drivers 84" wide, juice imbibition sprayers or water sprays, pipes, pumps, tanks, changes of rotors in present pumps, juice scales, controls and checks for the driving of the two steam turbines, etc.

Purification

In this department we consider the following equipment would have to be expanded.

One steel tank to mix and keep milk of lime, of around 6 m^3, with agitator and elevation equipment for manipulating drums.

A reheater for the mixed juice, with a heating area of 225 m^2, to work with exhaust steam or with first box steam, with its system for collecting condensate water.

A screen for clarified juice, the same as those already installed.

Two roatry vacuum filters for cake, of 37.5 m^2; 2.44

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m dia. x 4.88 m long. Each filter can treat and wash the cake from some 1,900 shprt tons of cane a day. The installation of these rotary filters presupposes that of their auxiliary equipment, for the extraction of diluted juices. From our point of view, and as the filters installed will be four, we think that the possibility of reducing the equipment collecting diluted huices should be considered, and also that of the vacuum, although this may be less convenient.

One reheater for the clarified juice, of some 190 m^2 of heating area, with its system for collecting condensed water.

Evaporation

At present there is installed a quadrulple effect evaporation with a heating area of 3,470 m^2, made up as follows: first effect of 1,100 m^2; second, third and fourth effect of 790 m^2 heating area each.

As we said about this department when we considered alternative A, it is undersized, causing at present difficulties in the manufacturing process; as we have been informed the main problems are: the syrup does not come out with the right brix and the times of the pans are longer than they should be, with the consequent repercussion on the production of steam from the boilers. When there is an excess of steam consumption in the Sugar Boiling Department, the pressure falls in the upper part of the first box and the amount of steam automatically coming into the tube bank of the first body increases..

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When the juice is longer in the evaporation than it should be, the colour of the syrup increases rapidly, and also sucrose losses by inversion, if the pH of the juice is not right.

In accordance with these considerations, in our opinion the evaporation surface should be increased by 6,000 m^3 in order to work 6,400 short tons of cane a day.

Our financial valuation for the installing of this evaporation area has been made according to the judgement of Fletcher, of installing one new independent quadruple effect, but we think it advisable to study the possibility that with the present evaporation and the expanded evaporation one single quadruple effect of 9,470 m^2 would be formed, so that the vapours of the same effect would run in parallel and the juices circulate in series through the evaporators of the same effect.

We regret we cannot make the valuation following this criterion, as we do not have the information necessary in order to know the implantation of the present evaporation and the space there is available for the installation of the new area.

The area of 6,000 m^2 we consider to be distributed in the following manner: 1,800 m^2 of heating area, first effect, then second, third and fourth of 1,400 m^2 each.

Also a barometric condenser at 26" Hg (4" Hgnabsolute) would be needed with its electric pumps and tanks.

Also considered are:

- The equipment for the operation of the condensate

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waters in the expanded evaporation, using the same criterion as that at present installed,,we consider that if the group of 9,470 m^2 is studied, a single system could be designed for the whole of the evaporation unit. According to our judgement, making the two evaporation units into one would be a little more expensive installationwise, but operation and control would be easier.

- one tank for reception of syrup of 6 m^3.

- electric pumps for the extraction of syrup at 35 m^3/h.

Sugar Boiling

As was said in the analysis of this department in Alternative A, the weighted average yield of sugar in the Jiboa sugar factory during the last harvests has been, in white crystal sugar 7.29% of the weight of the cane, and in raw sugar, 2.34% of the weight of the cane.

Basing ourselves on the criteria set forth in the study of alternative A, we may deduce the following:

The amounts of massacuite we shall obtain by working 6,400 short tons of cane per day (240 tonnes/h) will be the following:

Massacuite A: 48,000 kg/h
Massacuite B: 24,000 kg/h
Massacuite C: 19,200 kg/h

The amounts of massacuite we can work in the present installations are:
Massacuite A: 29,969 kg/h = 20,114 l/h
Massacuite B: 13,710 kg/h = 9,080 l/h
Massacuite C: 15,335 kg/h = 10,088 l/h

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If three pans of 45.4 m^3 each are installed, like the existing ones, one for each type of massacuite, A, B C the working capacity ofthe department would be like this:

Massacuite A: (2x45.400+25,000) ÷ 3.5 = 33,085 l/h=49,249 kg/h
Massacuite B: (2 x 45,400) ÷ 5 = 18,000 l/h=27,180 kg/h
Massacuite C: (3 x 45,400) ÷ 9 = 15,133 l/h=23,002 kg/h

With the installation of these three pans the operation of the sugar boiling department would remain with practically the same proportions of white and raw sugar as at present.

We have also considered:

- independent equipment to make a vacuum in each pan.

- equipment for the measurement and recording of supersaturation in pan C.

- expansion of the massacuite A and B receivers.

Centrifugals

The centrifugals now installed in the sugar factory are the following:

For massacuites A and B, seven centrifugals, completely automatic, of the following main characteristics:

Maximum capacity per load : 650 kg massacuite
Maximum loads per hour : 25

For the determination of the number of centrifuges necessary, these main characteristics are going to be altered in order to have a safety margin.

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According to our experience in the process of manufacture there may be variations in brixes the massacuites have on being centrifuged, and also variations in the grain of the strikes, which naturally affects the amount of massacuite each centrifugal can work per operation and the number of operations per hour.

The characteristics we shall adopt are the following:

Average capacity per load: 550 kg massacuite
For massacuite A, average number of cycles per hour: 17
For massacuite B, average number of cycles per hour: 13

For massacuite C there are three continuous centrifugals, with a minimum capacity of 5,000 kg/hour, which according to our calculations is adequate.

The seven centrifugals of massacuite A and B may be distributed thus: 4 centrifugals for massacuite A and 3 for massacuite B.

The work capacity of these centrifugals is:

Massacuite A: 4 x 550 x 17 = 37,400 kg massacuite A/hour
Massacuite B: 3 x 550 x 13 = 21,450 kg massacuite B/hour
Massacuite C: 3 x 5,000 = 15,000 kg massacuite C/hour

As we have said earlier, the quantities of massacuite that would be produced working 6,400 short tons of cane would be:

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Massacuite A: 48,000 kg/hour
Massacuite B: 24,000 kg/hour
Massacuite C: 19,200 kg/hour

Therefore it may be deduced that the following new centrifugals should be installed:

Two automatic centrifugals for massacuite A.
One automatic centrifugal for massacuite B
Two automatic centrifugals for massacuite C

The work capacity of the department would be as follows:

Massacuite A: 6 x 550 x 17 = 56,100 kg/hour
Massacuite B: 4 x 550 x 13 = 28,600 kg/hour
Massacuite C: 5 x 5,000 = 27,500 kg/hour

For information only we will say that in our financial valuation we have considered the price of a Fives centrifugal, type FC-1,000 with a minimum work capacity of 10,000 kg/hour.

Sugar Dryer and Packaging

As for the dryer-cooler for white sugar, we have considered in our study that with a small alteration to the fans and in the air heating radiator the existing machine may be used.

It is designed to dry and cool 15 short tons of white sugar per hour, the sugar in may reach 2% humidity, in our experience this humidity content is rather high, and we consider that one may unload from the centrifugals with less humidity: 1.20%, which is 40% less, with which the amount of sugar to be dried is practically reached.

However, and in view of the importance of this equipment, for the storage and marketing of sugar, we hope to make a more exact calculation when the facts necessary for it are made available to us.

The bagging, weighing and stitching machines have a maximum work capacity of 7-8 sacks per minute, using 100 lb. sacks.

In our judgement, the practical maximum output we can get from these machines we can set at 5 sacks per minute.

With a yield of 76.9 kg per 1000 kg of cane, and working 6,400 short tons of cane a day, the number of 100 lb sacks we shall obtain will be:
((6,400x0.9)÷24)x76.9÷ 45.35 = 407 sacks per hour = 7 sacks/min

We consider that for the future expansion it is necessary to instal another packaging line, weighing and stitching lines, like the existing ones.

Boiling

According to the data obtained on our last visit to El Salvador, during the last harvest and working 160 short tons of cane per hour, the two boilers installed in the sugar factory of 45 tonnes/hour were nearly at full capacity, especially when there were alterations in the sugar boiling department, motivated mainly because the syrup came out of the evaporation with a Bx under 65º.

According to our experience, if the evaporation and sugar boiling departments operate regularly, and there is sufficient order at the beginning of the work of the pans, so work is not begun using both at the same time, attempting to separate them in time as much as possible; both existing boilers should work at the normal regime.

However, experience shows that these abnormal circumstances present themselves with a certain frequency: due to malfunction of the evaporation, loss of the heat transfer capacity of the metal surfaces due tp salt incrustation; alterations in the order of work in the pans, due to delays or breakdowns in the centrifugals, causing an accumulation of molasses, etc. Taking into account these criteria, we consider Fletcher's proposal of expanding this department with a boiler of 70 Td steam/hour to be correct.

It is known that in order to produce one kg of sugar 3,500-4,000 Kcal/kg are necessary; we shall consider 4,000 Kcal/kg of sugar.

If the yield in sugar were 11% of cane, and starting from tbe present capacity of work at 3,400 short tons of cane per day, in order to compensate the alterations we will have:

(6,400-3,400)x0.9x110x4,000 ÷ 24 = 49,500,000 Kcal/hour
49,500,000 ÷ 750 = 66,000 kg steam/hour.

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Steam at 21 lg/cm^2 and 350ºc has an internal energy of 750 Kcal/kg.

When we analyse the possibility of installing an alcohol plant we will expound the advisability , for the flexibility of the whole, of producing this amount of steam in two boilers.

We consider, that although the installation of two boilers instead of one for the same production is less economical, of the order of 40%, as against the alternative of installing only one boiler; the decision to instal one or two boilers for the possible expansion should be thought over; as with four boilers the flexibility in the work will be greater.

Crystallisers

If we consider that the exhaustion of massacuite C is good at present as for quality,, we may deduce the expansion of the crystallisers basing ourselves on that reality.

Working 3,840 short tons of cane per day, with the bases assumed in the sugar boiling department we shall have a production of massacuite C of 8,526 m^3/h; with a cooling time of 27 hours (which is very ordinary) we shall need a volume of crystallisers of:

$8,526 \times 27 = 230\ m^3$

In the sugar factory there are installed five crystallisers with a capacity of 45.4 m^3 each, in all 227 m^3.

When 6,400 short tons of cane are worked a day, 14.21 m^3/h

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of massacuite C.

With the anticipated cooling time 14.21 x 27 = 383.57 m^3, 383.57 ÷ 45.4 = 8.45 crystallisers.

It will be necessary to instal four new crystallisers like those there are already of 45.4 m^3 and 93 m^2 of heat exchanger surface area.

Magma C

The magma C preparer can prepare 480 ft^3 of magma per hour, equivalent to 13.59 m^3 per hour. As the magma C produced is approximately the same amount as massacuite C, according to our criterion the present amalgamator may serve for the expansion of 6,400 short tons of cane per day.

Electric Station

Installation of one 1,750 kW turboalternator, like the existing ones.

Expansion of switchgear and bus bars.

Miscellaneous

The extension to the electricity distribution equipment has been taken into account to adapt the additional equipment such as:

- Expansion of the fire system.

- Painting of new equipment

- Thermal insulation.

- Expansion of the earthing system.

- Drains.

Balances and Consumptions

The balances included in section 6.1. are made on the basis of 100 tonnes of cane.

Applying the corresponding coefficient the specific balances and consumptions are obtained in this Alternative B.

The quantities resulting are those which have been applied in the valuation of the profitability study of this alternative.

6.3.2. Valuation of Investment "Alternative B" production Capacity 6400 short tons /day (104 days harvest)

Investment Costs	Foreign Currency $	Local Currency $	Total $
Main equipment	3 640,000	399,000	4 039,000
Service equipment	1 000,000	380,000	1 038,000
Various materials	-	991,000	991,000
Freight and insurance	-	510,000	510,000
Interning of equipment	-	233,000	233,000
installation of equipment	-	680,000	680,000
" various material	-	489,000	489,000
Preparation of land	-	130,000	130,000
Civil engineering work	-	588,000	588,000
Licences and Royalties	-	-	-
Engineering	-	425,000	425,000
Management and Owners expenses	-	169,000	169,000
Utilities and eventualities	466,000	464,000	930,000
Total	5 106,000	5,116,000	10 222,000

This alternative "B" assumes that first the investments planned in alternative "A" have been made, so the values here are increases.

SENER

6.3.3 Sugar Factory Alternative "B"

Annual Production Costs as Percentage of Capacity	Annual Amount	Cost/U US $	Foreign Currency	Local Curr.$
Days harvest = 104				
1. Raw materials:				
Sugar cane tonnes	600,000	22.22	-	13 332,000
Additives	-	-	137,000	-
2. Services:				
Electricity (CLES)				
kWh	410,000	-	-	-
Water m^3	165,000	-	-	-
3. Other costs	-	-	-	30,000
4. Equipment maintenance & repair	-	-	57,000	120,000
5. Labour:				
Direct	-	-	-	1 135,000
Indirect	-	-	-	178,000
6. Finance costs (interest)	ACCORDING TO THE TYPE OF CREDIT			
7. Depreciation	10% YEARLY			

SENER

6.4 ALTERNATIVE "C": EXPANSION OF THE WORK CAPACITY OF THE SUGAR FACTORY TO 5,760 tonnes/day (6,400 shprt tons /day) SATELLITE PLANTS

SENER

C O N T E N T S

SENER

3.4 energy Balance
    3.4.1 Energy Balance Panel Plant
    3.4.2 Energy Balance in General for Alternative "C"
3.5 Mass Balance
3.6 Consumption of Process Materials
3.7 Labour Panel Plant
3.8 Land and Buildings

ANNEX to point 3 - "Production of Steam and Electricity for the Panel Plant"

4. Treatment of Waste

6.4.2. Valuation of partial and Total Investment

6.4.3. Partial and Total Production Costs

SENER

6.4.1 Technical Description

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6.4.1 Technical Description

Now we are going to give a technical description of the various satellite plants of the complex in the following order: Sugar Factory, Alcohol Plant, Panel Factory and Waste Treatment.

First some brief considerations are made on the capacity of the alcohol plant in order to consider it with the rest of the complex.

in the terms or reference of UNIDO the installation of an alcohol plant was specified with a capacity of 220,000 l/day, to work 220 days a year.

On making the comments in 2.1 on the feasibility study carried out by Señor Lazarevitch, we have already expressed our judgement on the unadvisability of that alcohol plant of 220,000 l/day.

Nevertheless let us consider the possibility of installing an alcohol plant on the Jiboa Sugar Factory, based on the following hypotheses:

If the production of sugar cane in the area of influence of the sugar factory reaches 900,000 tonnes of cane, and basing ourselves on the study of the alcohol market, deducing that with the alcohol plant of 60,000 l/day which it is intended to instal only a little more than 40% of the needs of El Salvador for mixing with gasoline will be covered; it is logical to think technically in the possibility of installing an alcohol plant of 90,000 l/day coupled to the sugar factory, in which the raw materials

SENER

carrying fermentable sugars, would be treated as follows:

On increasing the work capacity of the sugar factory to 6,400 sgort tons of cane, we could do this in a way so as to increase all the installations up to the purification of juice, and from the purification of juice up to the end of the process of the obtainment of sugar expand only up to 5,000 short tons of cane per day.

In this case, it would be logical to convert the molasse produced in the Jiboa Sugar Factory also into alcohol.

Now we are going to justify the work capacity of the alcohol plant.

The weighted average polarization of the cane worked in the Jiboa sugar factory is 12.66.

The sucrose losses between mills, purification and preparation for fermentation we can estimate at 2.0% of the sucrose of the cane. 1,260 x (12.66 - 2.0) x 0.6 x 10 = 80,589 litres/day.

We can consider that the juice from the 1,260 tonnes (1,400 short tons of cane) will give us 80,000 litres per day of alcohol of 99.5 LG.

The other 10,000 litres/day will be obtained from the molasse produced in the sugar factory.

During the harvest we shall use every day the following amount of molasse.
10,000 x 3.3 = 35 tonnes of molasse per day.

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The rest of the characteristics of the alcohol plant are described in the relevant section of this point.

Lastly we should like to emphasize that in section 3.4.2 of point 6.4.1 we make a general balance of the energy of Alternative "C" complete.

We have preferred to include the balance at that point, so that the situation of the main fuel of the alternative is clearer.

SENER

1. Expansion of the Sugar Factory

In order to make the financial estimate of the expansion to the sugar factory in the part only corresponding to sugar, in this alternative, we have followed the following criterion.

From the unloading of cane, up to the evaporation. excluded, as in alternative "B".

From the evaporation, included, up to the bagging of sugar, as in Alternative "A".

In order not to repeat ourselves we shall not extend ourselves on these two points.

Belo we make a brief explanation of the installations different from those of Alternatives "A" and "B".

Boiling

In order to meet the needs of the alcohol plant, the steam we are going to need is 3.7 kg steam/litre of alcohol produced, which is 13,875 kg/hour; as for the expansion of the sugar factory we need a boiler of 45 Td/h, in all we will need a boiler of 60 Td/hour.

In order to meet in a more rational manner the work of the alcohol ĺant when the harvest finishes, and the molasse produced in the sugar factory will have to be converted, we consider it advisable, instead of installing one boiler of 60 Td/h, to instal two+ one of 45 Td/h and the other of 20 Td/h, which would be that operating on cane trash or Fuel Oil, when the harvest finishes.

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Electricity Generating Station

Installation of a turboalternator set of 1,750 kW

Balances and Consumptions

The balances included in section 6.1 are based on 100 tonnes of cane.

Therefore, by applying the corresponding coefficient the specific balances and consumptions of Alternative "C" are obtained.

The quamtities resulting are those which have been applied tothe valuation of the profitability study of this alternative.

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2. ALCOHOL PLANT OF 90,000 l/d

SENER

2.1 OBJECT

In this chapter a description will be made of an ethyl alcohol producing plant by fermentation for use as motor fuel of capacity 90,000 l/d.

the plant will consist of the following units:

- Storage of Molasse
- Preparation of Musts
- Fermentation
- Distillation and Rectification
- Dehydration
- Storage of finished product

The new alcohol plant will form part of a project joining the new units with a sugar factory 6existing and expanded) from cane situated in JIBOA (El Salvador).

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2.2 TECHNICAL BASIS

The starting data are the following:

a) The plant will use as the design basis and as feed raw material for the manufacture of alcohol, a mixture of ordinary products of JIBOA during the harvest :80,000 l/d come from the purified juice produced by 1,260 tonnes of cane, and 10,000 l/d come from the molasse produced by the sugar factory.

The characteristics of the juice are:

Brix of purified juice	B_x= 17.00
Polarization of purified juice	Pol=12.85
Purity	P=75.59
Density	d=1.07kg/l

The characteristics of the molasse are:

Brix of molasse	B_x=85.85
Polarization of molasse	Pol= 27.90
Purity	P=32.50
Density	d= 1.45 kg/l

With this mixture the plant will operate for 156 days. Alternatively the plant will operate for 83 days outside the harvesting season with molasses of the characteristics previously described at 100% design cvapacity.

With these two forms of feed, and making the following assumptions we will have:

1,200 Tonnes cane/day will produce 80,000 l alcohol/day

i kg sucrose = 0.6 l alcohol

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80,000 ÷ 0.6 ÷ 0.1285 = 1,037,613 kg juice / day
3.5 kg molasse = 1 l. alcohol

Case 1

80,000 l. alcohol/day of juice and 10,000 l/d of molasse during the harvesting season which is 156 days correspond to:

1,037,613 kg/day ÷ 24 = 43,234 kg/hr of juice
35,000 kg/day ÷ 24 = 1,458 kg/hr of molasse.

Case 2

90,000 l/d of alcohol from lolasses corresponding to

90,000 x 3.5 = 315,000 kg. molasse/day = 13.125 kg. molasse/hr

b) Alcohol Produced

A nominal production of 90,000 l/d is desired, of anhydrous alcohol with a minimum purity of 99.5% LG, and suitable for use as an additive up to 20% of motor fuel.

As due to the characteristics of the process alcohols of low degrees or other products will be produced, these will preferably be added directly in the battery limit of the plant to the dehydrated alcohol produced as long as the specifications imposed are met.

SENER

c) Yeast

The separation and net production of yeast is not desired in the plant as a product. Hpwever, it is aimed to recover and recycle a part of the yeast produced by fermentation in order to improve the net output of alcohol.

Any excess yeast produced (which will be minimised) will be thrown directly away with the plant effluent.

d) Services Available

in order to provide a frame for the valuation or estimate of this plant it is assumed that at the limit of the unit the following services are available:

- Water vapour. Two levels of pressure available.

Medium pressure	21 kg/cm^2
exhaust steam	1.5-2.5 kg/cm^2 saturated

- Condensate. the recovery of clean condensate for reuse in steam generation will be maximised as far as possible.

- Cooling Water. A closed circuit of water will be used, adding water losses from the well.

Pressure of supply	Sufficient
Temperature of supply	30ºC

- Process Water. As dilution water, well water will be used.

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Pressure of supply	Sufficient
Temperature of supply	30ºC
Characteristics	Potable

- Instrument air

Pressure	6 kg/cm^2
Temperature	40ºC ,max
Dew point	-30ºC

- Electricity

  Motors over 1 hp 440 V, 3 phase 60 HZ

  Lighting and services 220V 1 phase 60 Hz

  Control and Instrumentation 220 V 1 phase 60 Hz

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2.3 DESCRIPTION OF THE UNITS OF THE PLANT

SENER

2.3.1 Introduction

When at SENER we raised the question of including in this study a description of an ethyl alcohol production plant by fermentation for motor fuel of 90,000 l/d capacity, it was considered a priority to adopt the units of the plant which in our judgement are the most suitable for the place it is to be located, JIBOA (El Salvador). According to this, it was decided to propose discontinuous rather than continuous fermentation.

We decided this for the following reasons:

1) It obtains a higher alcohol yield.

2) In bad operation losses are less.

3) Easier to handle.

4) Needs less skilled workers.

5) It is more proven.

6) Other substances than sugar cane may be used, such as maize, sorghum, etc.

7) As a disadvantage, more labour is needed than for continuous fermentation, but we think that in Salvador the wage cost per man is not comparatively high, and the taking of this decision more than justifies the above advantages.

Lastly, we should also like to emphasize here two points: first, that continuous fermentation is at present beginning to be installed and we are not in favour of advising that installation for El

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Salvador, as although :he first plants installed are operating correctly, they need retouching, changes and/or control changes which advise their installation in countries which can make these changes quickly and economically; second it to insist that the production process of ethyl alcohol through the enzymatic decomposition of starch os feasible in countries where there are sufficient quantities at prices lower than the products of cane or beet (yucca, sorghum, manioc (cassava),etc) and in addition, in the case of sorghum it needs soil of a poorer quality , so it is not very adventurous to predict that whenthe technology is contrasted and tested, ethyl alcohol will be obtained by this means profitably, and it is easier to use a discontinuous fermentation unit than a continuous one.

As for the chilling of the fermentation vats, we decided to propose the installation of forced cooling by means of the recirculation of the fermented must through a plate heat exchanger ensuring the appropriate fermentation temperature at maximum yield.

For the distilling, we thought that it was better to install avacuum functioning unit, as its installation is common over all parts pof the globe, not presenting any porobleme and, to the contrary, a considerable energy saving is is obtained not only in raw materials but also in the need to install smaller boilers with the following saving of investment.

Inside the distillation unit it was also thought the project it in the open air or inside a building, we opted for the second solution as the first would mean that the equipment would have to be movable and we think that with stainless steel equipment in the installation and the design conditions (e.g. wind speed,etc,) it would be more economical tominstal them inside a building.

Lastly we should like to emphasize that we have thought of a plant of great versatility so it can operate with only cane juice, a mixture of currents of juice and molasse, and also molasse only at 100% capacity.

Having said all this we shall now describe the units making up the plant one by one.

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2.3.2 Storage of Molasse

2.3.2.1 General

in order to calculate the storage of molasse let us make the following considerations:

Sugar cane production	900,000 tonnes
Milling capacity	5,670 tonnes/day
Days of harvest	156 days

1,260 tonnes/day for alcohol production and
4,500 tonnes/day for sugar production.
1,260 tonnes x 156 days = 196,560 tonnes of cane for alcohol production, then remain 703,440 tonnes of cane for sugar production. Assuming we obtain 4.5% kg of molasse for every 100 kg of cane we will have:
703,440 tonnes x 0.045 = 31,655 tonnes of total molasse per year.

During the harvest we consume 35 tonnes/day x 156 days = 5,460 tonnes

31,655 tonnes - 5,460 tonnes = 315 tonnes/day
which assumes a duration of 83 days with the distillery functioning 100% on molasses.

2.3.2.2 Definition of Storage Tanks

Quantity of molasses to store 26,195 tonnes
Density = 1.4, which gives 18,711 m^3

As there is a molasse storage tank of 1,890 m^3, we propose to make a dump with tanks of two sizes.

SENER

1 set of 4 tanks of 3,000 m^3	12,000 m^3
1 set of 4 tanks of 1,890 m^3	7,560 m^3
Total	19,560 m^3

2.3.2.3 List of Equipment

R-101 4 molass storage tanks of capacity 3,000m^3 with conical top and flat bottom in carbon steel.

R-102 3 molasses storage tanks of capacity 1,890 m^3 with conical top and flat bottom, in carbon steel.

P-201 A/B Molasses pump, volumetric type of 14,000 kg/hr for transfer of molasse from tanks R-101.

P-202 A/B Molasse pump, volumetric type of 14,000 kg/hr for transfer of molasse from tanks R-102

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2.3.3 Preparation of Musts

2.3.3.1 Description of the Process

2.3.3.1.1 Treatment of Molasse.

The molasse from storage, first is preheated in R-301, in order to facilitate its passage through the volumetric meter, later the predilution of the molasse is effected and a flocculation aid is added, in order to favour the formation of flocculi, heating and acidification takes place in R-307, maintaining a time of one hour there.

the molasse is clarified in S-308; the sludge produced is washed and decanted into a hydrocyclone in order to recover the sugar. The washing liquid is reinjected into the circuit.

The clear liquid is adjusted for pH with ammonia water and is rediluted to achieve the right concentration and sterilisation is effected at 105ºC for 5 minutes. Then it is taken to the fermentation section.

2.3.3.1.2 Cane Juice

As the cane juice has already been clarified, it is only subjected to a pH adjustment and sterilisation at 105ºC.

2.3.3.2 Balance of Matter and Energy

SENER

2.3.3.3 Equipment List

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2.3.3.3 Equipment List

R 301 — Molasse Preheating Tank. Construction AISI 304. Vertical cylinder type. Design pressure: 1.5 kg/cm^2.

R 302 — Molasse Pre-Dilution Tank.

R 303 — Construction AISI 304, Vertical cylinder type, Design pressure: 1.5 kg/cm^2.

B 305 — Flocculation Aid Dilution Tank. VConstruction AISI 304. Vertical cylinder type. Design pressure: 1.5 kg/cm^2.

B 306 — Sulphuric Acid Tank. Construction carbon steel. Vertical cylinder type.

R 307 — Maturation Tank. Construction AISI 304. Vertical cylinder type. Design pressure 2 kg/cm^2.

B 310 — Sludge Treatment Tank. Construction AISI 304. Vertical cylinder type.

S 309 — Hydrocyclone - Secondary Decanter. Construction AISI 304. Vertical conical cylinder type. Design pressure: 2 kg/cm^2.

B 312 — Diluted Molasse Intermediate Tank. Construction AISI 304. Vertical cylinder type. Design pressure: 1.6 kg/cm^2.

B 311 — Continuous Molasse Diluter. Construction AISI 304. Vertical cylinder type. Design pressure: 1.4 kg/cm^2.

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B 313	Ammonia Water Tank. Construction AISI 304. Horizontal cylinder type. Design pressure: 1.4 kg/cm^2.
E 314	Steriliser. horizontal type.Construction AISI 304. Design pressure: 3 kg/cm^2 absolute.
E 315	Must Cooler. Construction AISI 304 and 316.
E 313	Plate Heat Exchanger. Construction AISI 316 with carbon steel rack. S-40 m^2.
S 308	Centrifugal Separator. Flow Rate: 60 m^3/h Motor power 36 hp tropicalised.
P 301 A/B	Two pumps for prediluted molasses. Volumetric type, Constructed in carbon steel, stainless steel shaft. Tropicalised motor. Flow rate : 20 Tonnes/ h.
P 307 A/B	Two centifugal open turbine pumps for prediluted molasses. Flow rate: 40m^3/h Material of stainless steel. Tropicalised motor P33.
P 310 A/B	Two Sludge Pumps. Open turbine centrifugal type. Flow rate : 6 m^3/h.
P 312 A/B	Two pumps for Diluted Molasses. Open turbine centrifugal type. Flow rate: 60 m^3/h.
FIT	Totaller indicator of Raw Molasse.
TIC	Temperature Controller in * R 301 * E 314

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TRC	Temperature Controller and Recorder in * R 307
FIC	General Flow Rate Controller of the Installation
PHIC	pH Controller in: * R 301 * B 312
LS	Level Sensor; * R 301 * B 306
TI	Temperature Indicator * B 310 * E 315
FI	Flow Rate Indicator. * Water to R 303 * In water to dilution H_2SO_4. * Water to B 305 * In H_2SO_4. * Water to B 311 * Outlet P 307 A/B * H_2SO_4 to B 310 * Water to B 310
PI	Pressure Indicator in: * S 308 * E 314
1	Control Panel

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2.3.3.4 DIAGRAM OF THE PROCESS

SENER

2.3.4 Fermentation and Recovery of Yeast

2.3.4.1 Description of the Process

2.3.4.1.1 Discontinuous Fermentation Section

In thie section fermentation of the raw material takes place. The system used is discontinuous. It consists of 8 vats working in parallel. Each vat is supplied with yeast sediment and sugared must and is cooled by plate heat exchangers (one for every two vats) - to reduce its temperature to 34ºC.

This section is completed by a central vat functioning continuously, where the yeast sediment needed for fermentation is produced. A system of pure cultivation can makes it possible to change the yeasr whenever necessary.

2.3.4.1.2 Yeast Recovery Section

When the fermented must is taken to the yeast recovery section, it is centrifuged there. The clear part serves as raw material for the distillation section and the cream of the yeast is washed in twice its volume of water, air and sulphuric acid is added and it is centrifuged again. The clear part returns to the must tank without yeast, as it contains alcohol, and the cream of the yeast is treated in a tank with sulphuric acid, water and air, before sending it to the main vat.

2.3.4.2 Balance of Matter

SOME FIGURES OF THIS DOCUMENT ARE TOO LARGE FOR MICROFICHING AND WILL NOT BE PHOTOGRAPHED.

SENER

2.3.4.3 Equipment List

SENER

2.3.4.3 Equipment List

2.3.4.3.1 Discontinuous Fermentation Section

R 405	Pure Cultivation Can. Vertical cylinder type. Constructed in AISI 304.
R 414 R 413	Hydraulic seals. Carbon Steel Volume: 200 litres
R 401 to R 408	8 fermenting vats. Cylinder type.Vertical. Flat bottom. Conical cover. Construction carbon steel. 200 m^3 capacity.
B 401 to B 408	8 hydraulic seals. Carbon steel construction. Volume: 200 litres.
E 401 to E 404	4 plate heat exchangers. One for each two vats. Construction AISI 304. Volume 25 m^3.
R 400	Central or main vat. Vertical cylinder type. Construction stainless steel AISI 304. Volume 25 m^3.
B 409	Hydraulic seal. Froth separator. Volume: 200 litres. Const ruction in carbon steel.
c 407	CO_2 washing column. Vertical cylinder type. Construction AISI 304.
P 408 A/B	2 blowers. Roots type Flow rate: 200 Nm^3/h.
S 409 A/B	2 filters for Roots blowers
P 400 A/B	2 Open turbine ventrifugal pumps. Flow rate 10 m^3/h. For yeast sediment.
P 401 A/B to P 408 A/B	16 pumps for must extraction. Flow rate 100 m^3/h. Open turbine type.
B 416	Antiseptic Tank
P 314	Anti froth pump
B 317	Anti Froth Tank
	1 Tank for the adjustment of the pH of the must. Capacity: 20 m^3. Constructed in Carbon steel. Vertical cylinder type.
	1 tank for sulphuric acid. Capacity 600 litres. Made of plastic. Vertical cylinder type.

SENER

1 tampon tank for unfermented must. Capacity 100 m^2.
Carbon steel construction.Vertical cylinder type.

2.3.4.3.2 Yeast Recovery Section.

B 407	Intermediate Tank for fermented must. AISI 304 and Carbon steel.
B 408	Must Tank without Yeast. AISI 304 and Carbon steel.
B 411	Water Pressure Tank. AISI 304 and carbon steel.
B 412	Hot water AISI 304 and crabon steel.
B 409	Cream of yeast tank
R 409 and R 410	Cream of Yeast tank
R 411	Cream of yeast tank
P 407 A/B	2 normal centrifugal pumps. Flow rate 20m^3/h
P 410 A/B	2 normal centrifugal pumps. Flow rate 7 m^3/h.
P 411 A/B	2 normal centrifugal pumps. Flow rate 20m^3/h. Open turbine.
P 412 A/B	2 normal centrifugal pumps. Flow rate 4.5m^3/h.
P 414 A/B	2 open turbine centrifugal pumps. Flow rate 20 m^3/h.
P 415 A/B	2 centrifugal pumps open turbine. Flow rate 2m^3/h.
S 402 A/B S 403	2 centrifugal separators. Flow rate 20 m^3/h
S 401	1 screen of rotary brushes. Flow rate 20m^3/h.
FI	7 flow rate indicators
PI	7 pressure indicators
TI	1 temperature indicator
NI	6 flow rate indicators
PHI	1 pH indicator
	1 set of pneumatically operated motorised valves.
	1 panel.

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2.3.4.4 Diagrams of the Process

SOME FIGURES OF THIS DOCUMENT ARE TOO LARGE FOR MICROFICHING AND WILL NOT BE PHOTOGRAPHED.

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2.3.5 Distillation-Rectification and Dehydration

2.3.5.1 Description of the Process

The fermented kust from the yeast recirculation section goes into the wine heater E 516, where its temperature rises up to 50-55ºC and in order to reduce the use of steam in column C510 or the shredding column the hot must is passed through E525, calorie recuperator, through interchange with other sediment from column C580 (benzene recovery column). This sediment has a temperature of 133ºC.

The hot must passes to column C510, the mashing column, where it loses a great part of the water it contains under the form of sediment which comes out the fo t of the column.

At the top of the column, a part of the alcohol vapours is extracted to degas the raw materials and they are condensed in E 515, using this condenser the column C 510 is connected to the vacuum system.

The column to work in double effect with column C520 (rectifying column) functions under a vacuum. which makes it possible to have an average temperature in the whole column of the order of 80ºC, which is below the precipitation temperature of calcium sulphate, and therefore the column does not get incrusted, besides, to decrease this risk of incrustations the plates of the column are capsules.

The centre alcohol comes out laterally, some plates below the top of the column, in the form of vapour and is condensed in : E 516, E 517 A/B and E 518A/B, the condensates conctitute the feed of column C 520 or the rectifying column. These condensates, before entering column C520 pass through the heat exchanger E 528 where their temperature increases, to reach their boiling

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point at the operating pressure of column C520 (1.8 kg/cm^2 abs).

The double effect operation of column C510 with column C520 permits the heating of the first by the condensation of alcohol vapours produced by the second, using as an intermediary the boiler E 510 operating at a vacuum and column C 520 at pressure.

In column C520, the alcohol is subjected to rectification in order to rectify its strength to 96.3 ºGL, and remove the impurities which mught hinder the functioning of the dehydration section.

At the foot of column C520 the sediment comes out at a temperature of 117ºC and they are used to reheat the supply of C 520 by E 528 and later they are subjected to flash evaporation in order to produce vapour for the degassing part of column C 510 and thus finish heating the raw material until its boiling point. Lastly the sediment is introduced at the level of B 510 for the production of vapour in E 510.

The centre alcohol coming out of column C 520 is extracted laterally some plates below the top of the column,. in the liquid phase (the output degree is controlled by a TRC, temperature recorder.controller) and is taken directly to column C 570 or the dehydrating column.

From column C 520 also Fusel oils are extracted which decant into S 536.

The vapours issued at the top of the column are condensed in E 510-E511 A/B. E510 being the boiler of E511 this boiler is of descending flow with a recirculation pump. the vapour is produced by the sediment introduced at the level of B 510, a pump

SENER

makes possible the recirculation of liquids. The sediment used is that of the C 520, having no vontact with the sediment boiler of column E 510, which are the most corrosive.

The condensates produced in E-510-E-511 A/B constitute in part the backflows of the column C 520 and in part the removal of heads

Both the removal of fusel oils and heads are carried out so as not to hinder the operation of the dehydration department, especially at the level of the azeotrope decanter. But taking into account that the dehydrated alcohol produced will be used as an additive for gasoline, it is planned to mix these extractions later with the alcohol.

The alcohol from column C520 passes directly to colum C 570 or the dehydration column. This column, in addition to the intake of rectified alcohol, has a benzene inlet or cyclohexane from the recovery column and an inlet of pure driver for entry into service or to replace the driver used up in time.

The dehydrated alcohol comes out the foot of Column C 570, cools in E 571 and is taken to storage.

The vapours given off by the top of the column are condensed in E 575 and E 576 and are returned to C 570 in their totality. The alcohol vapours which could get out through breathing condensers are washed in C 581 and C 582 successively with dehydrated alcohol and water, fluids which are returned to the process.

At the top of column c 570, there is a decanter where the two levels separate producing the azeotrope reintroducing

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the heavy one into the same column C 570 and the light one being taken to column C580, recovery column.

Columns C 570 and C-580 function in double effe ct, column C 580 heating Column C 570.

in column C 570 the driver is recovered and the alcohol it contained, removing the water at the bottom of the column in the form of sediment (this sediment is used in E 525 to reheat the raw materials.).

The vapours given off by column C 580 at the top are used to heat column C 570 , by the boiler E 570, the condensates produced are divided into two, one part constitutes the backflows of C 580 and the other part constitutes the power supply in the column C 570.

For both columns to work in the double effect. it is necessary for column 580 work at presure column C 570 at atmospheric pressure.

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2.3.5.2 Balance of Matter and Energy

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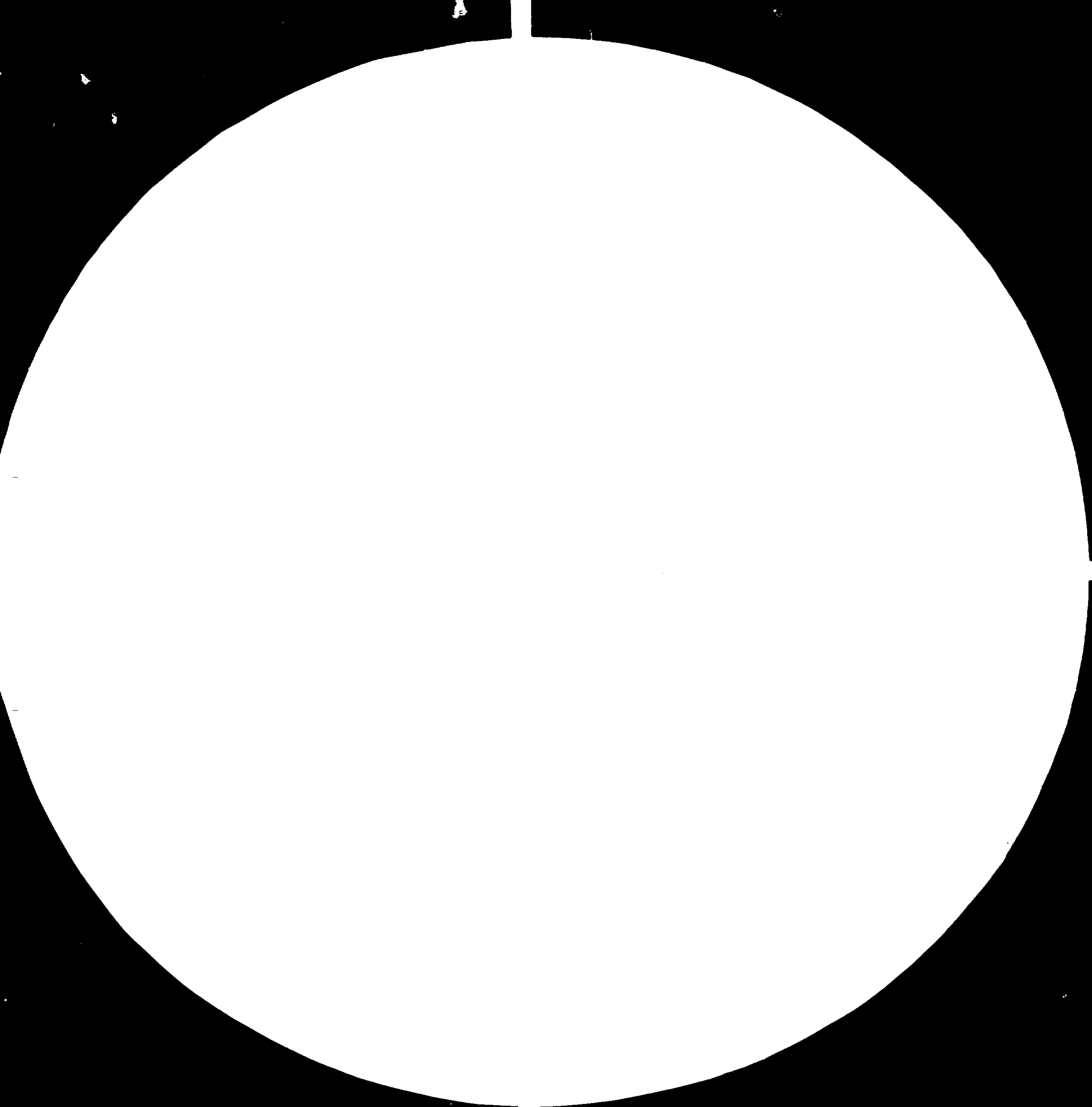

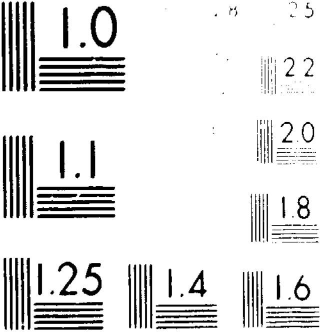
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2.3.5.3 Equipment List

2.3.5.3.1 Rectification Section

C 510 Shredding column. Construction AISI 316 with capsule plates. Design pressure, absolute vacuum.

c 520 Rectifying column. Construction AISI 316 and copper, exhaustion plates and concentration plates. Capsule plates. Design pressure: 3 kg/cm^2 abs.

C 501 Gas washing column. Construction AISI 316. Fill. Design pressure, absolute vacuum.

E 516 Wine heater. Construction AISI 316 and AISI 304. Multipass horizontal type. Shell design pressure, ansolute vacuum.

E 517 A/B Condenser complement. Construction AISI 304 an AISI 316. Multipass horizontal type. Design pressure, absolute vacuum.

E 513 A/B Duty condenser C 510. Construction AISI 316 and AISI 304. Vertical type. Design pressure absolute vacuum.

E 510 Boiler c 510. Construction AISI 304 and AISI 316. Vertical descending flow type. Design pressure, absolute vacuum.

E 515 Degassing condenser C 510. Construction AISI 316. Vertical type. Design pressure, absolute vacuum.

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E 511 A	Complement condenser C 520. Copper construction. Horizontal multipass type. Design pressure 2.5 kg/cm^2
E 511 B	Duty condenser C 520. Copper construction Vertical type. Design pressure 2.5 kg/cm^2.
E 525	Calorie Recuperator of the sediment of column C 580, by exchange with supply. Horizontal multipass type. Design pressure 2.5 Kg/cm^2
E 528	Juice Heating Supply C 520 by sediment C 520. Multipass horizontal type. Design pressure 2.5 kg/cm^2.
S 536	Fusel Oils Decanter. Construcation AISI 316 Vertical type. Design pressure 1.5 kg/cm^2.
B 521 B 522	Constant level tanks. Construction AISI 316 Horizontal type. Design pressure 1.5 kg/cm^2.
B 510	Vapour separator E 510 from C510. Construction AISI 316. Vertical (Cyclone) type. Design pressure absolute vacuum.
B 511	Barometric column. Construction AISI 316. Vertical type. Designpressure 1.8 kg/cm^2.
B 512	Flash tank for calorie recovery. Vertical type. Construction AISI 316. Design pressure, absolute vacuum.
B 501	Cyclone for preparation of froth of C 510 and E 516. Design pressure, absolute vacuum.
P 501 A/B	Liquid ring vacuum pump. All bronze construction. Anti-explosion motor. Absolute p

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	pressure 160 mm Hg. Flow rate 500 kg'h. Power 30 hp.
P 510 A/B	Recirculation pump, boiler E 510. all stainless steel construction. With anti-explosion motor. Accelerated type. Flow rate 20 m^3/h Power 20 hp.
p 511 A/B	Backflow pump C 520. All stainless steel construction. Anti-explosion motor. Self-suction pump type. Manometric head 20 m. Flow rate 35m^2/h Power 20 hp.
P 512 A/B	Feed column C 520. All stainless steel construction. Explosionproof motor. Self-suction type of pump. Manometric head 20 m Flow rate 10 m^3/h. Power 4 hp.
P 522 A/B	Degassing recirculation. All stainless steel construction. Explosionproof motor. Self-suction pump type. Manometric head 10 m. Flow rate 2m^3/h. Power 1 hp.
FIC	1 flow rate indicator and controller for the heating steam of C 520, with valve (carbon steel body, internals of stainless steel). Pneumatic to panel type.
PIC	1 vacuum indicator and controller to maintain vacuum in C 510, with automatic valve (carbon steel body, stainless steel internals). Pneumatic to panel type.

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FRC	1 Flow rate recorder and controller for raw material, with stainless steel valve. Pneumatic to panel type.
TRC	1 temperature recorder and controller for differential temperature to maintain constant strength in the outlet of alcohol from C 520, with stainless steel automatic valve. Electropneumatic to panel type.
LIC	1 level indicator and controller to maintain level of liquid at foot of C 520, with stainless steel pneumatic valve. Pneumatic to panel type.
PI	Vacuum indicator in C 510.
PI	Pressure indicator in C 520
TR	Temperature recorder in 12 directions (common with the dehydration section). * Exhaustion c 510 * Exhaustion C 520 * Outlet water E 515 * Outlet water E 517 A/B * Outlet water E 511 A/B * Outlet water column C 501
TI	Load column C 520
FI	Local type flow rate indicator. * Raw material * Degassing * Water C 501 * Feed C 520 * Heads C 520

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* Outlet alcohol C 520
* Outlet oils C 520
* Backflows C 520

PIC 1 pression controller to maintain pressure in C 520 with an automatic valve (carbon steel body, and stainless steel internals). Pneumatic to panel type.

1 Control Panel

NOTE:
All motors in this section will be tropicalised.

2.3.5.3.2 Dehydration Section

C 570 Dehydration column. Construction AISI 304. 70capsule plates. Design pressure 2 kg/cm^2.

C 580 Benzene recovery column. Construction AISI 304. 30 capsule plates. Design pressure 4.5 kg/cm^2.

E 575 Main condenser C 570. Multipass horizontal type. Construction AISI 304. Design pressure 1.3 kg/cm^2.

E 576 Duty condenser column C 570 Vertical type. Construction AISI 304. Design pressure 1.8 kg /cm^2.

C 570 Boiler C 570 - First condenser C 580. Thermo-siphon vertical type. Construction AISI 304. Design pressure 4.5 kg/cm^2.

E 571 Alcohol refresher vertical type. Construction

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	AISI 304. Liquid-Liquid heat exchanger. Design pressure 2 kg/cm^2.
C 581 C 582	Alcohol vapour washing columns. Fill type. AISI 304. Design pressure 1.5 kg/cm^2.
B 571	Constant alcohol recirculation tanl.AISI 304. Design pressure 1.5 kg/cm^2.
B 570	Cyclohexane or benzene tank. Horizontal cylinder type. Construction AISI 304. Design pressure 1.5 kg/cm^2.
P 571 A/B	Alcohol extraction pump C 570. All stainless steel. With explosionproof motor tropicalised. self.suction type. HMT 15 m Flow rate 6 m^3/h Power 2 hp
P 572 A/B	Pump feeding C 580. Stainless. Tropicalised explosionproof motor. Sel-suction type HMT 30 m Flow rate 5 m^3/h Power 4 hp.
P 573 A/B	Cyclohexane or benzene feed pump. All stainless construction. Tropicalised explosionproof motor. Self suction type. HMT 15 m Flow rate 500 l/h power 2 hp.
P 575 A/B	Backflow pump C 570. All stainless steel construction. Rropicalised explosionproof motor. Self suction type. HMT 15 m.
P 570 A/B	Backflow pump C 580. All stainless steel costruction. Tropicalised explosionproof motor. Self suction type HMT 15 m Flow rate 10 m^3/h Power 4 hp.

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PIC	ressre indicator controller to maintain pressure in C 580. With automatic valve (carbon steel body, stainless internals). Pneumatic to panel type.
TRC	1 temperature recorder controller to maintain the strength at the outlet of the azeotropic mixture from C 570, with stainless valve. Pneumatic to panel type.
FIC	1 flow rate indicator controller for heating steam from C 580, with automatic valve (carbon steel body and stainless steel internals). Pneumatic to panel type.
FIC	1 flow rate indicator controller for the heating steam of C 570, with automatic valve (carbon steel body, and stainless internals). Pneumatic to panel type.
LIC	1 level indicator controller for outlet of sediment from C 580, with automatic valve (stainless). Pneumatic to panel type.
FI	Rotameters indicators of flow rate. * Inlet of benzene or cyclohexane * Backflow of C 570 z Backflow of C 580 * Outlet of alcohol * Feed C 580 * Return benzene or cyclohexane to C 570

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2.3.5.4 PROCESS DIAGRAMS

SOME FIGURES OF THIS DOCUMENT ARE TOO LARGE FOR MICROFICHING AND WILL NOT BE PHOTOGRAPHED.

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2.3.6 Storage of the Final Product

2.3.6.1 Technical Description

A storage capacity of alcohol has been anticipated the quality of which corresponds to that specified, of 3,000 m^3 capacity, equyivalent to a month's nominal production, distributed in two vertical A.P.I. type tanks.

The small amounts produced of fusel oils and heads will be added directly to the product,. and there is no storage planned for these products.

Neither have any installations been planned for denaturalization of the product before dispatch, as explained before, it will be mixed with fusel oils and heads.

The product will be dispatched in lorry tankers, for which a loading installation with two pumps has been provided for (one pump inreserve) of 50 m^3/h, unit capacity.

Alcohol produced outside the sale specifications will be stored in two rejection tanks of 60 m^3 capacity. This product will be recycled to the peocess for redistillation.

2.3.6.2 Equipment List

R 601
R 602 Two storage tanks for dehydrated alcohol, API type. Capacity: 1,500 m^3. Conical top, flat bottom. Constructed in carbon steel.
With the following accessories:

* upper and lower access holes
* Alcohol intake and outlet holes.

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* Cooling and fire system
* Lightning conductor system
* Ladder and railing
* Safety valve system
* Sufficient respiration system fot product.

R 603
R 604 Two reject alcohol tanks, API type, conical top, flat bottom. Constructed in carbon steel. With the same accessories as the two previous tanks.
dia. 4,000 mm - H 5,500 mm.

P 601 A/B Two centrifugal pumps. Flow rate: 50 m^3/h. Differential pressure: 2 kg/cm^2 Material: carbon steel. Motor: electric 7 hp.

P 603 One centrifugal pump: Flow rate 2 m^3/h Differential pressure 2 kg/cm^2. Material carbon steel. Motor 2 hp

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2.3.7 Characteristics of Wastes and Residues of Manufacture

In the distillation-rectification and dehydration unit the main waste products are:

- Sediment (vinazas) from column C 510 ·46786 kg/hr with a DB05 of the order of 15,000 20,000
- Sediment from column C 520 5073 kg/h
- Sediment from column C 580 3848 kg/h
- Uncondensables from the vacuum column
- Head and fusel oils, which in this case will be mixed with the dehydrated alcohol.

I.e. that in the distillation columns we obtain sediment with the following characteristics:

Flow rate Q = 45-55 m^3/h
Temperature T = 84ºC
Concentration % solids 8% min 10% max.

Sediment is also obtained when the distillery operates only with molasses in the preparation of musts which may be of the order of 9 m^3/h with 50% solids and a temperature of 60ºC.

Therefore, we shall take as design figures for the processing of the sediment the following:

Flow rate Q = 50-55 m^3/h
Temperature T = 84ºC
Concentration % solids = 8% min 12% max

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2.3.8 Consumptions

2.3.8.1 Steam Consumption

- 3.17 kg/l of alcohol 99.5º GL is the steam consumption in the distillation-rectification and dehydration unit.

- 0.50 Kg/l of alcohol 99.5º GL is the steam consumption in the preparation of must unit, which goves an overall consumption of 3.67 kg/l of alcchol 99.5º GL.

In general when we talk of alcohol produced we refer to alcohol 99.5º GL = P.A. (pure alcohol)

2.3.8.2 Cooling Water Consumpt.on

-In the must preparation unit
4.49 m^3/100 l. P.A. of 30º

- In the fermentation unit:
5.45 m^3/100 l. P.A. of 30º

-In the distillation-rectification and dehydration unit:
10.1 m^3/100 l. P.A. of 30º
As it is not planned to use the water in series between fermentation and distillation, the overall consumption will be:
20.04 m^3/100 l. P.A.

2.3.8.3. Process Water Consumption

When the distillery is operated at 100% with molasses the consumptions are as follows:

Preparation of musts:
6.19 l. water/l P.A/

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Fermentation
2.10 l. water/l. P.A.

distillation-rectification, dehydration
0.05 l. water/l. P.A.

Which gives an overall consumption of
8.34 l. process water /l. P.A.

2.3.8.4 Sulphuric Acid Consumption

The consumption of sulphuric acid will be of the order pf 0.08 kg/l. P,A. in the case of only processing molasses as with cane juice it would be a lot less.

2.3.8.5 Ammonium Phosphate Consumption

The consumption of Ammonium Phosphate will be of the order of 1.7 kg/Hl. P.A.

2.3.8.6 Consumption of Instrument Air

The consunption will be of the order of 1 m^3/Hl. P.A.

2.3.8.7 Consumption of Driver

The consumption will be 0.096 kg/Hl. P.A.

2.3.8.8 Consumption of Anti-Frothing Agent

The consumption of the anti-frothing agent is 0.23 kg/HlP.A..

This consumption refers to antifrothing agent based on cocnut oil and dissolved at 5%.

2.3.8.9 Consumption of Electricity

The consumption of electricity will be 6.14hp/Hl. P.A.

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Certain consumptions such as:

* Sulphuric acid
* Nutritive salts
* Anti-frothing agent

depend exclusively on the type of raw material used and the own characteristics of the raw material used. In order to give the definitive consumptions it is absolutely necessary to obtain representative samples of the various raw materials to be processed.

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2.3.9 Brief Description of the Technical Specifications

The distillation and preparation of musts buildings will be closed in and with metal structures, and the fermentation building open with a roof for protection from the rain.

One must emphasize that the classification of the distillation area should be fireproof, therefore having to meet the requirements imposed by the said classificatopn as regards the equipment and materials installed in it.

The Plant will be protected against fire by means of a loop of pipes and valves under pressure, being so designed that any point can be attacked from two sides., a loop which will be connected to the general fire system of the sugar factory.

The columns of the distillation-rectification-dehydration section and the steam pipes will be thermally insulated.

The tanks, pipes, storage tanks . will receive a coat of primer and two coats sh on painting.

The laying of electrical cables will be underground whenever possible.

An earth installation in the plant will be made and the unit will be protected from lightning.

Lastly an alarm system with a panel will be designed to warn of incorrect actions and failures of the electrical system.

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3. Cane Trash Panel Plant

3.1 Untroduction

This study refers to the installation of a plant producing agglomerated particle board, from sugar cane trash, which reaches the factory with a humidity of 48% (above damp).

The union between the fibrous particles is achieved by means of urea formaldehyde resin, but if it were wished to produce panels with special characteristics, other substances could be used, such as phenol-formalin, without special problems.

Basic data:

- Production: 60,000 tonnes/year for 16 mm panel
- Average density of panel: 650 kg/m^3
- Working days: 314 days/year
- Shifts: three eight hour shifts daily
- Theoretical daily production: 191 tonnes/day
- Efficiency coefficient: 0.95
- Daily design production: 200 tonnes/day for 16 mm panel
- Types of panel to be produced: Thicknesses 16 mm, 19 mm and 22 mm
- Other production:

For 19 mm: 64,700 tonnes/year
For 22 mm: 65,600 tonnes/ year

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- Dimensions of panels: 1,220 x 2,440 mm
- Physical characteristics: according to DIN Standard. 68 761

3.2 Production Plan

The production of 60,000 tonnes/year of finished panels, calculated for the 16 mm thickness and a density of 650 kg/m^3 will be obtained in 314 days of three eight hour shifts, but considering only 22 hours as workable, the other two hours being estimated as necessary for changing distancing poles, ckeaning, small breakdowns, etc.

The 341 working days are the result of considering 35 days for general repairs, holidays, public holidays, etc., and 16 days, equivalent to 48 eight hour shifts for cleaning and weekly repairs.

Daily production will be 191 tonnes or 294 m^3.

3.3 Description of the Process

The manufacturing process of agglomerated panels made from cane trash is divided up into the following departments:

3.3.1 Preparation of raw materials
3.3.2 Cane trash storage area
3.3.3 Shredding and Drying
3.3.4 Screening and classification
3.3.5 Gluing
3.3.6 Forming and Pressing
3.3.7 Finishing line
3.3.8 Storage
3.3.9 Process equipment and auxiliary installations

Now we shall proceed to a description of each of these.

3.3.1 Preparation of Raw Materials

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3.3.1 Preparation of Raw Materials

The process begins with the unloading at the plant of the raw cane trash, from which the necessary samples will be taken to check its quality, especially its state of cleanness and degree of humidity, this being a fundamental factor, as the capacity of the installations for the preparation of cane trash could be insufficient, if there are considerable deviations from the specifications of purchase of 92% of humidity above dry.

We state the importance the pace of cane trash supply has, and this should be as uniform as possible, i.e. 1,285 tonnes per day (180,000 tonnes - 140 days).

Unloading the cane trash it is subjected to the first preparation operation, which is the removal of pith. The necessity of this has been amply demonstrated by the experience of a multitude of cellulose and panel factories, and it constitutes a guarantee of the conservation of the stored cane trash and the quality the market demands from particle board. The removal of pith is done dry, as it is simpler and more economical, as it avoids the later evaporation of the water added in the wet process.

As the cane trash is to be dried for the production of the panel, it does not mean an excessive cost to proceed, after the removal of pith, to a pre-drying of the cane trash which will improve its conservation in storage. The point to which it should be dried is defined, in addition to the suitable conditions for the conservation of the cane trash, by the equilibrium of this with the environment.

It has been calculated that the best pointin this case

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is a humidity of 20% above dry.

Lastlt, the unpithes and pre-dried cane trash is bundled, which facilitates atorage and conservation, removing a good part of the air. This last operation is carried out only during the harvesting season, and only with the cane trash in excess of that necessary for the manufacture of the panels.

3.3. 2 Cane Trash Storage Area

The bales of cane trash are stacked in rows with a triangular cross-section in order to facilitate drainage of rainwater and at the same time have sufficient aeration to prevent possible fermentation with fire hazards.

3.3.3. Shredding and Drying

The manufacturing process of the panels proper begins with the unbaling, where applicable , and shredding of the cane trash, then sending it to the wet silos, which dose it to the subsequent stages of the process. They are a new disintegration and uniformization of the cane trash, and then drying to a humidity of 3% above dry.

3.3.4 Screening and Classification

In this phase the screening and classification of the dry cane trash is carried out, so that four portions are obtained; the first with the pieces too large, unsuitable for manufacture; which are sent to a mill and returned to the process, at the input to the clarification phase; the second portion, of large granulometry, within acceptable limits, is separated and sent to a silo. This will make up ,the inside layer of the panel; the third portion is also acceptable, and finer, is separated

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and sent to a silo for use as the outer layer of the panel; the fourth portion. formed by pith,dust and impurities is eliminated from the process and sent to the boilers.

3.3.5 Gluing

Parallel with the screening and classification process, of the cane trash, and in an annex, the glue emulsions sre prepared based on urea-formaldehyde resin where also it is dosed, once pre-heated to working temperature.

When the glue is ready, proceed to gluing, separately, of the outer layers and the inner layer. In this operation care must be taken to obtain the highest quality of panel at the minimum cost.

3.3.6 Forming and Pressing

When the cane trash has been glues, the panels are fprmed on a particle mattress in the installation known as the forming train (spreader).

The mattress is pre pressed and pressed in a hot plate press, and the panei is manufactured.

3.3.7 Finishing Line

The finishing operations remain, which consist in cooling, squaring and cutting and lastly sanding. Waste is sent to the boiler.

3.3.8 Storage

When finished, the panels are carefully stored, so they may be cured or seasoned in the most suitable environmental conditions, in order to prevent warping and possible deteriorations of the panels obtained.

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3.3.9 Process Equipment and Auxiliary Installations

Below is a list of the most important equipment of the process adopted, and also the auxiliary installtions needed:

a) Process equipment: (60,000 tonnes/year 16 mm panels)

- Mobile equipment for handling the cane trash in weatherproof storage.
- Pith removing equipment for cane trash.
- Wet cane trash silos
- Pith silos
- Wet cane trash dryer
- Pre-dried cane trash silos
- Dry cane trash packing equipment
- Dry cane trash shredders
- Cane trash mills.
- Screening and classification system
- Dryers
- Silos for dry classified cane trash
- Glue preparation room and storage
- Gluing machine
- Spreading machine.
- Hot plate press with hydraulic system
- Panel extracter and cooler
- Sanding machine
- Squarer
- Dust and finishing residue removal system
- Transport systems between process equipment
- Panel stores mobile equipment

b) Auxiliary Installations:

- HV electric substation 3,500 kVA with input and corresponding MCC's, protections and LV distribution.
- Compressed air system of 35 Nm^3/h, with compressors and distribution network.

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- Water network
- Steam boiler plant and distribution. Treatment of boiler water. Fuel stores (fuel oil, pith and sawdust) in annex nº 1 we present a study for the installation of boilers and turbos.
- Fire Water system
- Communications network
- Weighbridge
- Laboratory tools
- Maintenance shop tools. Spares.

3.4 Energy Balance

3.4.1 Energy Balance Panel Plant

Of the supplementary installations, the boiler department is one of the fundamental ones, and it is advisable to expound the thermal situation of the plant.

Two clearly differentiated situations are produced: the 140 days in which fresh cane trash is received, we have taken a safety margin of 10% relating to the general time of the alternative "C" and the 174 days of production remaining.. During the first, the heat consumption is expressed by:

Pre-drying of fresh cane trash 362 tonnes of water per day.
Drying of cane trash for production 38 tonnes of water per day.

Let us assume that the work is carried out 22 hours a day and that to evaporate 1 kg of water we need 900 Kcal.

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For pre-drying and drying we shall need 360 x 10^6 Kcal /day = 16.4 Kcal/h.

To this consumption one must add that needed in the panel press which is Kcal/h.

Total consumption is 18 Kcal/hr.

In order to cover these needs we have available the following fuels:
321 tonnes/day of pith with 92% humidity, ovre dry, and a calorific value of 1,500 Kcal/kg.

29.0 tonnes/day of pith and dust with 3% humidity. over dry, with a calorific value of 3,800 Kcal/kg.

15.5 tonnes/day of sanding dust, with a calorific value of 3,800 Kcal/kg.

This fuel will provide in theory 650 x 10^6 Kcal/day or 29 x 10^6 kcal/hr, with which we have a theoretical excess of 12.6 x 10^6 Kcal/hour, as it depends on the output of the boilers..

In Annex nº 1 we present two alternatives for study bythe boilers and electricity generating department.

Below we develop tbe energy balance got Alternative "C" as a whole.

3.1.2 General Energy Balance for Alternative "C"

In this alternative "C" we are going to draw up the general energy balance altogether, taking into account the following hypotheses:

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Quantity of cane to work: 900,000 tonnes

Quantity of cane trash at output of mills: 24% of cane by weight

Cane trash left over in sugar factory 25% of that obtained

Calories in cane trash 1,900 Kcal/kg

Cane trash left over in alcohol plant, of 1,260 tonnes destined to produce juice for obtainment of alcohol.

Energy consumption in alcohol plant (fermentation, distillery) 3.67 kg steam per litre of alcohol; steam at 21 kg/cm2 and 350ºC; efficiency in boiler = 0.70%.

In the panel plant, to evaporate 1 kg of water we need 900 Kcal/kg.

The sediment concentration-incineration plant as for consumption and production of steam is very balanced , on the whole is endothermic, as in addition we have to supply electricity.

Sugar Factory

The amount of cane trash we would have left over and the therms necessary will be:

$$4{,}500 \times \frac{900{,}000}{5{,}670} \times 0.24 = 168{,}750 \text{ tonnes of cane trash}$$

Left over of cane trash after consuming the necessary to produce the energy needed:

168,750 x 0.25 = 42,187 tonnes.

Energy consumed in the sugar factory:
168,750 x 0.75 x 1,900 = 240,468,750 therms.

Alcohol Plant

Energy consumed in 156 + 83 = 239 days

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90,000 x 3.67 x 750 x 239 ÷ 0.70 = 84,580,392 Therms

Energy consumed in mills to work the 1,260 tonnes of cane per day

In cane cutter 1/5 of total = 2,422 kg steam/hour

In mills 8,638 kg/h.

The exhaust steam from the turbines driving the cane cutter and the mills is at 2.5 kg/cm^2 and 180ºC.

The calories we need for the drive will be 8,638 + 2,422) (750-860) ÷ 0.7 = 1,106,000 Kcal/h in fuel
1,106,000 x 24 x 156 = 4,140,864 Therms.

Equivalent in cane trash of the energy consumed in the alcohol plant (84,580,392 + 4,140,864) ÷ 1,900 = 46,695 tonnes.

Cane trash produced by the cane destined for alcohol plant 1,260 x 156 x 0.24 = 47,174 tonnes.

Cane trash left over. 47.174 - 46,695 = 479 tonnes.

Panels

Cane trash needed 180,000 tonnes

Energy Necessary

In first drying: 50,600 x 900 = 45,612,000 therms.

In drying disintegrated cane trash : 11,950 x 900 = 10,755,000 therms.

In panel press: 2,400,000 x 22 x 314 = 16,579,200 therms

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Total: 72,946,200 Therms

In fuel 72,946,200 therms ÷ 0.70 = 104,208,85 therms

Energy in products:

Pith 45,000 x 1,500 = 67,500,000 Therms
Pith 9,086 x 3,800 = 34,526,800 Therms
Sanded dust 4,875 x 3,800 = 18,525,000 Therms

Total: 120,551,800 Therms.

Energy over 16,342,943 therms equivalent to 8,601 tonnes of cane trash.

The theoretical amount of cane trash we will have left over for the production of panels will be:

From the sugar factory:	42 187 tonnes
From the alcohol plant	479tonnes
From the 180,000 tonnes cane trash:	8 601 tonnes

Total: 51,267 tonnes

3.5 Balance of Masses

This is represented by the block diagram attached.

in order to estimate the amount of cane trash we need, let us assume that its humidity on arrival at the plant is 92% dry base, 48% wet base, and the percentage of pith, dust, impurities, etc. eliminated before its conversion to panels is 35% referring to dry.

In these conditions, the amount of cane trash needed for the production established is 180,000 tonnes.

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REAL. POR P. LÓPEZ	DIAGRAMA FABRICACION	HOJA 96-B SIGUE EN 97
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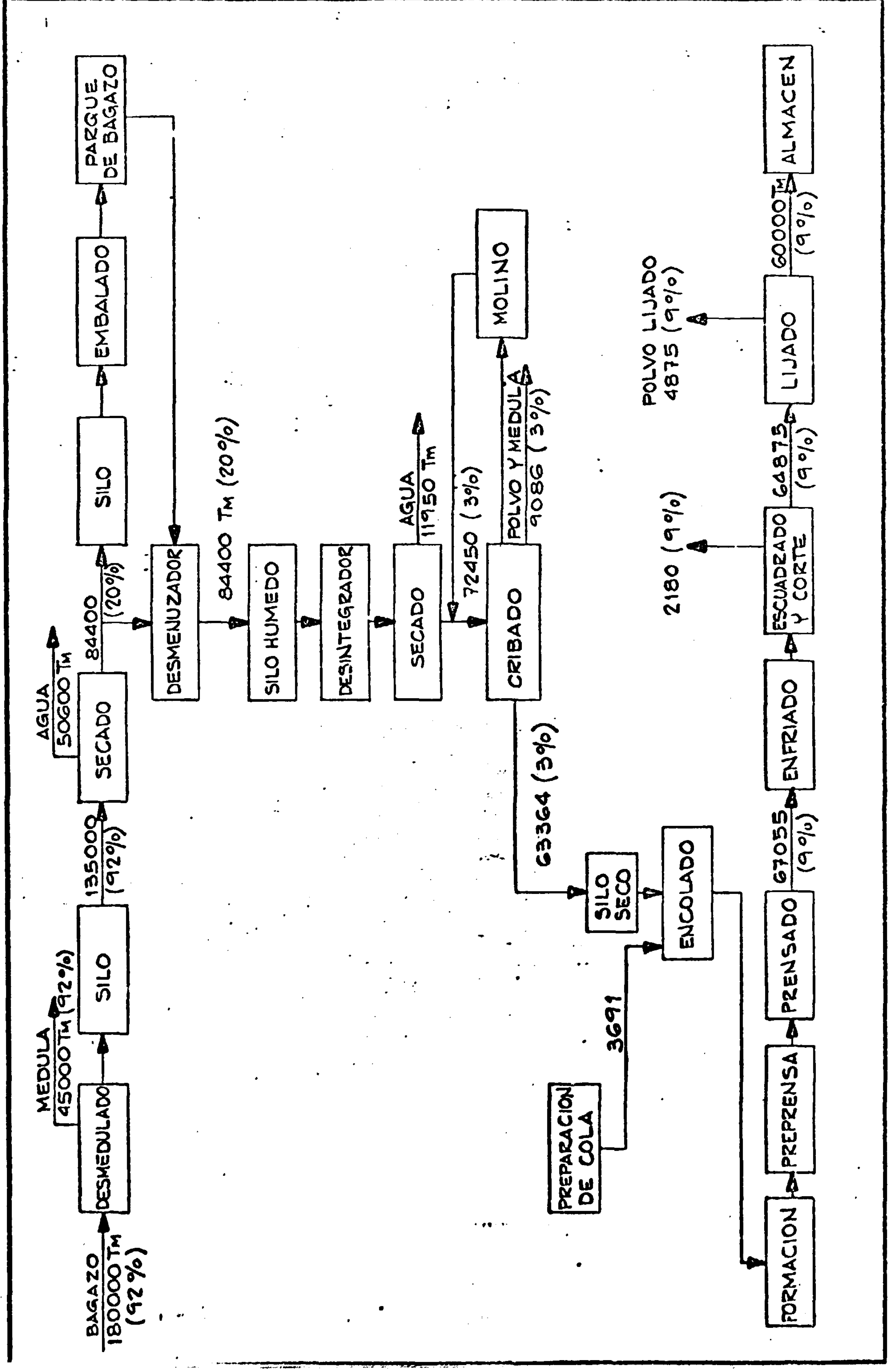

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From the results obtained in the general energy balance, for alternative "C", we deduce that it will be necessary to transport to the complex the following amount of cane trash 180,000 - 51,267 = 128,733 tonnes.

Making a small consideration this amount of cane trash will come from the following amount of cane
128,733 ÷ 0.24 = 536,387 tonnes.

As we have supposed that from the cane trash contained in the cane, 75% is used in the energy needs of the sugar factory and that 25% is left over, the amount of cane we will have to work to obtain the trash needed will be:
536,387÷ 0.25 = 2,145,550 tonnes = 2,383,944 short tons of cane.

3.6 Process Materials Consumptions

The consumption of glue, urea-formaldehyde resin, will be 5,000 tonnes per year, in solid resin.

In order to complete the preparation of the glue we also need the volume of emulsion of parrafin, equalling 250 tonnes/year, in solid paraffin; 44 tonnes/year of ammonium chloride and 27 tonnes/year of ammonia.

The normal mean concumption of water is 15 m^3/h, and it is advisable to provide 25 m3/h; the fire system must be supplied separately, and we have thought of that of the complex as a whole.

The consumption of compressed air is 35 Nm^3/mi at 7 kg/cm^2.

The consumption of electric power is 230 kWh/tonnes of panel produced.

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The specific consumptions are:

Glue, in solid resin	83.33	kg/tonne of panel
Paraffin, solid	4.17	kg/t "
Ammonium chloride	0.73	kg/t "
Ammonia	0.45	kg/t "
Fats and oils	1.5	kg/t "

SENER

3.7 Labour Per Month of Work in Panel Plant

	US$/month
Technicians	
1 Technical director	1,500
1 Engineer, head of maintenance	1,100
6 Overseers (production, mechanics, electrician) (500 US$/month)	3,000
Personnel	
13 workers (electricians, mechanics, drivers)	5,200
28 process workers (400 US$/month)	11,200
Cane trash bay and panel store	
1 Head of bay (500US$/month)	,500
1 Head of panel store (500 US$/month)	,500
10 workers (500US$/month)	,500
Total	28,000

Total Cost 28,000 x 12 = 336,000 US$ year

SENER

3.8 Land and Buildings

The land needed to locate the panel factory, taking into account a future extension is figured at around 12 Ha.

The buildings would reach 4,000 m^2 among which the following are included:

- Panel manufacturing line
- Finished product stores
- Glue preparation room
- Boiler
- Electrical and compressed air installations,
- Offices
- Maintenance shop
- Spares store

Storage in the open air of the cane trash with the pith removed will require an area of some 9 Ha.

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4. TREATMENT PROPOSED FOR DISTILLERY SEDIMENT

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4. TREATMENT PROPOSED FOR THE DISTILLERY SEDIMENT

in accordance with that set forth in point 4 of the study on the possible treatments of sediment and now adjusting this to the problem generated in the JIBOA sugar factory on installing a distillery of 90,000 l/d of alcohol of 99.5º GL capacity, SENER suggests the following treatment for the sediment generated by that plant.

We think the most suitable solution is the preparation of sediment hold up pools in which a natural evaporation is obtained leaving the farmers and livestock breeders complete freedom to take the sediment they wish. These pools should be connected to the general drainage system of the sugar factory.

We have made the following assumptions:

1) we assume that the land available is suitable for sediment (vinaza), with good characteristics of permeability and poor in potassium, so we estimate a figure within a standard average that 50 m^3 of sediment per year would be spread per hectare of land.

2. When the distillery is working with cane juice or when we are in the season of torrential rain, we will open; the valves connecting to the general drainage system connecting with the river as then the sediment will be a lot more diluted and the pollution problem is less.

3) During the dry season the sediment will be subjected to natural evaporation obtaining a concentrate rich in proteins highly suitable for the cattle raising of the area, which could be given away or sold at a token price to make it attractive to the cattle farmers installed there.

Now these assumptions have been described, we shall turn to a definition of the hold up pools.

SENER

Amount of sediment estimated = 50 m3/h.
Days distillery in operation - 239 days
Total amount of sediment produced - 50 x 24 x 239 =
286,800 m^3 of sediment to store as at the moment
we are not considering the sediment discharged into the
river when conditions are favourable.

in order to store this volume we think of the construction
of 3 compacted earth pools with the following dimensions:

130 m x 375 m x 2 m (height)

with a storage capacity of 97,500 m_3 each one, which
makes a total of 292,500 m^3 of total capacity.

The total cost of these pools with the connection pipes to
the general drainage system and the corresponding valves
is estimated at 684,000 US $.

In our view, this is the simplest solution, meaning
a financial cost which is mush less, and in this
way making the operation of the distillery potentially
profitable.

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ANNEX TO POINT 3

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STEAM AND ELECTRICITY PRODUCTION FOR THE PANEL PLANT

1. GENERAL

The panel factory will have the possibility of being supplied from two different electricity sources:

- the national grid
- autogeneration of electricity in the plant.

This factory presents the singularity of presenting two very different seasons in the year with regards to exploitation and consumption, especially of steam. In effect, during the harvesting period, the consumption of steam is almost five times higher than the consumption of the rest of the year.

For this last reason the imbalance in the consumption of steam/electricity does not make it possible for the plant to be totally independent in the generation of electricity during the whole period when there is no harvesting.

The change in the harvesting period, given the high steam consumption, it would be possible to produce more electricity than that consumed in the plant itself and sell the surplus to the national grid.

The installation of the generatoin of steam and electricity should then be capable of functioning, according to the exploitation modes of the factory:

- Supplied totally by the national grid, with the turbogenerator out of service.
- Isolated from the national grid and supplied only by the turbogenerator

- With the turbogenerator in parallel in the national grid, continually interchanging electricity between the factory and the grid (buying or selling according to the energy balance of the plant).

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2. ELECTRICITY CONSUMED

In a first approximation it may be assumed that the electricit consumed in the plant is similar in the two periods of the yesr (harvest and non-harvest).

The specific consumption of electricity is 230 kWh/tonne of panel.

Daily production of panels: 191 tonnes/day

Electricity required: $191 \times \frac{230}{24} = 1.80$ kW

it can be estimated that this figure includes the peaks and also the electricity consumption corresponding to the production of utilities (steam, compressed air, water, etc.). The nominal power of the generation for self sufficiency is therefore 1,850 kW.

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3. RATE OF STEAM AVAILABLE

We shall consider separately the 2 cases of harvest or non harvest for the calculation of the setam consumed in the plant.

3.1 Harvest Period

this period lasts for 140 days per year and the thermal consumption during this period is 18.8×10^6 Kcal/h.

This thermal energy comes from the condensation of low pressure saturated or nearly saturated steam (2.5 kg/cm^2 and 145-150ºC).

The latent heat of the condensation of this steam is 513 Kcal/Kg.

Th e rate of steam in normal production conditions:

$$\frac{18.8 \times 10^6}{513} = 36,700 \text{ kg/h}$$

To this process consumption we must add that corresponding to auxiliary services (degassing, heating of various fluids, cutting, etc) which may be estimated at approx. 3,300 kg/h-

Total flow rate: 40,000 kg/h

3.2 Non Harvest Period

this period lasts 174 days per year, and the consumption of thermal energy during this period is approximately

4×10^6 Kcal/h

The flow rate of steam consumed in nominal production conditions is $\frac{4 \times 10^6}{513}$ = 7,800 Kg/h

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Considering that the consumption of the auxiliary services would be of the order of 1,200 kg/h the total consumption would reach 9,000 kg/h

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4. ALTERNATIVES CONSIDERED

The consumptions of thermal energy do not adjust to the consumptions of electricity, bearing in mind the total efficiencies or outputs of the thermodynamic cycles considered, in order to reach a balance without the exchange of electricity between the plant and the grid.

4.1 Alternative nº 1

There exists the possibility of the sale of electricity to the grid.

in this case the turbo alternators will be dimensioned and the characteristics of the feed steam to these units, in order to increase as far as possible the production of electricity.

For this reason, during the harvest period the surplus electric electricity will be used and in the non hervest period the purchase of outside electricity will be kept to a minimum.

4.2 Alternative nº 2

The possibility of exporting electricity is not taken into account.

The installation will be dimensioned so as to balance during the harvest period the electrical and thermal consumptions. During the non harvest period, the plant will show a great deficit in electricity, which will be supplied by the outside grid.

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5. ALTERNATIVE Nº 1

5.1 Determination of the Characteristics of Steam

The characteristics of the exhxust steam from the turbine, due to the needs of the process equipment will be:

P = 2.5 kg/cm^2n
T = 145ºC
H = 656 Kcal/kg

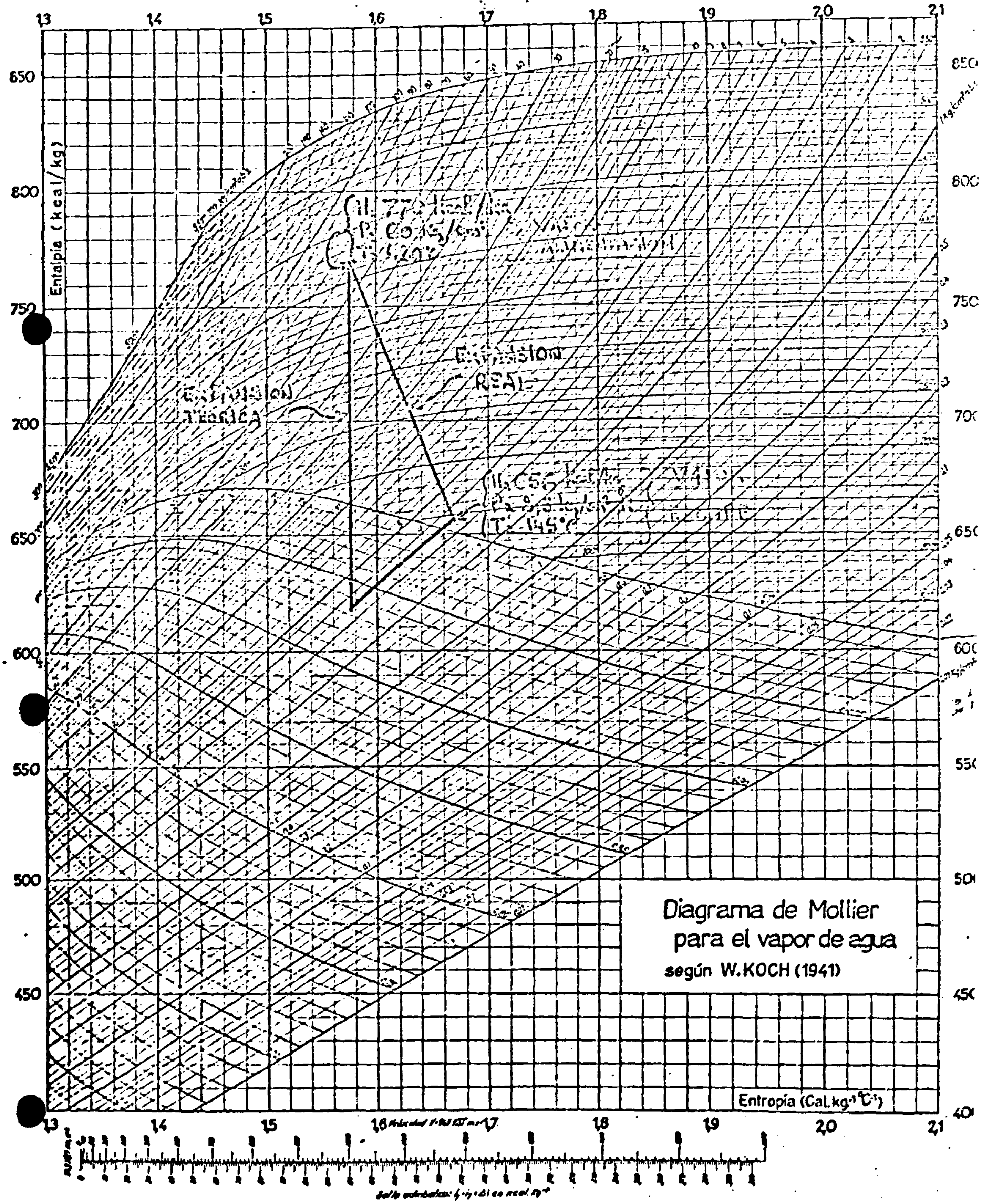
Owing to the differences in electricity production existing betwen the two periods, it is logical to foresee the installation of 2 groups of turbogenerators of the same power.

For turbogenerator groups of this power, the total mechanical efficiency is of the order of 90%.

As this alternative is aimed at increasing electricity production to the maximum, multistage turbines will be chosen with a thermodynamic efficiency of 75%. This increase in the initial investment will be compensated by the sales of electricity to the grid.

Starting out from these two assumptions (characteristics of the exhaust steam and the thermodynamic efficiency of the turbine) we can draw on the Mollier diagram on the following page the curve corresponding to the real expansion in the turbine.

In this way we choose the point corresponding to the high pressure feed steam of the turbine:
P = 60 kg/cm2
T = 420ºC
H = 770 Kcal/kg


Entalpia (kcal/kg)
Entropia (Cal.kg⁻¹°C⁻¹)
EXPANSION TEORICA
EXPANSION REAL
Diagrama de Mollier
para el vapor de agua
según W.KOCH (1941)

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These characteristics present the advantage of corresponding to boilers existing in series and the overheaters and high pressure steam pipes do not have to be of a special alloy steel.
This happens from temperatures of approximately 430ºC and would significantly raise the price, and would be a difficulty for construction and maintenance because of the welding.

The real enthalpy jump in the turbine is:
770 - 656 = 114 Kcal/kg

5.2 Electricity Production

5.2.1 Harvest Period

Flow rate of steam available: 40,000 kg/h

Real thermodynamic power produced in the turbine:
$40,000 \times 114 = 4.56 \times 10^6$ Kcal/h
1 KW = 861 kcal/h.

Taking into account the overall mechanical efficiency of the groups, the total production will be:

$$\frac{4.56 \times 10^6}{861} \times 0.9 = 4,750 \text{ kW}$$

The power exported will be:
4,750 - 1,850 = 2,900 kW.

5.,2.2. Non Harvest Period

Flow rate of steam available: 9,000 kg/h

Total electricity production:

$$\frac{9,000 \times 114}{861} \times 0.9 = 1,050 \text{ kW.}$$

The electricity bought from the grid will be:
1850 - 1050 = 800 kW.

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Diagram of the Installation

5.3 in diagrams 1 and 2 overleaf the steam and condensate installations of the plant are shown.

Also indicated are the main flows of operation for the 2 modes of operation of the plant (harvest period and non harvest period).

5.4 Characteristics of the Main Installations

In order to define the main equipment, mainly the criterion of ease of maintenance and standardised spares as far as possible has been taken into account.

An attempt has also been made for the equipment to operate in conditions of efficiency and safety acceptable in the two periods of the year under consideration, without raising their number too much.

The main characteristics of this equipment are the following:

5.4.1 Boilers

Number of boilers: 3
Type: aquotubular
Economiser : yes
Main fuel: cane pith
Auxiliary fuel : fuel oil
Nominal flow rate: 13,500 kg/h
Peak flow rate: 15,000 kg/h
Operating pressure: 60 kg/cm2
Bell pressure: 64 kg/cm2
Temperature of feedwater: 135ºC
Type of control: electronic
small boiler level: 3 element type
Fuel/air combustion: according to the steam pressure in the steam outlet pipe.

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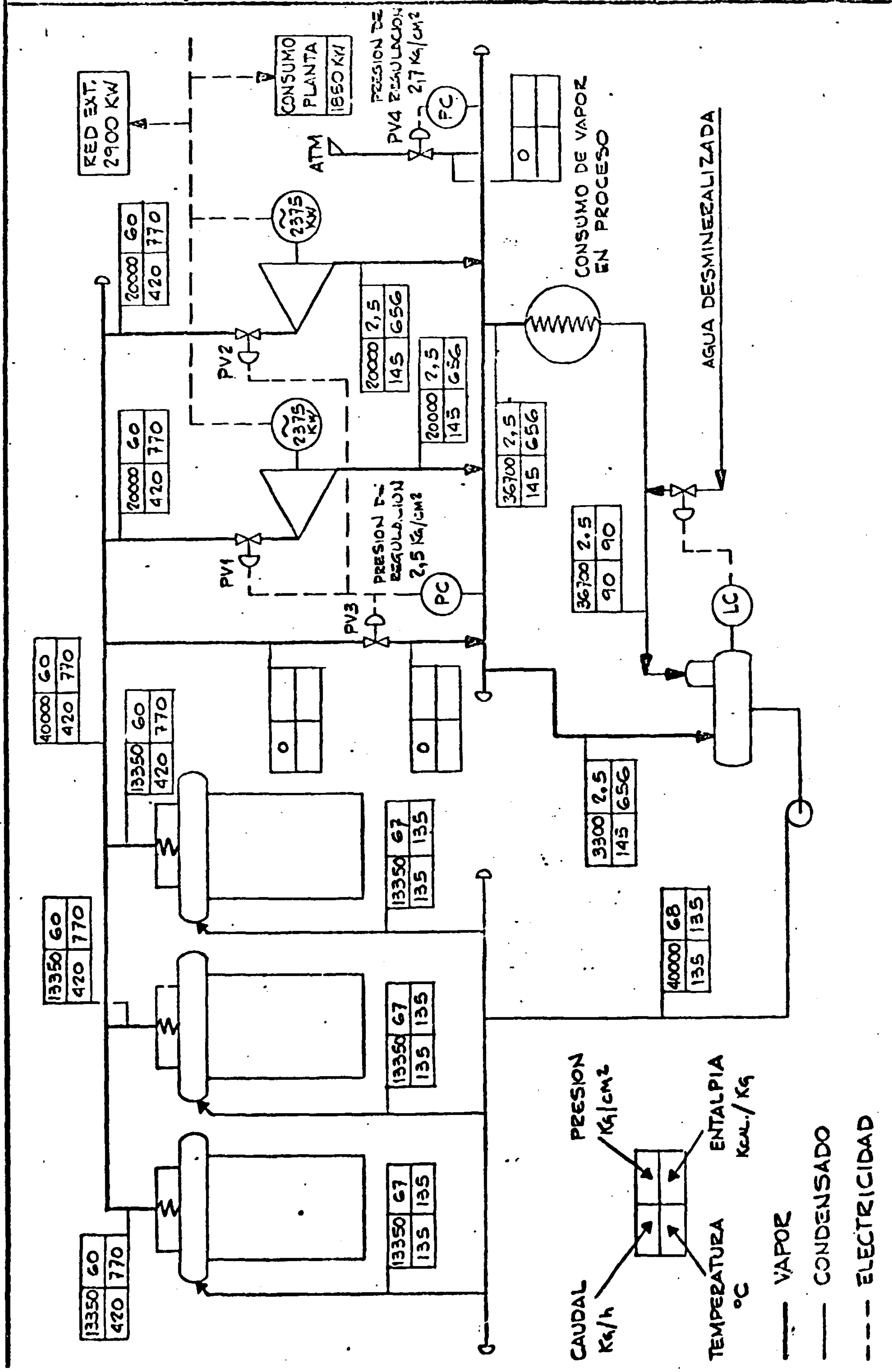
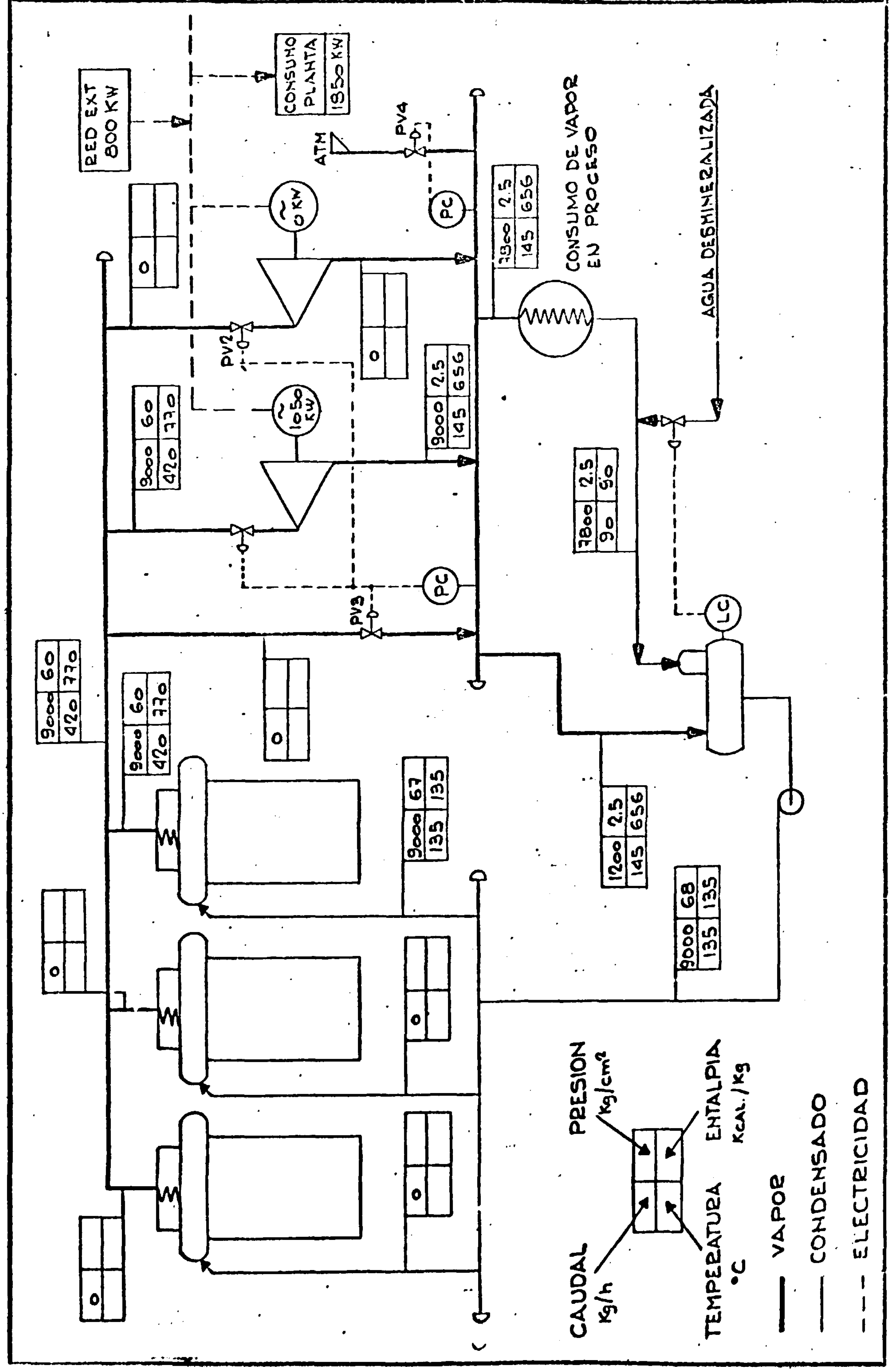
REAL. POR P. López	ESQUEMA Nº 1	HOJA 113B SIGUE EN 113C
APROB. POR	ALTERNATIVA Nº 1	REV. 1



SENER	UNIDO - ESTUDIO FACTIBILIDAD COMPLEJO JIBOA	PQ-3043
REAL. POR [illegible]	ESQUEMA Nº 2	HOJA 113 SIGUE EN 114
APROB. POR [illegible]	ALTERNATIVA Nº 1	REV. 1



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5.4.2 Feedwater Pumps

Number of pumps: 4 (3 in service, 1 emergency)
Drive : 3 electric motor
        1 turbine
Nominal flow rate: 17,000 kg/h
Impulsion pressure:67 kg/cm2
Suction pressure: 2.5 kg/cm2
Water temperature: 135ºC
Estimated drive power: 65 hp

5.4.3 Degasser

Number of items: 1
Nominal flow rate: 40,000 kg/h
Temperature water in : 90ºC
Temperature water out: 135ºC
Degassing steam pressure: 2.5 kg/cm2
Temperature " " 145ºC
Design pressure: 3.5 kg/cm2R
Design temperature0 175ºC
Useful storage capacity: 12 m3

5.4.4 Turbogenerators
Number of items:2
Feed steam pressure: 60 kg/cm2
Feed steam temperature: 420ºC
Exhaust steam pressure: 2.5 kg/cm2
Exhaust steam temperature: 145ºC
Nominal power: 2,400 kw
Estimated thermodynamic efficiency: 75%
Overall estimated mechanical efficiency: 90%
Type: multistage, to achieve efficieincy of75%

5.5 Operating Modes

This paragraph describes the main operating modes for the plant according to the period considered and the circumstances given in the national grid.

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5.5.1 Operation in Parallel with the Grid.

in this case, the electrical installation of the plant is connected simultaneously with the grid and the two turbogenerators.

Through the turbine passes the steam flow rate necessary for consumption in the plant and the production of electricity is a cinsequence of that flow rate of steam.

in order to balance the production/consumption of electricity, there is the outside grid for the purchase or sale of electricity according ot the circumstances.

In normal operating conditions no flow rate of steam passes through the pressure control valves of the low pipe PV3 and PV4..

Pressure regulation of the low pipe is carried out by acting onthe setting of the admission valves of the turbines PV1 and PV2.

The regulation of frequency, therefore ofthe speed of rotation of the turbines, is assured by the grid.

The greatest advantage offered by this mode of operation is the continuous optimization of the overall energy efficiency and the possibility of the sale of electrical energy outside should the balance of steam/electricity consumption so determine.

This should be the normal,operating mode of the plant and the balances are shown in diagrams 1 and 2.

5.5.2 Operation Isolated from the Outside Grid.

in this case, the plant is not connected to the outside

SENER

grid and depends solely on the two turbogenerators. These produce at all times a power identical to the instant consumption of the plant.

The flow of setam passing through the utrbine does rot depend on the needs of the thermal consumption of the plant, but on the electricity consumption the generator must produce.

The generator operates with regulation (by means of opening valves PV1 and PV2) which maintain the speed of rotation of the turbine constant, and therefore the frequency of the current produced.

If the exhaust flow rate is sufficient to feed the process units of the plant it is balanced by passing the complement through the pressure reducing valve of the low steam pipe. This is the normal case for harvest periods.

If, on the contraty, the turbine exhaust flow rate exceeds the consumption of the plant, the excess will be discharged to the atmosphere through valve PV4 which also regulates the pressure of the low steam pipe. this would be the end of the isolated operation in a non harvest period, operation which should be avoided in order not to shed to the atmosphere large quantities of steam which make commercial operation considerably more expensive.

this mode of operation presents the following main characteristics:

- Indeoendence from the grid and grester security in the case of unreliability of the grid (storms, strikes, etc).

- The plant is without electricity if one turbogenerator breaks down.

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- The overall thermodynamic efficiency of the system is not optimum especially when the balance demands discharging steam into the atmosphere.

- There is no possibility of the sale of electricity to the grid.

NOTE: passing from one mode of operation to another (parallel/isolated) presents no difficulties in design or exploitation.

SENER

6 ALTERNATIVE Nº 2

6.1 Determination of the Characteristics of Steam

The characteristics of the turbine exhaust steam are the same as in alternative nº 1:

P = 2.5 kg/cm2
T = 145ºC
H = 656 Kcal/kg

On not being able to sell energy to the grid, with the steam available in the harvest period only the electricity consumed in the plant should be produced. For this reason, a turbogenerator group will be selected which is simpler than in alternative nº 1, with only 1 or 2 stages. The estimated efficiencies are:

Overall mechanical efficiency of the group: 85%
Thermodynamic efficiency of the turbine: 60%

The thermodynamicpower the steam should transmit will be:

$$1{,}850 \times \frac{861}{0.85} = 1.87 \times 10^6 \text{ Kcal/h}$$

Real enthalpy jump for each kg of steam passing through the turbine:

$$\frac{1.87 \times 10^6}{40{,}000} = 46.8 \text{ Kcal/Kg}$$

Theoretical enthalpy jump per Kg of steam passing through the turbine:

$$\frac{46.8}{0.6} = 78 \text{ Kcal/kg}$$

Enthalpy of the turbine feed steam:
656 + 46.8 = 702.8 Kcal/Kg

Conditions of the feed steam (see attached Mollier diagram)

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$P = 18\ kg/cm^2\ R$
$T = 265ºC$

6.2 Electricity Production

6.2.1 Harvest Period

Because of the very manner in which the installation in the preceding paragraph has been dimensioned, we can see that the eletricity production is the same as the consumption of the plant i.e. 1,850 kW.

The exchange with the grid would be nil in theory.

6.2.2 Non Harvest Period

Flow rate of available steam: 9,000 kg/h

Total electricity production:

$$\frac{9,000 \times 46.8}{861} \times 0.85 = 416 \text{ kW.}$$

The electric power to be purchased from the outside grid will be:

1,850 - 416 = 1,434 kW.

6.3 Diagram of the Installation

The general diagram of the installation is similar to that set forth in alternative nº 1. On the other hand, the equipment is very different.

Diagrams nºs 3 and 4 indicate the characteristics of the main currents of steam and condensate for the 2 operating modes of the plant (harvest and non harvest).

6.4 Characteristics of tne Main Installations

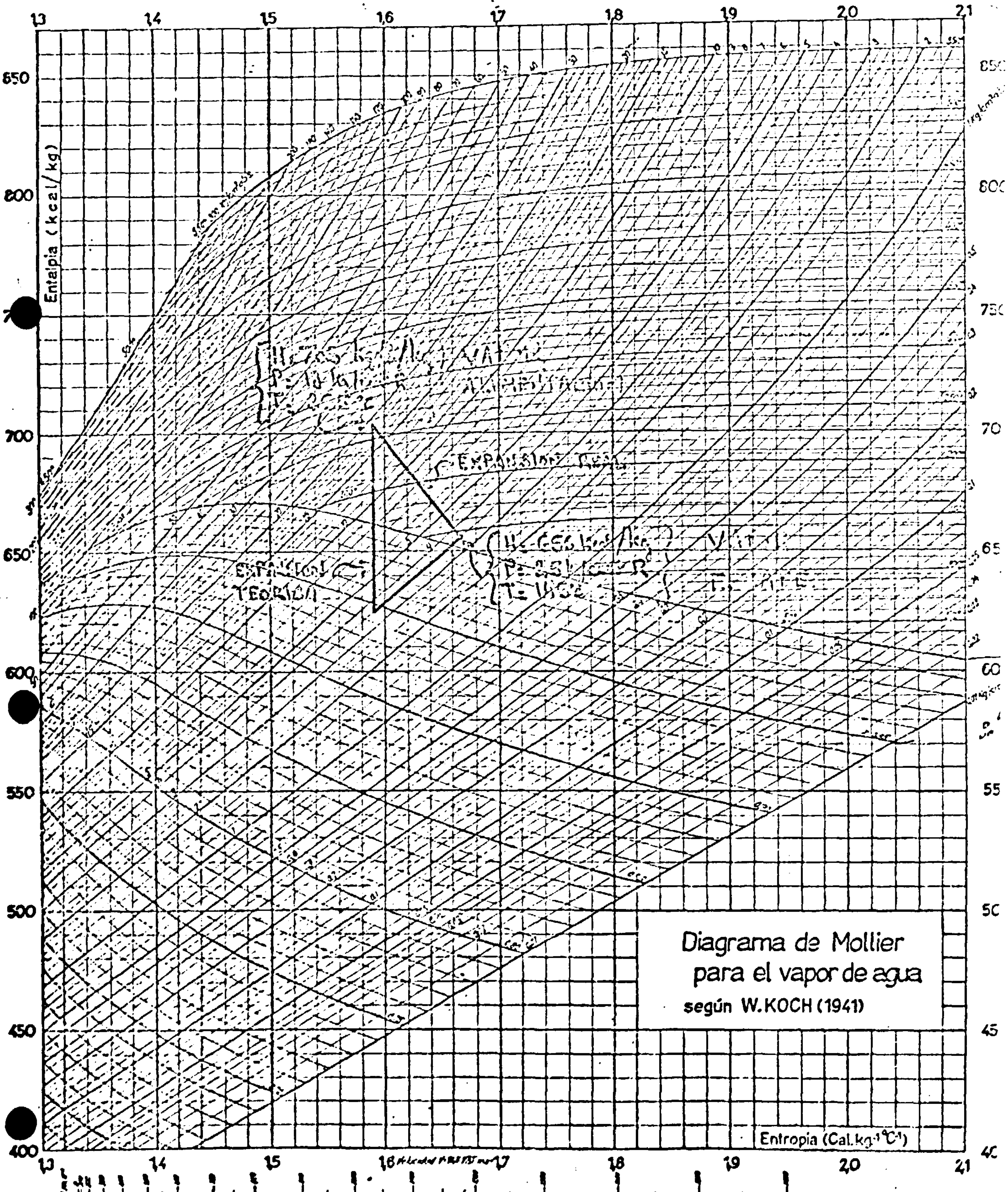
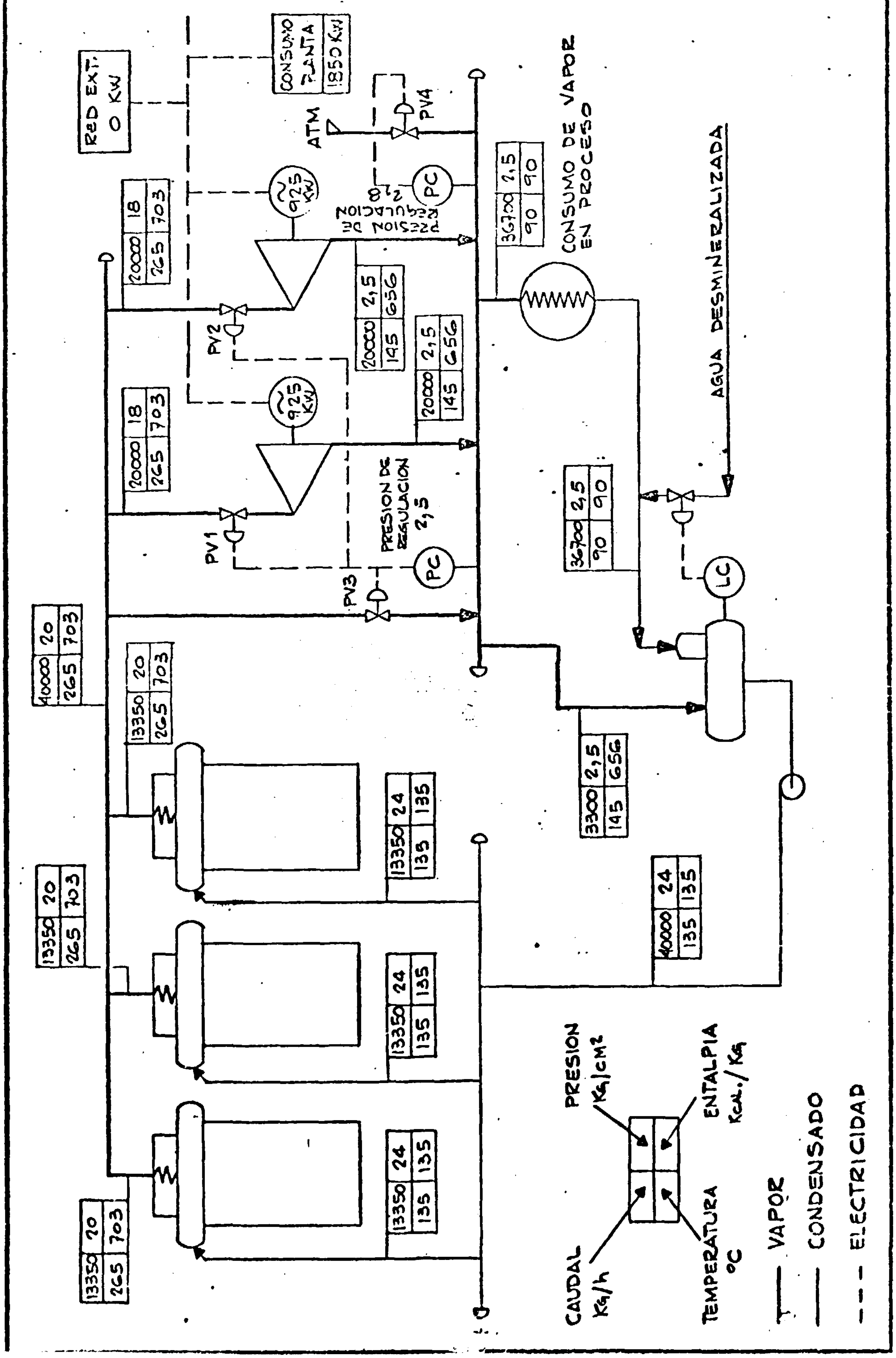
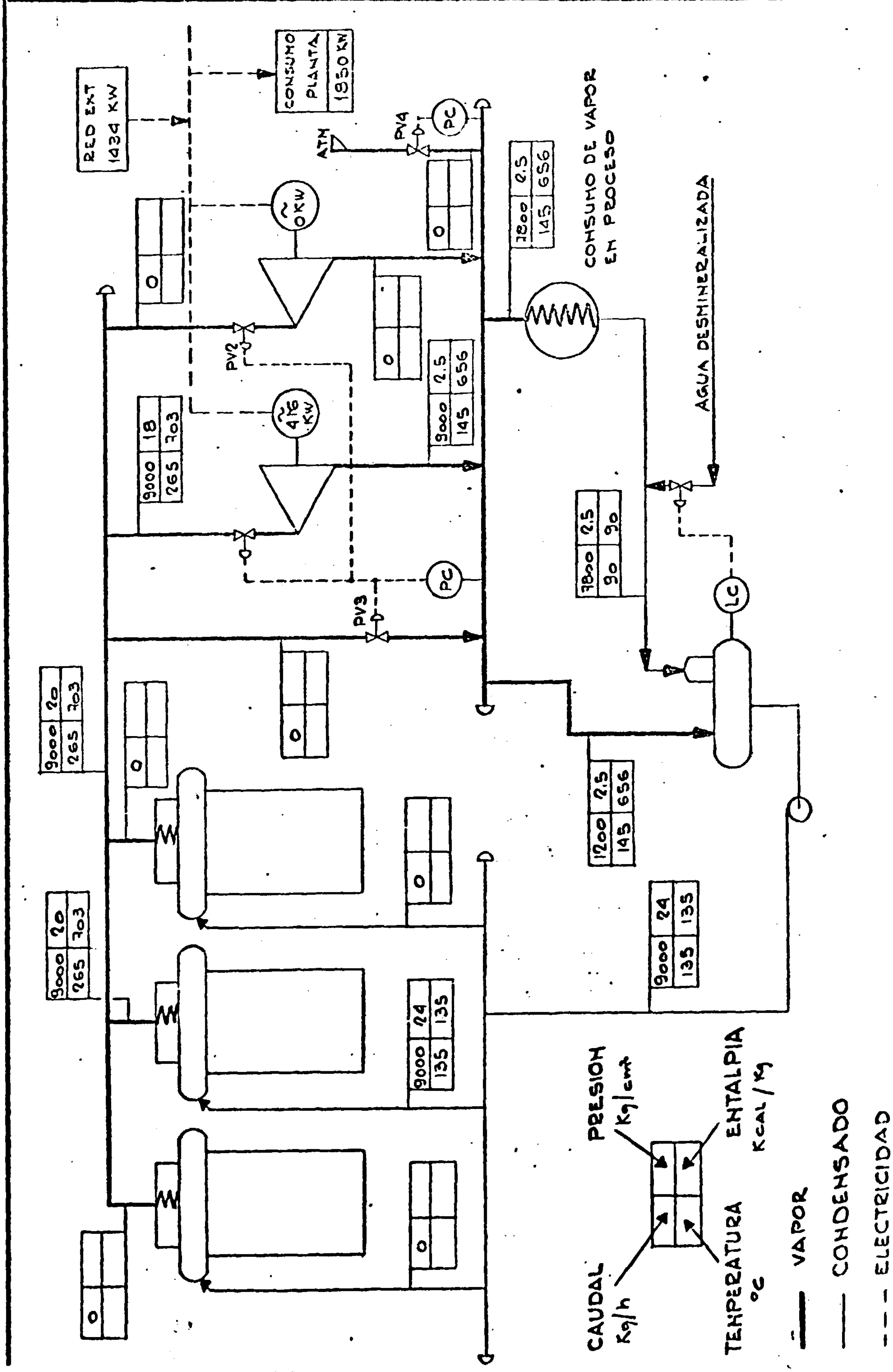


Diagrama de Mollier
para el vapor de agua
según W.KOCH (1941)
Entalpia (kcal/kg)
Entropia (Cal.kg-1°C-1)
EXPANSION REAL
EXPANSION TEORICA

SENER	UNIDO- ESTUDIO FACTIBILIDAD COMPLEJO JIBOA	PQ-3043
REAL. POR P. López	ESQUEMA Nº 3	HOJA 119C SIGUE EN 119D
APROB. POR	ALTERNATIVA Nº 2	REV. 1



SENER	UNIDO - ESTUDIO FACTIBILIDAD COMPLEJO JIBOA	PQ-3043
REAL. POR [illegible]	ESQUEMA N°4 ALTERNATIVA N°2	HOJA 119 SIGUE EN 120
APROB. POR [illegible]		REV. 1



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For the definition of these items of equipment, the same basic criteria as in the preceding alternative will be followed.

6.4.1 Boilers

Number of boilers: 3
Type: aquotubular
Economiser: yes
Main fuel: cane pith
Auxiliary fuel: Fuel Oil
Nominal flow rate: 13,500 kg/h
Peak flow rate: 15,000 kg/h
Operating pressure: 20 kg/cm^2
Bell pressure: 24 kg/cm^2
Feed Water temperature 135ºC
Type of control: electronic

* Level of small boiler: 3 elements
* Fuel/air of combustion according to steam pressure in steam outlet pipe.

6.4.2 Feed Water Pumps

Number of pumps: 4 (3 in service and 1 emergency)
Drive: 3 by electric motor
1 by turbine
Nominal flow rate: 17,000 kg/h
Impulsion pressure: 27 kg/cm^2
Suction pressure: 2.5 kg/cm^2
Water temperature: 135ºC
Estimated drive power: 25 hp

6.4.3 Degasser

Number of units: 1

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Nominal flow rate: 40,000 kg/h
Temperature water in: 90ºC
Temperature water out: 135ºC
Degassing steam pressure: 2.5 kg/cm^2
Degassing steam temperature: 145ºC
Design pressure: 3.5 kg/cm^2
Usable storage capacity: $12m^3$
Design temperature: 175ºC

6.4.4 Turbogenerators

Number of units :2
Feed steam pressure: 18 kg/cm^2
Feed steam temperature: 265ºC
Exhaust steam pressure: 2.5 kg/cm^2
Exhaust steam temperature: 145ºC
Nominal power: 925 kW
Estimated thermdynamic efficiency: 60%
Estimated overall mechanical efficiency: 85%
Type: 1 or 2 stages, to reach estimated efficiencies.

6.5 Operating Modes

The operating modes are similar to those already described in paragraph 5.5 for alternative nº 1. The only changes consist in the quantities both of steam and electricity.

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7. CONCLUSIONS

in order to carry out the present feasibility study of the plant overall, either of the electricity generating alternatives may be considered. Logically, for the needs of this feasibility study alternative nº 2 will be considered as we do not know the real possibilities of the sale of electricity.

Should the plant be constructed, both alternatives should be studied from the financial point of view and especially there should be talks with the bodies responsible for the outside grid to know the real possibilities of exporting electricity from the plant, the undertaking in the medium term, for this exportation and the sale price of kWh at various times of the day and of the year. (If there are different tariffs for peak, trough and normal times).

Also to be taken into account is the greater consumption of cane trash in the boilers (10%) in alternative nº 1 which would decrease somewhat the production of panels, which fact might or not be important with regards to the potential market for this product.

However, it is possible to say already that alternative nº 1 will certainly be very interesting if there is not an excessive price difference between the purchase and sale of electricity by the outside grid.

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6.4.2 Investment Costs. Alternative "C"

Sugar Factory

	Foreign Currency US $	Local Currency $	Total $
Main equipment	2,779, 000	370,000	3,149,000
Service equipment	1,140,000	380,000	1,520,000
Miscellaneous equipment	--	817,000	817,000
Freight & insurance	--	431,000	431,000
Interning of equipment	--	197,000	197,000
Installation of equipment	--	1 084,000	1,084,000
Installation of misc. equip.	--	462,000	462,000
Preparation of Land	--	105,000	105,000
Civil engineering work	--	570,000	570,000
Licences & royalties	--	--	--
Engineering	--	570,000	570,000
Management & property costs	--	304,000	304,000
Utilities and eventualities	392,000	529,000	921,000
	4,311,000	5 819,000	10,130,000

This alternative "C" assumes that the installations of alternative "A" have already been made, therefore the values are incremental

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6.4.2 Investment Costs. Alternative "C" Distillery

	Foreign Currency $	Local Currency$	Total $
Main equipment	862,000	5,344,000	6,206,000
Service equipment	338,000	1,063,000	1,401,000
Miscellaneous equipment	133,000	4,071,000	4,204,000
Freight & insurance	-	270,000	270,000
Interning of equipment	-	173,000	173,000
Installation of equipment	-	648,000	648,000
Installation of misc. equip	-	1,491,000	1,491,000
Preparation of land	-	72,000	72,000
Civil engineering work	-	1,296,000	1,296,000
Licences & royalties	161,000	-	161,00
Engineering	-	591,000	591,000
Management & property costs	-	320,000	320,000
Utilities & eventualities	149,000	1,138,000	1,287,000
Total	1,643,000	16,477,000	18,120,000

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Investment Costs Alternative "C"

Panel Plants

	Foreign Currency $	Local Currency $	Total $
Main equipment	3 850,000	880,000	4 730,000
Service equipment	1 760,000	273,000	2 033,000
Miscellaneous equipment	--	2 040,000	2 040,000
Freight & insurance	--	430,000	430,000
interning of equipment	--	310,000	310,000
Installation of equipment	--	858,000	858,000
Installation of misc. equip.	--	1 428,000	1 428,000
Preparation of land	--	235,000	235,000
Civil engineering work	--	1 785,000	1 785,000
Licences & royalties	260,000	--	260,000
Engineering	--	685,000	685,000
Management & property costs	--	263,000	263,000
Utilities & eventualities	587,000	919,000	1 506,000
Total	6 457,000	10 106,000	16 563,000

Investment Costs, Alternative "C" Total of Complex
Sugar Factory + Distillery + Panel Plants

	Foreign Currency $	Local Currency$	Total $
Main equipment	7,491,000	6,594,000	14,085,000
Service equipment	3,238,000	1,716,000	4,954,000
Miscellaneous equipment	133,000	6,928,000	7,061,000
Freight & insurance	-	1,131,000	1,131,000
Interning of equipment	-	680,000	680,000
Installation of equipment	-	2,590,000	2,590,000
Installation of misc.equip.	-	3,381,000	3,381,000
Preparation of land	-	412,000	412,000
Civil engineering work	-	3,651,000	3,651,000
Licences ´royalties	421,000	-	421,000
Engineering	-	1,846,000	1,846,000
Management & property costs	-	887,000	887,000
Utilities and eventualities	1,128,000	2,586,000	3,714,000
Total	12,411,000	32,402,000	44,813,000

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6.4.3 SUGAR FACTORY ALTERNATIVE "C"

Annual Production Costs at 100% Capacity	Annual Quantity	Unit Cost US$	Foreign Currency $	Local Currency $
Days of Harvest = 156				
1. Raw materials				
Sugar cane tonnes	900,000	22.2	-	19,980,000
Additives	-	-	112,500	-
2. Services				
Electricity (CLES)				
kWh				
Water				
3. Other costs:				
4. Equipment maintenance & operation	-	-	75,000	175,000
5. Labour				
Direct				1 290,625
Indirect				200,000
6. Financial costs (interest)	ACCORDING TO THE TYPE OF CREDIT			
7. Depreciation	10% yearly			

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ALCOHOL PLANT - ALTERNATIVE "C"

Annual Proction Costs at 100% Capacity

	Unit Cost US$	Foreign Currency $	Local Currency $
1.Raw Materials			
Molasse 31,605 tons	30	-	948,150
Purified juice from 196,500 tonnes cane	24	-	4 717,400
Process materials			319,000
Maintenance materials			80,000
Labour			230,000
Financial costs	ACCORDING TO TYPE OF CREDIT		
Depreciation	10% YEARLY		

SENER

PANEL PLANT - ALTERNATIVE "C"

Annual Production Costs at 100% Capacity

	Annual Quantity	Unit Cost US $	Foreign Currency $	Local Currency $
1. Raw materials				
Cane trash	180,000	35.8		6,444,000
Process raw materials				260,000
Maintenance materials				50,000
Labour				336,000
Financial costs	ACCORDING TO THE TYPE OF CREDIT			
Depreciation	10% YEARLY			

6.5 ALTERNATIVE "D" - Expansion of the Work Capacity of the Sugar Factory to 4,5000 tonnes/day (5,000 tonnes/day), with an Alcohol Plant of 60,000 litres/day

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6.5 ALTERNATIVE "D" - Expansion of the Work Capacity of the Sugar Factory to 4,500 tonnes/day (5,000 tonnes/day), with an Alcohol Plant of 60,000 litres/day

6.5.1 Technical Description

As a consequence of the meetings held on San SAlvador it is agreed to develop a further alternative for the Jiboa Sugar Factory, based on the following main criteria.

Sugar cane production in the zone of influence of the sugar factory from which it is advisable to increase the daily work of the sugar factory to 5,000 short tons was set at 400,000 short tons, which it is anticipated to reach in the 1982/83 harvest.

The maximum possible increase considered logical at this meeting for the area of influence of the Jiboa Sugar Factory was fixed at 100,000 short tons, which it is planned to reach within the space of five years.

When 500,000 short tons of cane are reached, the installation of an alcohol plant seems advisable, with a production capacity of 60,000 l/day, using the molasse produced from the sugar factory and a part of the juice from the last pressing produced in the mills, with the aim of obtaining a greater yield in crystallised sugar, on using the greater proportion of invert sugars in these juices in fermentation.

The amount of juice set for the alcohol plant is equal to that from 20% of the cane worked.

The greatest yield in crystallised sugar we shall set at 5% over the normal yield and in the two types of of sugar produced.

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The alcohol plant will be so designed that the prefermentation and fermentation have a capacity of 60,000 l/day, and distillery 90,000 l/day.

The analysis for the expansion of equipment is simpler than that developed in our Alternative A, and we agree with Señor Rodilla that it could be done as follows, and we shall only mention below those which differ from those we proposed in our previous alternative.

Purification

As the amount of cake obtained in Jiboa is 1.81% of the weight of the cane, and it is intended to carry on with the same amount, it is not necessary for the expansion envisaged to instal a new filter.

Evaporation

It is considered to increase the surface area by 1,500m^2.

Although according to our point of view this increase in surface area is a bit on the short side, we consider that taking great care in the cleaning of the evaporation and the purification of the juice, the 5,000 short tons a day ,may be worked using a total surface of 4,970 m^2.

Sugar Boiling

it is considered that it is not necessary to increase the number of pans in order to work the 5,000 short tons.

From our point of view, the evaporation should function perfectly, in order to decrease the times used by the pans, the syrup should have a content of dry matter

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of at least 70%.

Crystallisers

It isnot necessary to increase the crystallisers either.

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Revision of Alcohol Plant of 60,000 l/d

In accordance with the comments received on the visit to El Salvador we shall noe describe the points revised affecting the alcohol plant and which essentially are the following:

- Amount of cane 500,000 short tons = 450,000 tonnes
- Work capacity of the sugar factory 5,000 short tons/ dat = 4,500 tonnes.
- Juice of last pressing, the equivalent to that obtained from 20% of the cane.
- Percentage yields of the cane.
  For molasse = 5.68 - (10% x 5.68) = 5.11.
- Storage capacity of exiating molasse 6,000 m^3.

Staring from these data the following decisions have been taken:

1) The alcohol plant will be of 60,000 l/day, decreasing the units of must preparation and fermentation to this capacity i.e. 60,000 l/day and leaving the distillation-dehydration at the previously mentioned capacity of 90,000 l/day, although it will operate at 60,000 l/day.

2) Work days of the alcohol plant. The plant will operate using juice 500,000 ÷ 5,000 = 100 days and with molasse (450,000 - 0,0,2 x 450,000) x 0.0511 = 18,396 tonnes.

   As 60,000 l/day of molasse alcohol dorresponds to 60,000 x 3.5 = 210,000 kg molasse/day.

   18,386 ÷ 210 = 87.6 days functions the alcohol plant on molasses alone.

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All these changes have meant modifications which we shall now describe in detail.

Storage of Molasse

Quantity oif molasse to store 18,396 tonnes.

Density = 1.4 which is equal to 13,140 m^3.

As the molasse storage capacity existing is 6,000 m^3 (greatly higher than that we had prebiously supposed of 1,890 m^3) and as the quantity of the molasse to be stored is less, the saving in this section is very considerable as we only have to provide tankage for:

$$13,140\ m^3\ 8\ 6,000\ m^3 = 7,140\ m^3.$$

which is solved by one set of four tanks of 1890 m^3 = 7,560 m^3 of storage and the set of four storage tanks of 3,000 m^3 = 12,000 m^3 we had previously enivsaged can be done away with.

Preparation of Musts

The change from 90,000 l/day to 60,000 l/day does not affect at all the description of the process of the number of items of equipment, some, like centrifuges are the same, as their design gives very high jumps in capacity, only the dimensioning of some equipment (tanks, pipes, valves, etc.) will decrease in size as a consequence of the lower flow rate, so that the decrease in investment will not be high and we think you would have to think it over if the decrease in capacity of the unit is worth it or not.

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Balance of Matter and Energy

We include the new balance for the preparation of musts.

Fermentation and Yeast recovery.

The reduction in capacity of this unit from 90,000 l/day to 60,000 l/day would not affect the process at all, as it is the same as that described before. It will however change the equipment lists as the number and size of the vats will be reduced, and also the number of hydraulic seals, plate heat exchangers and pumps and also the dimensioning of equipment which is common,, so-that the reduction in investment is considerable and it is always possible to increase this unit to 90,000 l/day at low cost when needed taking this into account and leaving suitable and sufficient space for a future expansion.

Balance of Matter and Energy

We include the new balance for fermentation and recirculation of yeast.

Distillation-Rectification and Dehydration.

This unit has remainedas it was, that is designed for 90,000 l/day. but as it is going to operate at 60,000 l/day we include the new balance of matter and energy sheet.

Storage of Final Product

We maintain the criterion of having a storage capacity for the final product (alcohol) equal to one month's nominal production, which gives a reduction from 3,000 m^3 to 2,000 m^3 of capacity, distributed

SENER

in two vertical API type tanks of 1000 m^3 capacity each instead of 1,500 m^3 each with the consequent reduction in investment, the other equipment remaining unchanged.

Storage of Sediment (Vinazas)

In this section there have been substantial reductions due to the modifications introduced, as the dailt quantities of production of sediment have changed, as have the days of operation.

Previous Case

estimated production of sediment per hour 55 tonnes
(90,000 l/day)
Days of operation of the alcohol plant: 239 days
Storage capacity for sediment: 55 x 24 x 239 = 315,480 tonnes

present Case

Estimated production of sediment per hour 36 tonnes
(60,000 l/day)
Days of operation of alcohol plant: 188 days
Storage capacity for sediment 36 x 24 x 188 = 162,432 tonnes

Which is a reduction in the storage capacity for sediment of near 50 %

6.5.2 Investment costs. Alternative "D"

Sugar factory

Installed capacity 4,500 mT/day (100 days harvest)

	Foreighn Currency $	Local Currency$	Total $
Main equipment	410,000	120,000	530,000
Service equipment	300,000	80,000	380,000
Miscellaneous equipment	-	200,000	200,000
Freight & insurance	-	80,000	80,000
Interning of equipment	-	35,000	35,000
Installation of equipment	-	330,000	330,000
Installation of misc. equip.	-	160,000	160,000
Preparation of land	-	-	-
Civil engineering work	-	200,000	200,000
Licences & royalties	-	-	-
Engineering	-	140,000	140,000
Management & property costs	-	110,000	110,000
Utilities & eventualities	120,000	115,000	235,000
Total	830,000	1,570,00	2,400,000

6.5.2 Investment Costs. Alternative "D"

Distillery

Installed capacity 60,000 l/day (187,6 operation days)

	Foreign Currency $	Local Currency$	Total $
Main equipment	580,000	4,140,000	4,720,000
Service equipment	220,000	720,000	940,000
Micelaneous equipment	90,000	2,800,000	2,890,000
Freight & insurance	-	200,000	200,000
Interning of equipment	-	130,000	130,000
Installation of equipment	-	440,000	440,000
Installation of misc.equip.	-	900,000	900,000
Preparation of land	-	54,000	54,000
Civil engineering work	-	496,000	496,000
Licences & royalties	120,000	-	120,000
Engineering	-	450,000	450,000
Management & property costs	-	220,000	220,000
Utilities & eventualities	130,000	810,000	940,000
Total	1,140,000	11,360,000	12,500,000

6.5.2 Investment costs. Alternative "D" Total of complex

Sugar Factory & Distillery

	Foreign Currency $	Local Currency$	Total $
Main equipment	990,000	4,260,000	5,290,000
Service equipment	520,000	800,000	1,320,000
Miscellanous equipment	90,000	3,000,000	3,090,000
Freigth & insurance	-	280,000	280,000
Interning of equipment	-	165,000	165,000
Installation of equipment	-	770,000	770,000
Installation of misc. equip.	-	1,060,000	1,060,000
Preparation of land	-	54,000	54,000
Civil engineering work	-	696,000	696,000
Licences & royalties	120,000	-	120,000
Engineering	-	590,000	590,000
Management & property costs	-	330,000	330 000
Utilities and eventualities	250,000	925,000	1,175,000
Total	1,970,000	12,930,000	14,900,000

6.5.3 SUGAR FACTORY . Alternative "D"

Annual Production Costs at 100% capacity	Annual cuantity	Unit costs $	Foreign currency $	Local currency $
Days of Harvest=100				
1. Raw materials			-	
Sugar cane tonnes	450,000	22,2	-	9,999,000
Additives	-	-	85,000	-
2. Services				
Electricity(CLES)				
KW-h				
Water				
3. Other costs				15,000
4. Maintenance & operation equipment	-	-	35,000	115,000
5. Labour				
Direct				700,000
Indirect				100,000
6. Fianancial costs	According to the type of credit			
7. Depreciation	10 % yearly			

6.5.3 ALCOHOL PLANT Alternative "D"

Annual production costs, annual at 100 % capacity

	Unit costs $	Foreign currency $	Local currency $
1. Raw materials			
Molasse 18.396 mT.	30	-	551,880
Bagasse 20,636 mT.	35,8	-	738,768
Purified juice from 90,000 mT. of cane	24	-	2,160,000
Process materials			255,200
Maintenance materials			64,000
Labour			230,400
Financial costs	According to type of credit		
Depreciation	10 % annaul		

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(3 of 3)

3503

FEASIBILITY STUDY FOR "JIBOA" SUGAR FACTORY EXPANSION (SAN VICENTE) EL SALVADOR

VOLUME III

PROJECT No. DP/ELS/78/001. Industrial Promotion

SENER Reference: PQ-3040

DATE: July 1982

SENER

7. ECONOMIC-FINANCIAL EVALUATION

7. ECONOMIC AND FINANCIAL EVALUATION

7. ECONOMIC AND FINANCIAL EVALUATION

7.1. Methodology

The purpose of the economic and financial evaluation was to discover which of the three alternatives plans for the expansion of the JIBOA complex which were studied, was of most interest from the economic and financial standpoint.

In carrying out analyses of profitability use was made of the discounted cash flow technique, which builds into the calculation the way the effect of figures expressed in money terms varies according to the moment of time at which the sum in question is payable.

Measurement of profitability was carried out with one of the most widely used and reliable financial indicators, the Internal Rate of Return, which equates the present values of inflows and outflows of funds arising from the project under study.

Also calculated for each alternative studied was the pay-back in real terms, an indicator which measures the period of time required to recover the investment from the funds generated by the project, and also the net present value.

For each alternative an analysis was made first of the profitability of the marginal investment, taking into account marginal cash flows generated by the expansion under study and comparing them with the investment required for that expansion.

Then the economic and financial perfomance of the project overall was studied for each alternative, including in the calculation the present situation of the sugar factory. In this case, moreover , a calculation was made which took into account the method by which the project was to be financed, and return on equity capital was calculated.

Finally, in order to measure how strongly the indicators of profitability obtained would stand up to the changes in the variables regarded as most significant from the economic and financial standpoint, a series of additional sensivity analyse was carried out.

That study was undertaken with the MECRIN computer program, developed by SENER, on SENER's own Control Data Cyber 270 computer.

During the visit to El Salvador in June, the Salvadorian authorities requested SENER to modify some of the parameters used in the draft submitted for comment and to take into account some new considerations. This has been carried out in what we have thought it appropiate to call Alternative "D", for which calculations were carried out similar to those done for the other alternatives.

7.2 Basic Data

The basic assumptions used in the economic and financial evaluations made in the course of the study were the following:

As regards time series, assumptions were made as follows:

- Beguining of period studied : 1983
- Duration of period studied : 25 years.
- Unit of analysis : 1 year.

7.2.1. General Data

All investment costs have been calculated at prices ruling in May 1982. An overall escalation factor of 11% compound is assumed.

Production costs are also based on market prices as of May 1982, subject to the exceptions and specific considerations set out in 7.2.2. Throughout the life of the project an 11% price escalation is likewise assumed.

As regards the financing of the fixed capital on which this study is based, we have assumed a priori three sources of financing:

- Financing as far as possible from general funds - for the complex, that means self-financing.

- What cannot be self-financed will be financed as to 10% by contributions from the Government of El Salvador through the company which owns JIBOA by means of an increase in the share capital of that company, and as to the remaining 90% by a loan to be obtained from international banks at a rate of interest of 17% per annum payable half-yearly, with a grace period of 4 years from signature and repayment of principal over 10 years.

- Working capital will be financed by short-term bank credit at a rate of interest of 20%.

Since the JIBOA factory belongs to the State, a nil tax liability on the profits has been assumed.

In the studies of the individual cases, any changes in these basic assumptions will be pointed out.

7.2.2. Basic assumptions - unit costs

Given the fundamental way in which the profitability study is affected by certain raw material and energy prices, we set out below the values which have been chosen for such prices.

a) Sugar price.

In this study we shall take as the base price

of crystal sugar,	$ 0.45 per Kg.
of raw sugar,	$ 0.34 per Kg.

which are the data established by INAZUCAR for March 1982 and given to SENER in the meeting in El Salvador at the end of June. They are home market prices.

b) Cane price.

The available information gathered on our visit to El Salvador showed the factory gate price of sugar cane for the country as a whole is 50 colones a short ton, equivalent to a cost of $ U.S 22.22 per tonne.

c) Alcohol price.

In the context of this study, this price can be regarded as a matter of policy, as is the price of gasoline. At present the home price of 200º proof alcohol is significantly below the equivalent fob price on the east coast of the United States.

For the central case of our study the base value for the price of fuel alcohol has been fixed at 3.23 colones a gallon (= $ U.S. 1.292). It is not expected to vary downwards.

At the request of the Salvadorian authorities a sensivity study was carried out on the basis of $ 1.63 a gallon for the export market and of $ 4.54 a gallon for non-denatured alcohol, but these prices are not supported by any market study.

d) Molasses price.
As it is to go basically for agricultural and stock-rearing purposes and/or as raw material for distilleries (in Alternatives "C" and "D" of our study) we shall use these prices according to the final use of the molasses:

- Alternatives "A" and "B" : $ 0.02 per Kg.;
- Alternatives "C" and "D" : $ 0.03 per Kg.,

delivery at the sugar factory being assumed in either case.

e) Vinasse price.
Given that this is an effluent with no industrial use other than as fertiliser, it has been assigned zero value in this study.

f) Board price.
It can be seen from the market study in Chapter 5.3 that the home market price of particleboard in El Salvador in 1979 was $ 228 per cu. m. The average price of such board on the world market was $ 161 per cu. m.

With these parameters, given their annual trend, we would venture to assume for this study that the home market price will remain at $ 228 and that it will tend to approach the world market level.

g) Bagasse price.
It is the judgment of the FAO that six tons of bagasse with 50% liquid content can, in terms of energy yield, be substituted for one ton of fuel oil. Although the boiler combustion efficiency of bagasse is inferior to that obtained by burning fuel oil, we base the price of bagasse for the purposes of this survey on the FAO formula.

7.3. INDICATORS OF PROFITABILITY

As was said under point 7.1, two calculations have been made for Alternatives "A" and "B" (and only the second of them for Alternatives "C" and "D"):

The first calculation took into account the marginal value added by the act of making the expansion.

The second studied the project in global terms. For this calculation the existing complex was valued at $ U.S. 40,000,000 and was regarded as just another investment, capitalised in the same way as the investments in expansion.

For the calculation of the profitability of equity capital, the contributions of the Government of El Salvador were considered to fall into that category.

All the data and results of the economic study are collected in the attached computer output, from which one can see, for each alternative:

- First, a listing of the data used in the calculation.
- Next, year by year summaries of investments, loans, income and expenditure, showing the evolution of these variables over time.
- Thirdly, one can see the data on profitability of the investment without financing, together with the relevant sensitivity analysis.
- Finally, but only in the cases when the project is being studying globally, one can see the results relating to return on equity capital.

04.08.82

JIBOA SUGAR FACTORY STUDY
UNIDO

CASE A1.- INSTALLED CAPACITY 5000 TC/D
- 104 DAYS GRINDING SEASON

NUMBER OF PERIODS PER YEAR	1	
START OF STUDY	1983	
PROJECT LIFE	25	YEARS
STARTUP	1984	

INVESTMENTS AND INITIAL EXPENSES

DESCRIPTION	DATE	AMOUNT	INV AMT	INV DEP
FIXED ASSET	1983	4852.	*-L	*-L
WORKING CAPITAL	1984	1846.	*-K	*-K

SALVAGE VALUE	R	R.RATE ANUALPC
486.		

04.08.82

JIBOA SUGAR FACTORY STUDY
UNIDO

OPERATING COSTS

DESCRIPTION	----P E R I O D--- IN.DATE	FIN.DATE	---AMOUNT---- IN.VAL	INCR	K
CANE SUGAR	1984	*	68.06		
RAW MATERIAL	1984	*	1.00		
MAINTE. MATERIAL	1984	*	1.00		
LABOUR	1984	*	1.00		

INCOME - PRODUCTION AND SALES

DESCRIPTION	----P E R I O D--- IN.DATE	FIN DATE	---AMOUNT---- IN.VAL	INCR	K
CRISTAL SUGAR	1984	*	5585.		
RAW SUGAR	1984	*	1766.		
MOLASSE	1984	*	3530.		
BAGASSE	1984	*	4480.		
CAKE	1984	*	1224.		

TAX RATE	0.00	ANUAL PC
LOSS CARRY FORWARDS	0	YEARS
AVERAGE COST OF MONEY	17.00	ANUAL PC
AVERAGE INTEREST OF MONEY	17.00	ANUAL PC

--UNIT.COST--		
IN.VAL	INCR	K
------	----	-
27.4	11.0	A
18.5	11.0	A
0.	11.0	A
601.	11.0	A

--UNIT.PRICE-		
IN.VAL	INCR	K
------	----	-
.51	11.0	A
.42	11.0	A
.025	11.0	A
.040	11.0	A
.000	11.0	A

JIBOA SUGAR FACTORY STUDY
UNIDO

INVESTMENTS RESUME

T	FIXED ASSET	WORKING CAPITAL	TOTAL
1983	4852.	0.	4852.
1984	0.	1846.	1846.
1985	0.	0.	0.
1986	0.	0.	0.
1987	0.	0.	0.
1988	0.	0.	0.
1989	0.	0.	0.
1990	0.	0.	0.
1991	0.	0.	0.
1992	0.	0.	0.
1993	0.	0.	0.
1994	0.	0.	0.
1995	0.	0.	0.
1996	0.	0.	0.
1997	0.	0.	0.
1998	0.	0.	0.
1999	0.	0.	0.
2000	0.	0.	0.
2001	0.	0.	0.
2002	0.	0.	0.
2003	0.	0.	0.
2004	0.	0.	0.
2005	0.	0.	0.
2006	0.	0.	0.
2007	0.	0.	0.
TOTAL	4852.	1846.	6698.

JIBOA SUGAR FACTORY STUDY
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OPERATING COSTS RESUME

T	CANE SUGAR	RAW MATERIAL	MAINTE. MATERIAL	LABOUR	TOTAL
1983	0.	0.	0.	0.	0.
1984	1865.	19.	0.	601.	2484.
1985	2070.	21.	0.	667.	2758.
1986	2298.	23.	0.	740.	3061.
1987	2550.	25.	0.	822.	3398.
1988	2831.	28.	0.	912.	3771.
1989	3142.	31.	0.	1013.	4186.
1990	3488.	35.	0.	1124.	4647.
1991	3872.	38.	0.	1248.	5158.
1992	4298.	43.	0.	1385.	5725.
1993	4770.	47.	0.	1537.	6355.
1994	5295.	53.	0.	1706.	7054.
1995	5878.	58.	0.	1894.	7830.
1996	6524.	65.	0.	2103.	8691.
1997	7242.	72.	0.	2334.	9647.
1998	8038.	80.	0.	2591.	10709.
1999	8923.	89.	0.	2876.	11887.
2000	9904.	98.	0.	3192.	13194.
2001	10993.	109.	0.	3543.	14645.
2002	12203.	121.	0.	3933.	16256.
2003	13545.	134.	0.	4365.	18045.
2004	15035.	149.	0.	4845.	20030.
2005	16689.	166.	0.	5378.	22233.
2006	18525.	184.	0.	5970.	24678.
2007	20562.	204.	0.	6627.	27393.
TOTAL	190539.	1890.	0.	61407.	253836.

JIBOA SUGAR FACTORY STUDY
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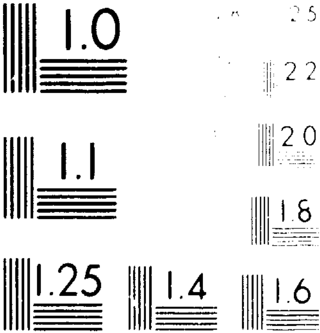
INCOMES RESUME

T	CRISTAL SUGAR	RAW SUGAR	MOLASSE	BAGASSE	CAKE	TOTAL
1983	0.	0.	0.	0.	0.	0.
1984	2848.	742.	88.	179.	0.	3858.
1985	3162.	823.	98.	199.	0.	4292.
1986	3509.	914.	109.	221.	0.	4753.
1987	3895.	1014.	121.	245.	0.	5276.
1988	4324.	1126.	134.	272.	0.	5856.
1989	4800.	1250.	149.	302.	0.	6500.
1990	5328.	1387.	165.	335.	0.	7215.
1991	5914.	1540.	183.	372.	0.	8009.
1992	6564.	1709.	203.	413.	0.	8890.
1993	7286.	1897.	226.	458.	0.	9868.
1994	8088.	2106.	251.	509.	0.	10953.
1995	8977.	2338.	278.	565.	0.	12158.
1996	9965.	2595.	309.	627.	0.	13495.
1997	11061.	2880.	343.	696.	0.	14980.
1998	12278.	3197.	380.	772.	0.	16628.
1999	13628.	3549.	422.	857.	0.	18457.
2000	15127.	3939.	469.	952.	0.	20487.
2001	16791.	4373.	520.	1056.	0.	22740.
2002	18638.	4853.	577.	1173.	0.	25242.
2003	20689.	5387.	641.	1302.	0.	28018.
2004	22964.	5980.	711.	1445.	0.	31101.
2005	25490.	6638.	790.	1604.	0.	34522.
2006	28294.	7368.	877.	1780.	0.	38319.
2007	31407.	8178.	973.	1976.	0.	42534.
TOTAL	291028.	75785.	9017.	18310.	0.	394139.


1.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

JIBOA SUGAR FACTORY STUDY
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INVESTMENT CASH-FLOW ANALISYS (WITHOUT FINANCING)

T	INVESTM	INCOME	SALVAGE VALUE	EXPENSES	INVESTM DEPREC.	PROFIT AFT.TAX	OPERAT. C.FLOW	PRESENT NET VAL
1983	4852.	0.	0.	0.	0.	0.	0.	0.
1984	1846.	3858.	0.	2484.	202.	1171.	1373.	313.
1985	0.	4282.	0.	2758.	202.	1322.	1524.	485.
1986	0.	4753.	0.	3061.	202.	1490.	1692.	755.
1987	0.	5276.	0.	3398.	202.	1676.	1878.	1102.
1988	0.	5856.	0.	3771.	202.	1882.	2085.	1507.
1989	0.	6500.	0.	4186.	202.	2112.	2314.	1954.
1990	0.	7215.	0.	4647.	202.	2366.	2568.	2432.
1991	0.	8009.	0.	5158.	202.	2649.	2851.	2929.
1992	0.	8890.	0.	5725.	202.	2962.	3165.	3438.
1993	0.	9868.	0.	6355.	202.	3310.	3513.	3952.
1994	0.	10953.	0.	7054.	202.	3697.	3899.	4466.
1995	0.	12158.	0.	7830.	202.	4126.	4328.	4975.
1996	0.	13495.	0.	8691.	202.	4602.	4804.	5475.
1997	0.	14980.	0.	9647.	202.	5130.	5332.	5965.
1998	0.	16628.	0.	10709.	202.	5717.	5919.	6443.
1999	0.	18457.	0.	11887.	202.	6368.	6570.	6906.
2000	0.	20487.	0.	13194.	202.	7091.	7293.	7354.
2001	0.	22740.	0.	14645.	202.	7893.	8095.	7787.
2002	0.	25242.	0.	16256.	202.	8783.	8985.	8203.
2003	0.	28018.	0.	18045.	202.	9772.	9974.	8603.
2004	0.	31101.	0.	20030.	202.	10869.	11071.	8987.
2005	0.	34522.	0.	22233.	202.	12087.	12289.	9354.
2006	0.	38319.	0.	24678.	202.	13438.	13641.	9705.
2007	0.	42534.	2332.	27393.	202.	15425.	17473.	10041.
TOTAL	6698.	394139.	2332.	253836.	4852.	135937.	142635.	10041.

INTERNAL RATE OF RETURN = 32.702 ANUAL PC

DISCOUNTED PAY BACK = 6.270 YEARS

MINIMUM PROJECT LIFE = 0.000 YEARS

04.08.82

JIBOA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE CANE SUGAR PRICE

CANE PRICE	I.R.R	PAY-BACK	MINIMUN LIFE
27.40	32.702	6.270	0.000
28.77	31.078	6.818	0.000
30.14	29.444	7.475	0.000
31.51	27.793	8.271	0.000
32.88	26.119	9.261	4.534
34.25	24.415	10.530	6.802
35.62	22.670	12.212	9.371
36.99	20.870	14.570	12.588
38.36	18.995	18.137	16.987

SENSITIVITY TO THE SUGAR PRICE

CRISTAL SUGAR	RAW SUGAR	I.R.R	PAY-BACK	MINIMUN LIFE
.204	.168	*	*	*
.255	.210	*	*	*
.306	.252	*	212.285	*
.357	.294	11.106	45.931	70.216
.408	.336	19.566	16.886	15.494
.459	.378	26.371	9.095	0.000
.510	.420	32.702	6.270	0.000
.561	.462	38.899	4.790	0.000
.612	.504	45.092	3.877	0.000
.663	.546	51.330	3.259	0.000
.714	.588	57.631	2.810	0.000
.765	.630	63.997	2.473	0.000

04.09.82

JIBOA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE PRODUCTION CAPABILITY

PRODUCT. CAPABIL.	I.R.R	PAY-BACK	MINIMUN LIFE
.600	20.129	15.806	14.165
.650	21.822	13.226	10.799
.700	23.460	11.393	8.162
.750	25.057	10.010	5.955
.800	26.623	8.937	0.000
.850	28.165	8.074	0.000
.900	29.689	7.369	0.000
.950	31.200	6.774	0.000
1.000	32.702	6.270	0.000

SENSITIVITY TO THE INVESTMENT IN FIX ASSET

INVESTM. FACTOR	I.R.R	PAY-BACK	MINIMUN LIFE
1.000	32.702	6.270	0.000
1.050	31.809	6.554	0.000
1.100	30.981	6.837	0.000
1.150	30.209	7.127	0.000
1.200	29.488	7.426	0.000
1.250	28.812	7.725	0.000
1.300	28.176	8.025	0.000
1.350	27.577	8.340	0.000
1.400	27.011	8.655	3.838

JIBOA SUGAR FACTORY STUDY
UNIDO

CASE A2.- INSTALLED CAPACITY : 5000 TC/D
- 104 DAYS GRINDING SEASON
- INCLUDED THE ACTUAL SUGAR FACTORY

NUMBER OF PERIODS PER YEAR 1
START OF STUDY 1983
PROJECT LIFE 25 YEARS
STARTUP 1983

INVESTMENTS AND INITIAL EXPENSES

DESCRIPTION	DATE	AMOUNT	INV AMT	INV DEP	SALVAGE VALUE	R	R.RATE ANUALPC
FIXED ASSETS	1983	4852.	*-L	*-L	486.		
SALE VALUE	1983	40000.	*-L	*-L	4000.		
WORKING CAPITAL	1983	5511.	*-K	*-K			
-	1984	1946.	*-K	*-K			

EQUITY

DESCRIPTION	DATE	AMOUNT
EQUITY	1983	4056.4

LOANS

DESCRIPTION	DATE	AMOUNT	INT.RATE ANUAL PC	PARAMETERS K	PG	PI	PA	RET. PER.
BANK LOAN	1983	36507.6	17.00	AK	4	1	1	6

JIBOA SUGAR FACTORY STUDY
UNIDO

OPERATING COSTS

DESCRIPTION	PERIOD IN.DATE	PERIOD FIN.DATE	AMOUNT IN.VAL	AMOUNT INCR	AMOUNT K	UNIT.COST IN.VAL	UNIT.COST INCR	UNIT.COST K
CANE SUGAR	1983		400.			24.6	11.0	A
-	1984	*	468.			-	11.0	A
RAW MATERIAL	1983		1.00			98.	11.0	A
-	1984	*	1.00			128.	11.0	A
MAINTE. MATERIAL	1983		1.00			170.	11.0	A
-	1984	*	1.00			192.	11.0	A
LABOUR	1983		1.00			915.	11.0	A
-	1984	*	1.00			1615.	11.0	A

INCOME - PRODUCTION AND SALES

DESCRIPTION	PERIOD IN.DATE	PERIOD FIN DATE	AMOUNT IN.VAL	AMOUNT INCR	AMOUNT K	UNIT.PRICE IN.VAL	UNIT.PRICE INCR	UNIT.PRICE K
CRISTAL SUGAR	1983		30760.			.50	11.0	A
-	1984	*	35945.			-	11.0	A
RAW SUGAR	1983		10480.			.38	11.0	A
-	1984	*	12246.			-	11.0	A
MOLASSE	1983		22720.			.022	11.0	A
-	1984	*	26520.			-	11.0	A
BAGASSE	1983		24000.			.040	11.0	A
-	1984	*	28080.			-	11.0	A
CAKE	1983		7200.			.000	11.0	A
-	1984	*	8424.			.000	11.0	A

TAX RATE	0.00	ANNUAL PC
LOSS CARRY FORWARDS	0	YEARS
AVERAGE COST OF MONEY	17.00	ANNUAL PC
AVERAGE INTEREST OF MONEY	17.00	ANNUAL PC

JIBOA SUGAR FACTORY STUDY
UNIDO

INVESTMENTS RESUME

T	FIXED ASSETS	SALE VALUE	WORKING CAPITAL	TOTAL
1983	4852.	40000.	5511.	50363.
1984	0.	0.	0.	0.
1985	0.	0.	0.	0.
1986	0.	0.	0.	0.
1987	0.	0.	0.	0.
1988	0.	0.	0.	0.
1989	0.	0.	0.	0.
1990	0.	0.	0.	0.
1991	0.	0.	0.	0.
1992	0.	0.	0.	0.
1993	0.	0.	0.	0.
1994	0.	0.	0.	0.
1995	0.	0.	0.	0.
1996	0.	0.	0.	0.
1997	0.	0.	0.	0.
1998	0.	0.	0.	0.
1999	0.	0.	0.	0.
2000	0.	0.	0.	0.
2001	0.	0.	0.	0.
2002	0.	0.	0.	0.
2003	0.	0.	0.	0.
2004	0.	0.	0.	0.
2005	0.	0.	0.	0.
2006	0.	0.	0.	0.
2007	0.	0.	0.	0.
TOTAL	4852.	40000.	5511.	50363.

05.08.82

JIBDA SUGAR FACTORY STUDY
UNIDO

INTERNATIONAL BANKS LOANS

T	LOANS	LOAN INTEREST	LOAN AMORT.	AMORT. + INTEREST	UNPAID BALANCE
1983	36507.6	0.0	0.0	0.0	36507.6
1984	0.0	6206.3	0.0	6206.3	36507.6
1985	0.0	6206.3	0.0	6206.3	36507.6
1986	0.0	6206.3	0.0	6206.3	36507.6
1987	0.0	6206.3	0.0	6206.3	36507.6
1988	0.0	6206.3	6084.6	12290.9	30423.0
1989	0.0	5171.9	6084.6	11256.5	24338.4
1990	0.0	4137.5	6084.6	10222.1	18253.8
1991	0.0	3103.1	6084.6	9187.7	12169.2
1992	0.0	2068.8	6084.6	8153.4	6084.6
1993	0.0	1034.4	6084.6	7119.0	0.0
1994	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0
2004	0.0	0.0	0.0	0.0	0.0
2005	0.0	0.0	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0	0.0
2007	0.0	0.0	0.0	0.0	0.0
TOTAL	36507.6	46547.2	36507.6	83054.8	0.0

05.08.82

JIRDA SUGAR FACTORY STUDY
UNIDO

OPERATING COSTS RESUME

T	CANE SUGAR	PAN MATERIAL	MAINTE. MATERIAL	LABOUR
1983	9840.	98.	170.	915.
1984	12779.	128.	192.	1615.
1985	14185.	142.	213.	1793.
1986	15745.	158.	237.	1990.
1987	17477.	175.	263.	2209.
1988	19400.	194.	291.	2452.
1989	21534.	216.	324.	2721.
1990	23902.	239.	359.	3021.
1991	26532.	266.	399.	3353.
1992	29450.	295.	442.	3722.
1993	32690.	327.	491.	4131.
1994	36286.	363.	545.	4586.
1995	40277.	403.	605.	5090.
1996	44707.	448.	672.	5650.
1997	49625.	497.	746.	6271.
1998	55084.	5[illegible]	829.	6961.
1999	61143.	612.	919.	7727.
2000	67869.	680.	1020.	8577.
2001	75335.	755.	1132.	9521.
2002	83621.	838.	1256.	10568.
2003	92820.	930.	1395.	11730.
2004	103030.	1032.	1548.	13021.
2005	114363.	1145.	1718.	14453.
2006	126943.	1271.	1907.	16043.
2007	140907.	1411.	2117.	17807.
TOTAL	1315545.	13176.	19787.	165926.

TOTAL
11023.
14714.
16333.
18129.
20124.
22337.
24794.
27522.
30549.
33909.
37639.
41780.
46376.
51477.
57139.
63425.
70401.
78146.
86742.
96283.
106874.
118631.
131690.
146165.
162243.
1514435.

JIBOA SUGAR FACTORY STUDY
UNIDO

INCOMES RESUME

T	CRISTAL SUGAR	RAW SUGAR	MOLASSE	BAGASSE	CAKE	TOTAL
1983	15390.	3982.	500.	960.	0.	20832.
1984	19949.	5165.	648.	1247.	0.	27009.
1985	22144.	5734.	719.	1384.	0.	29980.
1986	24580.	6364.	798.	1536.	0.	33278.
1987	27284.	7064.	886.	1705.	0.	36939.
1988	30285.	7841.	983.	1893.	0.	41002.
1989	33616.	8704.	1091.	2101.	0.	45512.
1990	37314.	9661.	1211.	2332.	0.	50518.
1991	41418.	10724.	1345.	2588.	0.	56075.
1992	45974.	11904.	1492.	2873.	0.	62244.
1993	51031.	13213.	1657.	3189.	0.	69091.
1994	56645.	14667.	1839.	3540.	0.	76691.
1995	62876.	16280.	2041.	3929.	0.	85126.
1996	69792.	18071.	2266.	4362.	0.	94490.
1997	77469.	20059.	2515.	4841.	0.	104884.
1998	85991.	22265.	2792.	5374.	0.	116422.
1999	95450.	24714.	3099.	5965.	0.	129228.
2000	105950.	27433.	3439.	6621.	0.	143443.
2001	117604.	30450.	3818.	7350.	0.	159222.
2002	130540.	33800.	4239.	8158.	0.	176736.
2003	144900.	37518.	4704.	9056.	0.	196177.
2004	160839.	41645.	5221.	10052.	0.	217757.
2005	178531.	46226.	5796.	11157.	0.	241710.
2006	198170.	51311.	6433.	12385.	0.	269298.
2007	219968.	56955.	7141.	13747.	0.	297811.
TOTAL	2053701.	531749.	66570.	128346.	0.	2780465.

JIBOA SUGAR FACTORY STUDY
UNIDO

INVESTMENT CASH-FLOW ANALISYS (WITHOUT FINANCING)

T	INVESTM	INCOME	SALVAGE VALUE	EXPENSES	INVESTM DEPREC.	PROFIT AFT.TAX	OPERAT. C.FLOW	PRESENT NET VAL
1983	50363.	20822.	0.	11023.	0.	9799.	9799.	9799.
1984	1846.	27009.	0.	14714.	1869.	10426.	12295.	11553.
1985	0.	29980.	0.	16333.	1869.	11779.	13647.	14019.
1986	0.	33278.	0.	18129.	1869.	13280.	15149.	17242.
1987	0.	36939.	0.	20124.	1869.	14946.	16815.	21039.
1988	0.	41002.	0.	22337.	1869.	16796.	18665.	25259.
1989	0.	45512.	0.	24794.	1869.	18849.	20718.	29777.
1990	0.	50518.	0.	27522.	1869.	21128.	22997.	34493.
1991	0.	56075.	0.	30549.	1869.	23658.	25526.	39326.
1992	0.	62244.	0.	33909.	1869.	26465.	28334.	44210.
1993	0.	69091.	0.	37639.	1869.	29582.	31451.	49092.
1994	0.	76691.	0.	41780.	1869.	33042.	34911.	53931.
1995	0.	85126.	0.	46376.	1869.	36882.	38751.	58693.
1996	0.	94490.	0.	51477.	1869.	41145.	43013.	63355.
1997	0.	104884.	0.	57139.	1869.	45876.	47745.	67896.
1998	0.	116422.	0.	63425.	1869.	51128.	52997.	72303.
1999	0.	129228.	0.	70401.	1869.	56958.	58827.	76565.
2000	0.	143443.	0.	78146.	1869.	63429.	65297.	80677.
2001	0.	159222.	0.	86742.	1869.	70611.	72480.	84634.
2002	0.	176736.	0.	96283.	1869.	78584.	80453.	88433.
2003	0.	196177.	0.	106874.	1869.	87434.	89303.	92077.
2004	0.	217757.	0.	118631.	1869.	97257.	99126.	95564.
2005	0.	241710.	0.	131680.	1869.	108161.	110030.	98899.
2006	0.	268298.	0.	146165.	1869.	120264.	122133.	102084.
2007	0.	297811.	11843.	162243.	1869.	138185.	147411.	105123.
TOTAL	52209.	2780465.	11843.	1514435.	44852.	1225664.	1277873.	105123.

INTERNAL RATE OF RETURN = 40.253 ANUAL PC

DISCOUNTED PAY BACK = 4.380 YEARS

MINIMUM PROJECT LIFE = 0.000 YEARS

05.08.82

JIRDA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE CANE SUGAR PRICE

PRECIO CANA	I.R.R	PAY-BACK	MINIMUM LIFE
24.60	40.253	4.380	0.000
25.83	38.361	4.712	0.000
27.06	36.505	5.087	0.000
28.29	34.691	5.526	0.000
29.52	32.885	6.024	0.000
30.75	31.113	6.621	0.000
31.98	29.359	7.325	0.000
33.21	27.617	8.177	0.000
34.44	25.879	9.235	0.000

SENSITIVITY TO THE SUGAR PRICE

CRISTAL SUGAR	RAW SUGAR	I.R.R	PAY-BACK	MINIMUM LIFE
.200	.152	*	*	*
.250	.190	*	238.571	0.000
.300	.228	10.934	50.852	0.000
.350	.266	19.150	17.619	0.000
.400	.304	26.119	9.072	0.000
.450	.342	33.008	5.987	0.000
.500	.380	40.253	4.380	0.000
.550	.418	48.097	3.384	0.000
.600	.456	56.720	2.707	0.000
.650	.494	66.286	2.217	0.000
.700	.532	76.976	1.845	0.000
.750	.570	89.007	1.557	0.000

JIRDA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE PRODUCTION CAPABILITY

PRODUCT. CAPABIL.	I.R.R	PAY-BACK	MINIMUN LIFE
.400	19.532	16.791	0.000
.450	21.279	13.785	0.000
.500	22.990	11.686	0.000
.550	24.679	10.124	0.000
.600	26.359	8.917	0.000
.650	28.036	7.952	0.000
.700	29.720	7.167	0.000
.750	31.415	6.513	0.000
.800	33.131	5.951	0.000
.850	34.868	5.479	0.000
.900	36.632	5.059	0.000
.950	38.426	4.700	0.000
1.000	40.253	4.380	0.000

SENSITIVITY TO THE INVESTMENT IN FIXED ASSET

INVESTM. FACTOR	I.R.R	PAY-BACK	MINIMUN LIFE
1.000	40.253	4.380	0.000
1.050	40.090	4.409	0.000
1.100	39.910	4.437	0.000
1.150	39.741	4.465	0.000
1.200	39.574	4.494	0.000
1.250	39.409	4.522	0.000
1.300	39.245	4.551	0.000
1.350	39.084	4.579	0.000
1.400	38.924	4.608	0.000

JIBOA SUGAR FACTORY STUDY
UNIDO

EQUITY CASH-FLOW ANALISYS (WITH FINANCING)

T	INVESTM	EQUITY	LOANS	LOAN INTEREST	LOAN AMORT.	INCOME	EXPENSES	INVESTM DEPREC.	PROFIT AFT.TAX	OPERAT. C.FLOW
1983	50363.0	4056.4	36507.6	0.0	0.0	20822.2	11023.0	0.0	9799.2	9799.2
1984	1846.0	0.0	0.0	6206.3	0.0	27009.2	14714.2	1868.8	4219.9	6088.7
1985	0.0	0.0	0.0	6206.3	0.0	29980.2	16332.8	1868.8	5572.3	7441.2
1986	0.0	0.0	0.0	6206.3	0.0	33278.0	18129.4	1868.8	7073.5	8942.4
1987	0.0	0.0	0.0	6206.3	0.0	36938.6	20123.6	1868.8	8739.9	10609.7
1988	0.0	0.0	0.0	6206.3	6084.6	41001.9	22337.2	1868.8	10589.6	12458.4
1989	0.0	0.0	0.0	5171.9	6084.6	45512.1	24794.3	1868.8	13677.0	15545.9
1990	0.0	0.0	0.0	4137.5	6084.6	50518.4	27521.7	1868.8	16990.4	18859.2
1991	0.0	0.0	0.0	3103.1	6084.6	56075.4	30549.1	1868.8	2055[illegible].4	22423.2
1992	0.0	0.0	0.0	2068.9	6084.6	62243.7	33909.4	1868.8	24396.7	26265.5
1993	0.0	0.0	0.0	1034.4	6084.6	69090.6	37639.5	1868.8	28547.9	30416.7
1994	0.0	0.0	0.0	0.0	0.0	76690.5	41779.8	1868.8	33041.8	34910.7
1995	0.0	0.0	0.0	0.0	0.0	85126.5	46375.6	1868.8	36882.0	38750.9
1996	0.0	0.0	0.0	0.0	0.0	94490.4	51476.9	1868.8	41144.6	43013.5
1997	0.0	0.0	0.0	0.0	0.0	104884.3	57139.4	1868.8	45876.1	47744.9
1998	0.0	0.0	0.0	0.0	0.0	116421.6	63424.7	1868.8	51129.0	52996.9
1999	0.0	0.0	0.0	0.0	0.0	129228.0	70401.4	1868.8	56957.7	58826.5
2000	0.0	0.0	0.0	0.0	0.0	143443.1	78145.6	1868.8	63428.6	65297.4
2001	0.0	0.0	0.0	0.0	0.0	159221.8	86741.6	1868.8	70611.3	72480.2
2002	0.0	0.0	0.0	0.0	0.0	176736.2	96283.2	1868.8	78584.2	80453.0
2003	0.0	0.0	0.0	0.0	0.0	196177.2	106874.4	1868.8	87434.0	89302.8
2004	0.0	0.0	0.0	0.0	0.0	217756.7	118630.5	1868.8	97257.3	99126.1
2005	0.0	0.0	0.0	0.0	0.0	241709.9	131679.9	1868.8	108161.2	110030.0
2006	0.0	0.0	0.0	0.0	0.0	268298.0	146164.7	1868.8	120264.5	122133.3
2007	0.0	0.0	0.0	0.0	0.0	297810.7	162242.8	1868.8	138185.1	147411.0
TOTAL	52209.0	4056.4	36507.6	46547.2	36507.6	2780465.1	1514434.7	44852.0	1179117.3	1231326.3

INTERNAL RATE OF RETURN = 144.502 ANUAL PC

JIBOA SUGAR FACTORY STUDY
UNIDO

CASE B1.- INSTALLED CAPACITY :
5000 TC/DAY UNTIL 1986
6400 TC/DAY SINCE 1987
- 104 DAYS GRINDING SEASON

NUMBER OF PERIODS PER YEAR	1
START OF STUDY	1983
PROJECT LIFE	25 YEARS
STARTUP	1984

INVESTMENTS AND INITIAL EXPENSES

DESCRIPTION	DATE	AMOUNT	INV AMT	INV DEP	SALVAGE VALUE	R	R.RATE ANUALPC
FIXED ASSET	1983	4852.	*-L	*-L	486.		
-	1985	6990.	*-L	*-L	699.		
-	1986	7759.	*-L	*-L	776.		
WORKING CAPITAL	1984	1846.	*-K	*-K			
-	1987	2398.	*-K	*-K			

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JIBOA SUGAR FACTORY STUDY
UNIDO

OPERATING COSTS

DESCRIPTION		----P E R I O D---- IN.DATE	FIN.DATE	---AMOUNT---- IN.VAL	INCR	K
CANE	SUGAR	1984	1986	68.06		
-		1987	*	200.00		
RAW	MATERIAL	1984	1986	1.00		
-		1987	*	1.00		
MAINTE.	MATERIAL	1984	1986	1.00		
-		1987	*	1.00		
LABOUR		1984	1986	1.00		
-		1987	*	1.00		

INCOME - PRODUCTION AND SALES

DESCRIPTION		----P E R I O D---- IN.DATE	FIN DATE	---AMOUNT---- IN.VAL	INCR	K
CRISTAL	SUGAR	1984	1986	5185.		
-		1987	*	15306.		
RAW	SUGAR	1984	1986	1766.		
-		1987	*	5240.		
MOLASSE		1984	1986	3530.		
-		1987	*	11360.		
BAGASSE		1984	1986	4080.		
-		1987	*	12000.		
CAKE		1984	1986	1224.		
-		1987	*	3800.		

TAX RATE	0.00	ANUAL PC
LOSS CARRY FORWARDS	0	YEARS
AVERAGE COST OF MONEY	17.00	ANUAL PC
AVERAGE INTEREST OF MONEY	17.00	ANUAL PC

--UNIT.COST--

IN.VAL	INCR	K
27.4	11.0	A
-	11.0	A
0.	11.0	A
80.8	11.0	A
18.5	11.0	A
91.2	11.0	A
601.	11.0	A
821.9	11.0	A

--UNIT.PRICE-

IN.VAL	INCR	K
.55	11.0	A
-	11.0	A
.42	11.0	A
-	11.0	A
.025	11.0	A
-	11.0	A
.044	11.0	A
-	11.0	A
.000	11.0	A
.000	11.0	A

JIRDA SUGAR FACTORY STUDY
UNIDO

INVESTMENTS RESUME

T	FIXED ASSET	WORKING CAPITAL	TOTAL
1983	4852.	0.	4852.
1984	0.	1846.	1846.
1985	6990.	0.	6990.
1986	7759.	0.	7759.
1987	0.	0.	0.
1988	0.	0.	0.
1989	0.	0.	0.
1990	0.	0.	0.
1991	0.	0.	0.
1992	0.	0.	0.
1993	0.	0.	0.
1994	0.	0.	[illegible]
1995	0.	0.	[illegible]
1996	0.	0.	[illegible]
1997	0.	0.	0.
1998	0.	0.	0.
1999	0.	0.	0.
2000	0.	0.	0.
2001	0.	0.	0.
2002	0.	0.	0.
2003	0.	0.	0.
2004	0.	0.	0.
2005	0.	0.	0.
2006	0.	0.	0.
2007	0.	0.	0.
TOTAL	19601.	1846.	21447.

06.0[illegible].82

ITBOA SUGAR FACTORY STUDY
UNIDO

OPERATING COSTS RESUME

T	CANE SUGAR	RAW MATERIAL	MAINTE. MATERIAL	LABOUR	TOTAL
1983	0.	0.	0.	0.	0.
1984	1865.	0.	19.	601.	2484.
1985	2070.	0.	21.	667.	2758.
1986	2298.	0.	23.	740.	3061.
1987	7495.	81.	91.	822.	8499.
1988	8319.	90.	101.	912.	9422.
1989	9234.	100.	112.	1013.	10459.
1990	10250.	111.	125.	1124.	11609.
1991	11377.	123.	139.	1248.	12886.
1992	12629.	136.	154.	1385.	14304.
1993	14018.	151.	171.	1537.	15877.
1994	15560.	168.	189.	1706.	17624.
1995	17272.	186.	210.	1894.	19562.
1996	19172.	207.	233.	2102.	21714.
1997	21280.	229.	259.	2334.	24102.
1998	23621.	255.	287.	2590.	26754.
1999	26220.	283.	319.	2875.	29697.
2000	29104.	314.	354.	3192.	32963.
2001	32305.	348.	393.	3543.	36589.
2002	35859.	387.	436.	3932.	40614.
2003	39803.	429.	484.	4365.	45082.
2004	44181.	476.	538.	4845.	50041.
2005	49041.	529.	597.	5378.	55545.
2006	54436.	587.	662.	5970.	61655.
2007	60424.	651.	735.	6626.	68437.
TOTAL	547832.	5839.	6652.	61403.	621727.

JIBDA SUGAR FACTORY STUDY
UNIDO

INCOMES RESUME

T	CRISTAL SUGAR	RAW SUGAR	MOLASSE	BAGASSE	CAKE	TOTAL
1983	0.	0.	0.	0.	0.	0.
1984	2852.	742.	88.	180.	0.	3861.
1985	3165.	823.	98.	199.	0.	4286.
1986	3514.	914.	109.	221.	0.	4757.
1987	11513.	3010.	388.	722.	0.	15634.
1988	12760.	3341.	431.	802.	0.	17353.
1989	14185.	3708.	479.	890.	0.	19262.
1990	15746.	4116.	531.	988.	0.	21381.
1991	17478.	4569.	590.	1096.	0.	23733.
1992	19400.	5072.	654.	1217.	0.	26343.
1993	21534.	5630.	726.	1351.	0.	29241.
1994	23903.	6249.	806.	1499.	0.	32458.
1995	26532.	6936.	895.	1664.	0.	36028.
1996	29451.	7699.	994.	1847.	0.	39991.
1997	32691.	8546.	1103.	2050.	0.	44390.
1998	36287.	9486.	1224.	2276.	0.	49273.
1999	40278.	10530.	1359.	2526.	0.	54693.
2000	44709.	11688.	1508.	2804.	0.	60709.
2001	49627.	12974.	1674.	3113.	0.	67387.
2002	55086.	14401.	1858.	3455.	0.	74800.
2003	61145.	15985.	2063.	3835.	0.	83028.
2004	67871.	17744.	2290.	4257.	0.	92161.
2005	75337.	19695.	2542.	4725.	0.	102299.
2006	83624.	21862.	2821.	5245.	0.	113552.
2007	92822.	24267.	3131.	5822.	0.	126042.
TOTAL	841529.	219988.	28363.	52783.	0.	1142664.

JIBOA SUGAR FACTORY STUDY
UNIDO

INVESTMENT CASH-FLOW ANALISYS (WITHOUT FINANCING)

T	INVESTM	INCOME	SALVAGE VALUE	EXPENSES	INVESTM DEPREC.	PROFIT AFT.TAX	OPERAT. C.FLOW	PRESENT NET VAL
1983	4852.	0.	0.	0.	0.	0.	0.	0.
1984	1846.	3961.	0.	2494.	202.	1175.	1377.	316.
1985	6990.	4296.	0.	2759.	202.	1326.	1528.	491.
1986	7759.	4757.	0.	3061.	520.	1177.	1696.	-156.
1987	2398.	15634.	0.	8489.	889.	6256.	7145.	1359.
1988	0.	17353.	0.	9422.	889.	7042.	7931.	2889.
1989	0.	19262.	0.	10459.	889.	7914.	8803.	4590.
1990	0.	21391.	0.	11609.	889.	8882.	9772.	6412.
1991	0.	23733.	0.	12886.	889.	9957.	10847.	8313.
1992	0.	26343.	0.	14304.	889.	11150.	12040.	10262.
1993	0.	29241.	0.	15877.	889.	12475.	13364.	12232.
1994	0.	32458.	0.	17624.	889.	13945.	14834.	14201.
1995	0.	36028.	0.	19562.	889.	15577.	16466.	16153.
1996	0.	39991.	0.	21714.	889.	17388.	18277.	18074.
1997	0.	44390.	0.	24102.	889.	19398.	20288.	19954.
1998	0.	49273.	0.	26754.	889.	21630.	22519.	21786.
1999	0.	54693.	0.	29697.	889.	24107.	24996.	23563.
2000	0.	60709.	0.	32963.	889.	26857.	27746.	25282.
2001	0.	67387.	0.	36589.	889.	29909.	30798.	26941.
2002	0.	74800.	0.	40614.	889.	33297.	34186.	28536.
2003	0.	83028.	0.	45082.	889.	37057.	37946.	30069.
2004	0.	92161.	0.	50041.	889.	41231.	42120.	31538.
2005	0.	102299.	0.	55545.	889.	45864.	46754.	32945.
2006	0.	113552.	0.	61655.	889.	51007.	51897.	34290.
2007	0.	126042.	6205.	68437.	889.	58677.	63810.	35574.
TOTAL	23845.	1142664.	6205.	621727.	19601.	503297.	527142.	35574.

INTERNAL RATE OF RETURN = 35.901 ANUAL PC

DISCOUNTED PAY BACK = 7.061 YEARS

MINIMUM PROJECT LIFE = 0.000 YEARS

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JIRDA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE CANE SUGAR PRICE

CANE PRICE	I.R.R	PAY-BACK	MINIMUN LIFE
10.96	52.139	4.911	0.000
13.70	49.431	5.136	0.000
16.44	46.730	5.399	0.000
19.18	44.032	5.704	0.000
21.92	41.332	6.066	0.000
24.66	38.625	6.515	0.000
27.40	35.901	7.061	0.000
30.14	33.150	7.768	0.000
32.88	30.354	8.699	4.452
35.62	27.489	9.981	6.239
38.36	24.520	11.889	9.004
41.10	21.383	15.020	13.225

SENSITIVITY TO THE SUGAR PRICE

CRISTAL SUGAR	RAW SUGAR	I.R.R	PAY-BACK	MINIMUN LIFE
.220	.168	*	*	*
.275	.210	*	183.105	*
.330	.252	10.705	45.337	65.260
.385	.294	18.664	19.649	18.813
.440	.336	24.906	11.600	8.570
.495	.378	30.535	8.631	0.000
.550	.420	35.901	7.061	0.000
.605	.462	41.156	6.093	0.000
.660	.504	46.376	5.436	0.000
.715	.546	51.603	4.952	0.000
.770	.588	56.859	4.594	0.000
.825	.630	62.162	4.308	0.000

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JIRDA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE PRODUCTION CAPABILITY

PRODUCT. CAPABIL.	I.R.R	PAY-BACK	MINIMUM LIFE
.600	23.489	12.757	10.201
.650	25.145	11.427	8.318
.700	26.756	10.392	6.818
.750	28.333	9.563	5.611
.800	29.882	8.681	4.682
.850	31.410	8.317	0.000
.900	32.920	7.834	0.000
.950	34.416	7.425	0.000
1.000	35.901	7.061	0.000

SENSITIVITY TO THE INVESTMENT IN FIXED ASSET

INVESTM. FACTOR	I.R.R	PAY-BACK	MINIMUM LIFE
1.000	35.901	7.061	0.000
1.050	34.887	7.301	0.000
1.100	33.947	7.541	0.000
1.150	33.071	7.780	0.000
1.200	32.252	8.021	0.000
1.250	31.496	8.273	0.000
1.300	30.765	8.526	0.000
1.350	30.087	8.779	0.000
1.400	29.446	9.033	4.938

JIBOA SUGAR FACTORY STUDY
UNIDO

CASE B2.- INSTALLED CAPACITY :
5000 TC/DAY UNTIL 1986
6400 TC/DAY SINCE 1987
- 104 DAYS GRINDING SEASON
- INCLUDED THE ACTUAL SUGAR FACTORY

NUMBER OF PERIODS PER YEAR	1
START OF STUDY	1983
PROJECT LIFE	25 YEARS
STARTUP	1983

INVESTMENTS AND INITIAL EXPENSES

DESCRIPTION	DATE	AMOUNT	INV AMT	INV DEP	SALVAGE VALUE	K	R.RATE ANUALPC
FIXED ASSET	1983	4852.	*-L	*-L	486.		
-	1985	6990.	*-L	*-L	699.		
-	1986	7759.	*-L	*-L	776.		
SALE VALUE	1983	40000.	*-L	*-L	4000.		
WORKING CAPITAL	1983	5511.	*-K	*-K			
-	1984	1846.	*-K	*-K			
-	1987	2398.	*-K	*-K			

EQUITY

DESCRIPTION	DATE	AMOUNT
EQUITY	1983	4056.4

LOANS

DESCRIPTION	DATE	AMOUNT	INT.RATE ANUAL PC	PARAMETERS K	PG	PI	PA	RET. PER.
BANK LOAN	1983	36507.6	17.00	AK	4	1	1	6

JIRDA SUGAR FACTORY STUDY
UNIDO

OPERATING COSTS

DESCRIPTION	PERIOD IN.DATE	PERIOD FIN.DATE	AMOUNT IN.VAL	AMOUNT INCR	AMOUNT K	UNIT.COST IN.VAL	UNIT.COST INCR	UNIT.COST K
CANE SUGAR	1983		400.			24.6	11.0	A
-	1984	1986	468.			-	11.0	A
-	1987	*	600.			-	11.0	A
RAW MATERIAL	1983		1.00			98.	11.0	A
-	1984	1986	1.00			138.	11.0	A
-	1987	*	1.00			230.	11.0	A
MAINTE. MATERIAL	1983		1.00			170.	11.0	A
-	1984	1986	1.00			192.	11.0	A
-	1987	*	1.00			350.	11.0	A
LABOUR	1983		1.00			915.	11.0	A
-	1984	1986	1.00			1615.	11.0	A
-	1987	*	1.00			1793.	11.0	A

INCOME - PRODUCTION AND SALES

DESCRIPTION	PERIOD IN.DATE	PERIOD FIN DATE	AMOUNT IN.VAL	AMOUNT INCR	AMOUNT K	UNIT.PRICE IN.VAL	UNIT.PRICE INCR	UNIT.PRICE K
CRISTAL SUGAR	1983		30760.			.50	11.0	A
-	1984	1986	35945.			-	11.0	A
-	1987	*	46066.			-	11.0	A
RAW SUGAR	1983		10480.			.38	11.0	A
-	1984	1986	12246.			-	11.0	A
-	1987	*	15720.			-	11.0	A
MOLASSE	1983		22720.			.022	11.0	A
-	1984	1986	26520.			-	11.0	A
-	1987	*	34080.			-	11.0	A
BAGASSE	1983		24000.			.040	11.0	A
-	1984	1986	28080.			-	11.0	A
-	1987	*	36000.			-	11.0	A
CAKE	1983		7200.			.000	11.0	A
-	1984	1986	8424.			.000	11.0	A
-	1987	*	11000.			.000	11.0	A

TAX RATE	0.00	ANUAL PC
LOSS CARRY FORWARDS	0	YEARS
AVERAGE COST OF MONEY	17.00	ANUAL PC
AVERAGE INTEREST OF MONEY	17.00	ANUAL PC

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1990	0.	0.	0.	0.
1991	0.	0.	0.	0.
1992	0.	0.	0.	0.
1993	0.	0.	0.	0.
1994	0.	0.	0.	0.
1995	0.	0.	0.	0.
1996	0.	0.	0.	0.
1997	0.	0.	0.	0.
1998	0.	0.	0.	0.
1999	0.	0.	0.	0.
2000	0.	0.	0.	0.
2001	0.	0.	0.	0.
2002	0.	0.	0.	0.
2003	0.	0.	0.	0.
2004	0.	0.	0.	0.
2005	0.	0.	0.	0.
2006	0.	0.	0.	0.
2007	0.	0.	0.	0.
TOTAL	19601.	40000.	9755.	69356.

JIRDA SUGAR FACTORY STUDY
UNIDO

INTERNATIONAL BANK LOAN

T	LOANS	LOAN INTEREST	LOAN AMORT.	AMORT. + INTEREST	UNPAID BALANCE
1983	36507.6	0.0	0.0	0.0	36507.6
1984	0.0	6206.3	0.0	6206.3	36507.6
1985	0.0	6206.3	0.0	6206.3	36507.6
1986	0.0	6206.3	0.0	6206.3	36507.6
1987	0.0	6206.3	0.0	6206.3	36507.6
1988	0.0	6206.3	6084.6	12290.9	30423.0
1989	0.0	5171.9	6084.6	11256.5	24338.4
1990	0.0	4137.5	6084.6	10222.1	18253.8
1991	0.0	3103.1	6084.6	9187.7	12169.2
1992	0.0	2068.8	6084.6	8153.4	6084.6
1993	0.0	1034.4	6084.6	7119.0	0.0
1994	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0
2004	0.0	0.0	0.0	0.0	0.0
2005	0.0	0.0	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0	0.0
2007	0.0	0.0	0.0	0.0	0.0
TOTAL	36507.6	46547.2	36507.6	83054.8	0.0

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JIRDA SUGAR FACTORY STUDY
UNIDO

OPERATING COSTS RESUME

T	CANE SUGAR	RAW MATERIAL	MAINTE. MATERIAL	LABOUR	TOTAL
1983	9840.	98.	170.	915.	11023.
1984	12779.	128.	192.	1615.	14714.
1985	14185.	142.	213.	1793.	16333.
1986	15745.	158.	237.	1990.	18129.
1987	22407.	230.	350.	1793.	24780.
1988	24871.	255.	389.	1990.	27505.
1989	27607.	283.	431.	2209.	30531.
1990	30644.	315.	479.	2452.	33890.
1991	34015.	349.	531.	2722.	37617.
1992	37757.	388.	590.	3021.	41755.
1993	41910.	430.	655.	3354.	46[illegible]8.
1994	46520.	478.	727.	3723.	51447.
1995	51637.	530.	807.	4132.	57106.
1996	57317.	588.	895.	4587.	63387.
1997	63622.	653.	994.	5091.	70360.
1998	70621.	725.	1103.	5651.	78100.
1999	78389.	805.	1224.	6273.	86691.
2000	87012.	893.	1359.	6963.	96227.
2001	96583.	991.	1509.	7729.	106812.
2002	107207.	1100.	1675.	8579.	118561.
2003	119000.	1222.	1859.	9522.	131602.
2004	132090.	1356.	2063.	10570.	146079.
2005	146620.	1505.	2290.	11733.	162147.
2006	162748.	1671.	2542.	13023.	179984.
2007	180650.	1854.	2822.	14456.	199782.
TOTAL	1671774.	17147.	26104.	135884.	1850909.

	TOTAL
0.	20822.
0.	27009.
0.	29980.
0.	33278.
0.	47358.
0.	52568.
0.	58350.
0.	64769.
0.	71893.
0.	79801.
0.	88580.
0.	98323.
0.	109139.
0.	121144.
0.	134470.
0.	149262.
0.	165681.
0.	183905.
0.	204135.
0.	226590.
0.	251515.
0.	279181.
0.	309891.
0.	343979.
0.	381817.
0.	3533442.

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JIRDA SUGAR FACTORY STUDY
UNIDO

INCOMES RESUME

T	CRISTAL SUGAR	RAW SUGAR	MOLASSE	BAGASSE	CAKE
1983	15380.	3982.	500.	960.	
1984	19949.	5165.	648.	1247.	
1985	22144.	5734.	719.	1384.	
1986	24580.	6364.	798.	1536.	
1987	34966.	9068.	1138.	2186.	
1988	38812.	10066.	1263.	2426.	
1989	43081.	11173.	1402.	2693.	
1990	47820.	12402.	1557.	2990.	
1991	53080.	13766.	1728.	3319.	
1992	58919.	15281.	1919.	3684.	
1993	65400.	16962.	2129.	4089.	
1994	72594.	18827.	2363.	4539.	
1995	80580.	20898.	2623.	5038.	
1996	89444.	23197.	2912.	5592.	
1997	99282.	25749.	3232.	6207.	
1998	110203.	28581.	3587.	6890.	
1999	122326.	31725.	3982.	7648.	
2000	135782.	35215.	4420.	8489.	
2001	150719.	39089.	4906.	9423.	
2002	167297.	43388.	5446.	10459.	
2003	185699.	48161.	6045.	11610.	
2004	206126.	53459.	6710.	12887.	
2005	228800.	59339.	7448.	14304.	
2006	253968.	65867.	8267.	15878.	
2007	281904.	73112.	9176.	17624.	
TOTAL	2608856.	676571.	84916.	163100.	

JIBUA SUGAR FACTORY STUDY
UNIDO

INVESTMENT CASH-FLOW ANALISYS (WITHOUT FINANCING)

T	INVESTM	INCOME	SALVAGE VALUE	EXPENSES	INVESTM DEPREC.	PROFIT AFT.TAX	OPERAT. C.FLOW	PRESENT NET VAL
1983	50363.	20822.	0.	11023.	0.	9799.	9799.	9799.
1984	1846.	27009.	0.	14714.	1869.	10426.	12295.	11553.
1985	6990.	29980.	0.	16333.	1869.	11779.	13647.	14019.
1986	7759.	33278.	0.	18129.	2187.	12962.	15149.	16322.
1987	2398.	47358.	0.	24780.	2556.	20023.	22579.	21553.
1988	0.	52568.	0.	27505.	2556.	22506.	25062.	27148.
1989	0.	58350.	0.	30531.	2556.	25263.	27819.	33158.
1990	0.	64769.	0.	33890.	2556.	28323.	30879.	39445.
1991	0.	71893.	0.	37617.	2556.	31720.	34276.	45897.
1992	0.	79801.	0.	41755.	2556.	35490.	38046.	52424.
1993	0.	88580.	0.	46349.	2556.	39675.	42231.	58955.
1994	0.	98323.	0.	51447.	2556.	44321.	46877.	65433.
1995	0.	109139.	0.	57106.	2556.	49477.	52033.	71812.
1996	0.	121144.	0.	63387.	2556.	55201.	57757.	78059.
1997	0.	134470.	0.	70360.	2556.	61554.	64110.	84147.
1998	0.	149262.	0.	78100.	2556.	68606.	71162.	90057.
1999	0.	165681.	0.	86691.	2556.	76434.	78990.	95774.
2000	0.	183905.	0.	96227.	2556.	85123.	87679.	101290.
2001	0.	204135.	0.	106812.	2556.	94767.	97324.	106599.
2002	0.	226590.	0.	118561.	2556.	105473.	108029.	111699.
2003	0.	251515.	0.	131602.	2556.	117356.	119912.	116589.
2004	0.	279181.	0.	146079.	2556.	130547.	133103.	121271.
2005	0.	309891.	0.	162147.	2556.	145188.	147744.	125748.
2006	0.	343979.	0.	179984.	2556.	161440.	163996.	130024.
2007	0.	381817.	15716.	199782.	2556.	185440.	197751.	134104.
TOTAL	69356.	3533442.	15716.	1850909.	59601.	1628893.	1698249.	134104.

INTERNAL RATE OF RETURN = 40.316 ANUAL PC

DISCOUNTED PAY BACK = 4.996 YEARS

MINIMUM PROJECT LIFE = 0.000 YEARS

05.08.82

JIBOA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE CANE SUGAR PRICE

CANE PRICE	I.R.R	PAY-BACK	MINIMUN LIFE
24.60	40.316	4.996	0.000
25.83	38.532	5.307	0.000
27.06	36.779	5.653	0.000
28.29	35.053	6.041	0.000
29.52	33.352	6.499	0.000
30.75	31.670	7.018	0.000
31.98	30.003	7.640	0.000
33.21	28.346	8.377	0.000
34.44	26.692	9.272	0.000

SENSITIVITY TO THE SUGAR PRICE

CRISTAL SUGAR	RAW SUGAR	I.R.R	PAY-BACK	MINIMUN LIFE
.200	.152	*	*	*
.250	.190	-1.199	151.092	0.000
.300	.228	12.728	40.090	0.000
.350	.266	20.301	15.727	0.000
.400	.304	26.920	9.135	0.000
.450	.342	33.468	6.466	0.000
.500	.380	40.316	4.996	0.000
.550	.418	47.691	4.072	0.000
.600	.456	55.771	3.391	0.000
.650	.494	64.729	2.808	0.000
.700	.532	74.753	2.186	0.000
.750	.570	86.071	1.746	0.000

JIBOA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE PRODUCTION CAPABILITY

PRODUCT. CAPABIL.	I.R.R	PAY-BACK	MINIMUN LIFE
.400	20.663	15.137	0.000
.450	22.318	12.912	0.000
.500	23.943	11.275	0.000
.550	25.551	10.007	0.000
.600	27.149	9.001	0.000
.650	28.745	8.184	0.000
.700	30.347	7.504	0.000
.750	31.958	6.923	0.000
.800	33.585	6.433	0.000
.850	35.230	5.997	0.000
.900	36.899	5.628	0.000
.950	38.593	5.296	0.000
1.000	40.316	4.996	0.000

SENSITIVITY TO THE INVESTMENT IN FIXED ASSET

INVESTM. FACTOR	I.R.R	PAY-BACK	MINIMUN LIFE
1.000	40.316	4.996	0.000
1.050	39.979	5.064	0.000
1.100	39.647	5.132	0.000
1.150	39.321	5.201	0.000
1.200	39.001	5.269	0.000
1.250	38.686	5.337	0.000
1.300	38.376	5.405	0.000
1.350	38.071	5.474	0.000
1.400	37.772	5.542	0.000

JIBOA SUGAR FACTORY STUDY
UNIDO

EQUITY CASH-FLOW ANALISYS (WITH FINANCING)

T	INVESTM	EQUITY	LOANS	LOAN INTEREST	LOAN AMORT.	INCOME	EXPENSES	INVESTM DEPREC.	PROFIT AFT.TAX	OPERAT. C.FLOW
1983	50363.0	4056.4	36507.6	0.0	0.0	20822.2	11023.0	0.0	9799.2	9799.2
1984	1846.0	0.0	0.0	6206.3	0.0	27009.2	14714.2	1868.8	4219.9	6088.7
1985	6990.0	0.0	0.0	6206.3	0.0	29980.2	16332.8	1868.8	5572.3	7441.2
1986	7759.0	0.0	0.0	6206.3	0.0	33278.0	18129.4	2186.6	6755.8	8942.4
1987	2398.0	0.0	0.0	6206.3	0.0	47358.3	24779.7	2556.0	13816.2	16372.3
1988	0.0	0.0	0.0	6206.3	6084.6	52567.7	27505.5	2556.0	16299.9	18855.9
1989	0.0	0.0	0.0	5171.9	6084.6	58350.1	30531.1	2556.0	20091.1	22647.1
1990	0.0	0.0	0.0	4137.5	6084.6	64758.6	33889.5	2556.0	24185.6	26741.6
1991	0.0	0.0	0.0	3103.1	6084.6	71893.2	37617.4	2556.0	28616.6	31172.7
1992	0.0	0.0	0.0	2068.8	6084.6	79801.4	41755.3	2556.0	33421.4	35977.4
1993	0.0	0.0	0.0	1034.4	6084.6	88579.6	46348.3	2556.0	38640.8	41196.9
1994	0.0	0.0	0.0	0.0	0.0	98323.4	51446.7	2556.0	44320.7	46876.7
1995	0.0	0.0	0.0	0.0	0.0	109138.9	57105.8	2556.0	49477.1	52033.1
1996	0.0	0.0	0.0	0.0	0.0	121144.2	63387.4	2556.0	55200.7	57756.8
1997	0.0	0.0	0.0	0.0	0.0	134470.1	70360.1	2556.0	61554.0	64110.0
1998	0.0	0.0	0.0	0.0	0.0	149261.8	78099.7	2556.0	68606.1	71162.1
1999	0.0	0.0	0.0	0.0	0.0	165680.6	86690.6	2556.0	76433.9	78989.9
2000	0.0	0.0	0.0	0.0	0.0	183905.4	96226.6	2556.0	85122.8	87678.8
2001	0.0	0.0	0.0	0.0	0.0	204135.0	106811.5	2556.0	94767.5	97323.5
2002	0.0	0.0	0.0	0.0	0.0	226589.9	118560.8	2556.0	105473.1	108029.1
2003	0.0	0.0	0.0	0.0	0.0	251514.8	131602.5	2556.0	117356.3	119912.3
2004	0.0	0.0	0.0	0.0	0.0	279181.4	146078.7	2556.0	130546.6	133102.7
2005	0.0	0.0	0.0	0.0	0.0	309891.4	162147.4	2556.0	145187.9	147743.9
2006	0.0	0.0	0.0	0.0	0.0	343979.4	179983.6	2556.0	161439.7	163995.8
2007	0.0	0.0	0.0	0.0	0.0	381817.1	199781.8	2556.0	185440.[illegible]	197751.3
TOTAL	69356.0	4056.4	36507.6	46547.2	36507.6	3533442.0	1850909.3	59601.0	1582345.5	1651701.5

INTERNAL RATE OF RETURN = 104.198 ANNUAL PC

JIRDA SUGAR FACTORY STUDY
UNIDO

CASE C1.- ALCOHOL PLANT

NUMBER OF PERIODS PER YEAR	1	
START OF STUDY	1984	
PROJECT LIFE	25	YEARS
STARTUP	1987	

INVESTMENTS AND INITIAL EXPENSES

DESCRIPTION	DATE	AMOUNT	INV AMT	INV DEP	SALVAGE VALUE	R	R.RATE ANUALPC
FIXED ASSET	1984	8930.	*-L	*-L	893.		
-	1985	12390.	*-L	*-L	1239.		
-	1986	2750.	*-L	*-L	275.		
WORKING CAPITAL	1986	5289.	*-K	*-K			

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JIRDA SUGAR FACTORY STUDY
UNIDO

OPERATING COSTS

DESCRIPTION	PERIOD IN.DATE	PERIOD FIN.DATE	AMOUNT IN.VAL	AMOUNT INCR K
MOLASSE	1987		28.4	
-	1986	*	31.6	
CLEAR JUICE	1987		176.8	
-	1988	*	196.5	
LABOUR	1987	*	1.0	
RAW MATERIAL	1987	*	1.0	
MAINTE. MATERIAL	1987	*	1.0	

INCOME - PRODUCTION AND SALES

DESCRIPTION	PERIOD IN.DATE	PERIOD FIN DATE	AMOUNT IN.VAL	AMOUNT INCR K
ALCOHOL	1987		19359.	
-	1988	*	21510.	
VINASSE	1987		258.1	
-	1988	*	286.8	

TAX RATE	0.00	ANUAL PC
LOSS CARRY FORWARDS	0	YEARS
AVERAGE COST OF MONEY	17.00	ANUAL PC
AVERAGE INTEREST OF MONEY	17.00	ANUAL PC

--UNIT.COST--		
IN.VAL	INCR	K
50.5	11.0	A
-	11.0	A
40.4	11.0	A
-	11.0	A
389.	11.0	A
539.1	11.0	A
135.2	11.0	A

--UNIT.PRICE-		
IN.VAL	INCR	K
.580	11.0	A
-	11.0	A
.0	11.0	A
.0	11.0	A

JIBOA SUGAR FACTORY STUDY
UNIDO

INVESTMENTS RESUME

T	FIXED ASSET	WORKING CAPITAL	TOTAL
1984	8930.	0.	8930.
1985	12390.	0.	12390.
1986	2750.	5289.	8039.
1987	0.	0.	0.
1988	0.	0.	0.
1989	0.	0.	0.
1990	0.	0.	0.
1991	0.	0.	0.
1992	0.	0.	0.
1993	0.	0.	0.
1994	0.	0.	0.
1995	0.	0.	0.
1996	0.	0.	0.
1997	0.	0.	0.
1998	0.	0.	0.
1999	0.	0.	0.
2000	0.	0.	0.
2001	0.	0.	0.
2002	0.	0.	0.
2003	0.	0.	0.
2004	0.	0.	0.
2005	0.	0.	0.
2006	0.	0.	0.
2007	0.	0.	0.
2008	0.	0.	0.
TOTAL	24070.	5289.	29359.

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TIBOA SUGAR FACTORY STUDY
UNIDO

OPERATING COSTS RESUME

T	MOLASSES	CLEAR JUICE	LABOUR	RAW MATERIAL	MAINTE. MATERIAL
1984	0.	0.	0.	0.	0.
1985	0.	0.	0.	0.	0.
1986	0.	0.	0.	0.	0.
1987	1434.	7143.	389.	539.	135.
1988	1771.	8912.	432.	598.	150.
1989	1966.	9781.	479.	664.	167.
1990	2182.	10857.	532.	737.	185.
1991	2423.	12051.	591.	818.	205.
1992	2689.	13377.	655.	908.	228.
1993	2985.	14848.	728.	1008.	253.
1994	3313.	16482.	808.	1119.	281.
1995	3678.	18295.	896.	1242.	312.
1996	4082.	20307.	995.	1379.	346.
1997	4531.	22541.	1105.	1531.	384.
1998	5030.	25021.	1226.	1699.	426.
1999	5583.	27773.	1361.	1886.	473.
2000	6197.	30828.	1511.	2093.	525.
2001	6879.	34219.	1677.	2324.	583.
2002	7635.	37983.	1861.	2579.	647.
2003	8475.	42161.	2066.	2863.	718.
2004	9407.	46799.	2293.	3178.	797.
2005	10442.	51947.	2545.	3528.	885.
2006	11591.	57661.	2825.	3916.	982.
2007	12866.	64003.	3136.	4346.	1090.
2008	14281.	71044.	3481.	4824.	1210.
TOTAL	129440.	643932.	31592.	43793.	10980.

TOTAL
0.
0.
0.
9640.
11763.
13057.
14494.
16088.
17858.
19822.
22003.
24423.
27109.
30091.
33401.
37076.
41154.
45681.
50706.
56283.
62474.
69347.
76975.
85442.
94841.
859727.

JIBDA SUGAR FACTORY STUDY
UNIDO

INCOMES RESUME

T	ALCOHOL	VINASSE	TOTAL
1984	0.	0.	0.
1985	0.	0.	0.
1986	0.	0.	0.
1987	11228.	0.	11229.
1988	13848.	0.	13848.
1989	15371.	0.	15371.
1990	17062.	0.	17062.
1991	18939.	0.	18939.
1992	21022.	0.	21022.
1993	23335.	0.	23335.
1994	25902.	0.	25902.
1995	28751.	0.	28751.
1996	31914.	0.	31914.
1997	35424.	0.	35424.
1998	39321.	0.	39321.
1999	43646.	0.	43646.
2000	48447.	0.	48447.
2001	53776.	0.	53776.
2002	59692.	0.	59692.
2003	66258.	0.	66258.
2004	73546.	0.	73546.
2005	81636.	0.	81636.
2006	90616.	0.	90616.
2007	100584.	0.	100584.
2008	111648.	0.	111648.
TOTAL	1011966.	0.	1011966.

JIRDA SUGAR FA[illegible]RY STUDY
UNIDI

INVESTMENT CASH-FLOW ANALISYS (WITHOUT FINANCING)

T	INVESTM	INCOME	SALVAGE VALUE	EXPENSES	INVESTM DEPREC.	PROFIT AFT.TAX	OPERAT. C.FLOW	PRESENT NET VAL
1984	8930.	0.	0.	0.	0.	0.	0.	0.
1985	12390.	0.	0.	0.	0.	0.	0.	-1298.
1986	9039.	0.	0.	0.	0.	0.	0.	-3945.
1987	0.	11228.	0.	9640.	1094.	494.	1588.	-6665.
1988	0.	13848.	0.	11763.	1094.	991.	2085.	-8672.
1989	0.	15371.	0.	13057.	1094.	1220.	2314.	-10189.
1990	0.	17062.	0.	14494.	1094.	1474.	2569.	-11322.
1991	0.	18939.	0.	16088.	1094.	1757.	2851.	-12140.
1992	0.	21022.	0.	17858.	1094.	2071.	3165.	-12702.
1993	0.	23335.	0.	19822.	1094.	2419.	3513.	-13057.
1994	0.	25902.	0.	22003.	1094.	2805.	3899.	-13245.
1995	0.	28751.	0.	24423.	1094.	3234.	4328.	-13300.
1996	0.	31914.	0.	27109.	1094.	3710.	4804.	-13249.
1997	0.	35424.	0.	30091.	1094.	4239.	5333.	-13115.
1998	0.	39321.	0.	33401.	1094.	4825.	5919.	-12917.
1999	0.	43646.	0.	37076.	1094.	5476.	6570.	-12670.
2000	0.	48447.	0.	41154.	1094.	6199.	7293.	-12387.
2001	0.	53776.	0.	45681.	1094.	7001.	8095.	-12077.
2002	0.	59692.	0.	50706.	1094.	7892.	8986.	-11750.
2003	0.	66256.	0.	56283.	1094.	8880.	9974.	-11412.
2004	0.	73546.	0.	62474.	1094.	9977.	11072.	-11068.
2005	0.	81636.	0.	69347.	1094.	11195.	12289.	-10723.
2006	0.	90616.	0.	76975.	1094.	12547.	13641.	-10380.
2007	0.	100584.	0.	85442.	1094.	14048.	15142.	-10042.
2008	0.	111648.	7696.	94841.	1094.	18120.	24503.	-9711.
TOTAL	29359.	1011966.	7696.	859727.	24070.	130575.	159934.	-9711.

INTERNAL RATE OF RETURN = 12.236 ANUAL PC

DISCOUNTED PAY BACK = 41.159 YEARS

MINIMUM PROJECT LIFE = 53.306 YEARS

IRBA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE CLEAR JUICE PRICE

JUICE PRICE	I.R.R	PAY-BACK	MINIMUM LIFE
40.40	12.238	41.159	53.306
42.42	10.221	50.967	76.146
44.44	7.826	64.540	121.390
46.46	4.783	95.229	253.731
48.48	.329	120.192	7186.271
50.50	*	171.997	*
52.52	*	423.705	*
54.54	*	*	*
56.56	*	*	*

SENSITIVITY TO THE ALCOHOL PRICE

ALCOHOL PRICE	I.R.R	PAY-BACK	MINIMUM LIFE
.580	12.238	41.159	53.306
.725	23.034	12.470	10.317
.870	30.655	7.795	4.740
1.015	37.066	6.032	3.401
1.160	42.769	5.107	2.924
1.305	47.973	4.538	2.655
1.450	52.790	4.146	2.507
1.595	57.234	3.864	2.414
1.740	61.534	3.653	2.350
1.885	65.548	3.486	2.303
2.030	69.365	3.351	2.267
2.175	73.008	3.239	2.232
2.320	76.496	3.145	2.216
2.465	79.845	3.064	2.197
2.610	83.069	2.995	2.181
2.755	[illegible].178	[illegible].931	2.168

05.08.82

JIRDA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE INVESTMENT IN FIXED ASSET

INVESTM. FACTOR	I.R.R	PAY-BACK	MINIMUM LIFE
1.000	12.239	41.159	53.306
1.050	11.869	43.061	56.700
1.100	11.520	44.963	60.125
1.150	11.189	46.865	63.581
1.200	10.874	48.767	67.069
1.250	10.574	50.669	70.588
1.300	10.287	52.571	74.139
1.350	10.013	54.473	77.723
1.400	9.751	56.375	81.341

JIBOA SUGAR FACTORY STUDY
UNIDO

CASE C2.- ALCOHOL PLANT + SUGAR FACTORY
+ BOARDS PLANT

NUMBER OF PERIODS PER YEAR 1
START OF STUDY 1983
PROJECT LIFE 25 YEARS
STARTUP 1983

INVESTMENTS AND INITIAL EXPENSES

DESCRIPTION	DATE	AMOUNT	INV AMT	INV DEP	SALVAGE VALUE	K	R.RATE ANUALPC
FIXED ASSET	1983	44952.	*-L	*-L	4485.		
-	1984	22085.	*-L	*-L	2208.		
-	1985	30643.	*-L	*-L	3064.		
-	1986	6802.	*-L	*-L	680.		
WORKING CAPITAL	1983	5511.	*-K	*-K			
-	1984	1846.	*-K	*-K			
-	1987	20000.	*-K	*-K			

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JIBOA SUGAR FA[illegible]ORY STUDY
UNIDO

EQUITY

DESCRIPTION	DATE	AMOUNT
EQUITY	1983	4202.4
-	1984	1353.0
-	1985	1909.8

LOANS

DESCRIPTION		DATE	AMOUNT	INT.RATE ANUAL PC
BANK	LOAN	1983	37821.6	17.00
	-	1984	12177.0	17.00
	-	1985	17188.2	17.00
SHORT	LOAN	1984	6430.1	20.00
	-	1985	9593.2	20.00
	-	1986	8133.0	20.00

PARAMETERS K	PG	PI	PA	RET. REP.
AK	4	1	1	6
AK	4	1	1	6
AK	4	1	1	6
AK	2	1	1	2
AK	1	1	1	2
AK	0	1	1	2

JIBOA SUGAR FACTORY STUDY
UNIDO

OPERATING COSTS

DESCRIPTION	PERIOD IN.DATE	PERIOD FIN.DATE	AMOUNT IN.VAL	AMOUNT INCR	K	UNIT.COST IN.VAL	UNIT.COST INCR	K
CANE SUGAR	1983		400.			24.6	11.0	A
-	1984	1986	468.			-	11.0	A
-	1987	*	900.			-	11.0	A
RAW MATERIAL	1983		1.0			98.	11.0	A
-	1984	1986	1.0			128.	11.0	A
-	1987	*	1.0			1292.	11.0	A
MAINTE. MATERIAL	1983		1.0			170.	11.0	A
-	1984	1986	1.0			192.	11.0	A
-	1987	*	1.0			642.	11.0	A
LABOUR	1983		1.0			915.	11.0	A
-	1984	1986	1.0			1615.	11.0	A
-	1987	*	1.0			3476.	11.0	A
BAGASSE	1987	*	12600.			.61	11.0	A

INCOME - PRODUCTION AND SALES

DESCRIPTION	PERIOD IN.DATE	PERIOD FIN DATE	AMOUNT IN.VAL	AMOUNT INCR	K	UNIT.PRICE IN.VAL	UNIT.PRICE INCR	K
CRISTAL SUGAR	1983		30760.			.50	11.0	A
-	1984	1986	35945.			-	11.0	A
-	1987	*	54070.			-	11.0	A
RAW SUGAR	1983		10480.			.38	11.0	A
-	1984	1986	12246.			-	11.0	A
-	1987	*	18392.			-	11.0	A
ALCOHOL	1987	*	21510.			.578	11.0	A
BOARDS	1987	*	92300.			.365	11.0	A

TAX RATE	0.00	ANUAL PC
LOSS CARRY FORWARDS	0	YEARS
AVERAGE COST OF MONEY	17.00	ANUAL PC
AVERAGE INTEREST OF MONEY	17.00	ANUAL PC

JIBOA SUGAR F[illegible]ORY STUDY
UNIDO

INVESTMENTS RESUME

T	FIXED ASSET	WORKING CAPITAL	TOTAL
1983	44852.	5511.	50363.
1984	22085.	1846.	23931.
1985	30643.	0.	30643.
1986	6802.	0.	6802.
1987	0.	20000.	20000.
1988	0.	0.	0.
1989	0.	0.	0.
1990	0.	0.	0.
1991	0.	0.	0.
1992	0.	0.	0.
1993	0.	0.	0.
1994	0.	0.	0.
1995	0.	0.	0.
1996	0.	0.	0.
1997	0.	0.	0.
1998	0.	0.	0.
1999	0.	0.	0.
2000	0.	0.	0.
2001	0.	0.	0.
2002	0.	0.	0.
2003	0.	0.	0.
2004	0.	0.	0.
2005	0.	0.	0.
2006	0.	0.	0.
2007	0.	0.	0.
TOTAL	104382.	27357.	131739.

06.08.82

JIBOA SUGAR FACTORY STUDY
UNIDO

INTERNATIONAL BANK LOANS

T	LOANS	LOAN INTEREST	LOAN AMORT.	AMORT. + INTEREST
1983	37821.6	0.0	0.0	0.0
1984	12177.0	6429.7	0.0	6429.7
1985	17188.2	8499.8	0.0	8499.8
1986	0.0	11421.8	0.0	11421.8
1987	0.0	11421.8	0.0	11421.8
1988	0.0	11421.8	6303.6	17725.4
1989	0.0	10350.1	9333.1	19683.2
1990	0.0	8933.5	11197.8	20131.3
1991	0.0	7029.9	11197.8	18227.7
1992	0.0	5126.3	11197.8	16324.1
1993	0.0	3222.6	11197.8	14420.4
1994	0.0	1319.0	4894.2	6213.2
1995	0.0	487.0	2864.7	3351.7
1996	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0
2004	0.0	0.0	0.0	0.0
2005	0.0	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0
2007	0.0	0.0	0.0	0.0
TOTAL	67186.8	85663.2	67186.8	152850.0

UNPAID BALANCE
37821.6
49998.6
67186.8
67186.8
67186.8
60883.2
52550.1
41352.3
30154.5
18956.7
7758.9
2864.7
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0

JIRDA SUGAR FACTORY STUDY
UNIDO

SHORT LOAN

T	LOANS	LOAN INTEREST	LOAN AMORT.	AMORT. + INTEREST	UNPAID BALANCE
1983	0.	0.	0.	0.	0.
1984	6430.	0.	0.	0.	6430.
1985	9593.	1286.	0.	1286.	16023.
1986	8133.	3205.	0.	3205.	24156.
1987	0.	4831.	12078.	16909.	12078.
1988	0.	2416.	12078.	14494.	0.
1989	0.	0.	0.	0.	0.
1990	0.	0.	0.	0.	0.
1991	0.	0.	0.	0.	0.
1992	0.	0.	0.	0.	0.
1993	0.	0.	0.	0.	0.
1994	0.	0.	0.	0.	0.
1995	0.	0.	0.	0.	0.
1996	0.	0.	0.	0.	0.
1997	0.	0.	0.	0.	0.
1998	0.	0.	0.	0.	0.
1999	0.	0.	0.	0.	0.
2000	0.	0.	0.	0.	0.
2001	0.	0.	0.	0.	0.
2002	0.	0.	0.	0.	0.
2003	0.	0.	0.	0.	0.
2004	0.	0.	0.	0.	0.
2005	0.	0.	0.	0.	0.
2006	0.	0.	0.	0.	0.
2007	0.	0.	0.	0.	0.
TOTAL	24156.	11738.	24156.	35894.	0.

JIRDA SUGAR FA[illegible]RY STUDY
UNIDO

OPERATING COSTS RESUME

T	CANE SUGAR	RAW MATERIAL	MAINTE. MATERIAL	LABOUR	BAGASSE	TOTAL
1983	9840.	98.	170.	915.	0.	11023.
1984	12779.	128.	192.	1615.	0.	14714.
1985	14185.	142.	213.	1793.	0.	16333.
1986	15745.	158.	237.	1990.	0.	18129.
1987	33610.	1292.	642.	3476.	7686.	46706.
1988	37307.	1434.	713.	3859.	8531.	51844.
1989	41411.	1592.	791.	4283.	9470.	57547.
1990	45966.	1767.	878.	4754.	10512.	63877.
1991	51022.	1961.	975.	5277.	11668.	70903.
1992	56635.	2177.	1082.	5857.	12951.	78702.
1993	62865.	2417.	1201.	6502.	14376.	87360.
1994	69780.	2682.	1333.	7217.	15957.	96969.
1995	77456.	2977.	1480.	8011.	17713.	107636.
1996	85976.	3305.	1642.	8892.	19661.	119476.
1997	95433.	3669.	1823.	9870.	21824.	132618.
1998	105931.	4072.	2023.	10956.	24224.	147206.
1999	117583.	4520.	2246.	12161.	26889.	163399.
2000	130517.	5017.	2493.	13498.	29847.	181373.
2001	144874.	5569.	2767.	14983.	33130.	201324.
2002	160810.	6182.	3072.	16631.	36774.	223469.
2003	178500.	6862.	3410.	18461.	40820.	248053.
2004	198135.	7616.	3785.	20491.	45310.	275337.
2005	219929.	8454.	4201.	22745.	50294.	305624.
2006	244122.	9384.	4663.	25247.	55826.	339242.
2007	270975.	10417.	5176.	28025.	61967.	376559.
TOTAL	2481387.	93892.	47206.	257506.	555430.	3435421.

JIRDA SUGAR F[illegible]TORY STUDY
UN[illegible]O

INCOMES RESUME

T	CRISTAL SUGAR	RAW SUGAR	ALCOHOL	BOARDS	TOTAL
1983	15380.	3982.	0.	0.	19362.
1984	19949.	5165.	0.	0.	25115.
1985	22144.	5734.	0.	0.	27877.
1986	24580.	6364.	0.	0.	30944.
1987	41041.	10610.	12433.	35536.	99619.
1988	45556.	11777.	13800.	39444.	110577.
1989	50567.	13072.	15319.	43783.	122741.
1990	56129.	14510.	17003.	48599.	136242.
1991	62303.	16106.	18874.	53945.	151229.
1992	69157.	17978.	20950.	59879.	167864.
1993	76764.	19845.	23254.	66466.	186329.
1994	85208.	22029.	25812.	73777.	206825.
1995	94581.	24451.	28652.	81893.	229576.
1996	104984.	27140.	31804.	90901.	254829.
1997	116533.	30125.	35302.	100900.	282860.
1998	129351.	33439.	39185.	111999.	313975.
1999	143580.	37118.	43495.	124319.	348512.
2000	159374.	41201.	48280.	137994.	386849.
2001	176905.	45733.	53591.	153174.	429402.
2002	196364.	50763.	59486.	170023.	476636.
2003	217965.	56347.	66029.	188725.	529066.
2004	241941.	62545.	73292.	209485.	587264.
2005	268554.	69425.	81355.	232529.	651863.
2006	298095.	77062.	90304.	259107.	723567.
2007	330986.	85539.	100237.	286498.	803160.
TOTAL	3047889.	797959.	898457.	2567978.	7302283.

JIBOA SUGAR FACTORY STUDY
UNION

INVESTMENT CASH-FLOW ANALISYS (WITHOUT FINANCING)

T	INVESTM	INCOME	SALVAGE VALUE	EXPENSES	INVESTM DEPREC.	PROFIT AFT.TAX	OPERAT. C.FLOW	PRESENT NET VAL
1983	50363.	19362.	0.	11023.	0.	8339.	8339.	8339.
1984	23931.	25115.	0.	14714.	1869.	8532.	10401.	9474.
1985	30643.	27977.	0.	16333.	2829.	8716.	11545.	6030.
1986	6802.	30944.	0.	18129.	4222.	8593.	12815.	969.
1987	20000.	99619.	0.	46706.	4546.	48367.	52913.	17614.
1988	0.	110577.	0.	51844.	4546.	54188.	58733.	33261.
1989	0.	122741.	0.	57547.	4546.	60648.	65194.	49425.
1990	0.	136242.	0.	63977.	4546.	67820.	72365.	65862.
1991	0.	151229.	0.	70903.	4546.	75780.	80326.	82375.
1992	0.	167864.	0.	78702.	4546.	84616.	89161.	98800.
1993	0.	186329.	0.	87360.	4546.	94423.	98969.	115040.
1994	0.	206825.	0.	96969.	4546.	105310.	109856.	130972.
1995	0.	229576.	0.	107636.	4546.	117394.	121940.	146531.
1996	0.	254829.	0.	119476.	4546.	130808.	135353.	161663.
1997	0.	282960.	0.	132618.	4546.	145696.	150242.	176326.
1998	0.	313975.	0.	147206.	4546.	162223.	166769.	190492.
1999	0.	348512.	0.	163399.	4546.	180568.	185113.	204144.
2000	0.	386849.	0.	181373.	4546.	200930.	205476.	217273.
2001	0.	429402.	0.	201324.	4546.	223532.	228078.	229874.
2002	0.	476636.	0.	223469.	4546.	248621.	253167.	241950.
2003	0.	529056.	0.	248051.	4546.	276469.	281015.	253506.
2004	0.	587264.	0.	275337.	4546.	307381.	311927.	264553.
2005	0.	651863.	0.	305624.	4546.	341693.	346239.	275101.
2006	0.	723567.	0.	339242.	4546.	379779.	384325.	285165.
2007	0.	803160.	37794.	376559.	4546.	432492.	464395.	294759.
TOTAL	131739.	7302283.	37794.	3435421.	104382.	3772916.	3904657.	294759.

INTERNAL RATE OF RETURN = 40.478 ANUAL PC

DISCOUNTED PAY BACK = 5.765 YEARS

MINIMUM PROJECT LIFE = 0.000 YEARS

JIBOA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE CANE SUGAR PRICE

CANE PRICE	I.R.R	PAY-BACK	MINIMUN LIFE
24.60	40.478	5.765	0.000
25.83	39.343	5.944	0.000
27.06	38.222	6.143	0.000
28.29	37.112	6.359	0.000
29.52	36.014	6.590	0.000
30.75	34.926	6.840	0.000
31.98	33.847	7.114	0.000
33.21	32.775	7.421	0.000
34.44	31.710	7.753	0.000

SENSITIVITY TO THE SUGAR PRICE

CRISTAL SUGAR	RAW SUGAR	I.R.R	PAY-BACK	MINIMUN LIFE
.200	.152	19.553	17.680	16.833
.250	.190	22.957	12.927	11.254
.300	.228	26.213	10.270	0.000
.350	.266	29.581	8.554	0.000
.400	.304	33.044	7.349	0.000
.450	.342	36.659	6.456	0.000
.500	.380	40.478	5.765	0.000
.550	.418	44.555	5.215	0.000
.600	.456	48.949	4.768	0.000
.650	.494	53.725	4.398	0.000
.700	.532	58.962	4.080	0.000
.750	.570	64.756	3.751	0.000

JIBOA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE BOARD PRICE

BOARD PRICE	I.R.R	PAY-BACK	MINIMUM LIFE
.385	40.478	5.765	0.000
.327	38.380	6.098	0.000
.270	36.143	6.531	0.000
.212	33.740	7.094	0.000
.154	31.132	7.881	0.000
.096	28.264	9.043	0.000
.039	25.043	10.948	0.000
-.019	21.306	14.663	0.000
-.077	16.707	24.750	0.000
-.135	10.227	45.864	0.000

SENSITIVITY TO THE ALCOHOL PRICE

ALCOHOL PRICE	I.R.R	PAY-BACK	MINIMUM LIFE
.578	40.478	5.765	0.000
.723	41.646	5.602	0.000
.867	42.777	5.457	0.000
1.012	43.874	5.326	0.000
1.156	44.939	5.207	0.000
1.301	45.975	5.099	0.000
1.445	46.983	5.001	0.000
1.590	47.966	4.916	0.000
1.734	48.925	4.837	0.000
1.879	49.860	4.764	0.000
2.023	50.775	4.697	0.000
2.168	51.669	4.634	0.000
2.312	52.543	4.576	0.000
2.457	53.400	4.522	0.000

JIBUA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE INVESTMENT IN FIXED ASSET

INVESTM. FACTOR	I.R.R	PAY-BACK	MINIMUM LIFE
1.000	40.478	5.765	0.000
1.050	39.294	5.942	0.000
1.100	38.204	6.127	0.000
1.150	37.195	6.314	0.000
1.200	36.257	6.501	0.000
1.250	35.384	6.689	0.000
1.300	34.568	6.876	0.000
1.350	33.802	7.067	0.000
1.400	33.082	7.264	0.000

JIRDA SUGAR FA[illegible]ORY STUDY
UNIDO

EQUITY CASH-FLOW ANALISYS (WITH FINANCING)

T	INVESTM	EQUITY	LOANS	LOAN INTEREST	LOAN AMORT.	INCOME	EXPENSES	INVESTM DEPREC.	PROFIT AFT.TAX	OPERAT. C.FLOW
1983	50363.0	4202.4	37821.6	0.0	0.0	19362.4	11023.0	0.0	8339.4	8339.4
1984	23931.0	1353.0	18607.1	6429.7	0.0	25114.8	14714.2	1868.6	2102.1	3971.0
1985	30643.0	1909.8	26781.4	9785.9	0.0	27877.5	16332.8	2829.1	-1070.1	1758.9
1986	6802.0	0.0	8133.0	14626.4	0.0	30944.0	18129.4	4221.9	-6033.7	-1811.8
1987	20000.0	0.0	0.0	16253.0	12078.2	99619.0	46706.1	4545.8	32114.1	36660.0
1988	0.0	0.0	0.0	13837.4	19381.8	110577.1	51843.7	4545.8	40350.2	44896.0
1989	0.0	0.0	0.0	10350.1	8333.1	122740.6	57546.6	4545.8	50298.1	54843.9
1990	0.0	0.0	0.0	8933.5	11197.8	136242.1	63876.7	4545.8	58886.1	63431.9
1991	0.0	0.0	0.0	7029.9	11197.8	151228.7	70903.1	4545.8	68749.9	73295.7
1992	0.0	0.0	0.0	5126.3	11197.8	167863.9	78702.5	4545.8	79489.3	84035.2
1993	0.0	0.0	0.0	3222.6	11197.8	186328.9	87359.7	4545.6	91200.7	95746.5
1994	0.0	0.0	0.0	1319.0	4894.2	206825.1	96969.3	4545.8	103991.0	108536.8
1995	0.0	0.0	0.0	487.0	2864.7	229575.9	107635.9	4545.8	116907.1	121452.9
1996	0.0	0.0	0.0	0.0	0.0	254829.2	119475.9	4545.8	130807.5	135353.3
1997	0.0	0.0	0.0	0.0	0.0	282860.4	132618.2	4545.8	145696.4	150242.2
1998	0.0	0.0	0.0	0.0	0.0	313975.1	147206.2	4545.8	162223.0	166768.8
1999	0.0	0.0	0.0	0.0	0.0	348512.3	163398.9	4545.8	180567.6	185113.4
2000	0.0	0.0	0.0	0.0	0.0	386848.7	181372.8	4545.8	200930.1	205475.9
2001	0.0	0.0	0.0	0.0	0.0	429402.0	201323.8	4545.8	223532.4	228078.2
2002	0.0	0.0	0.0	0.0	0.0	476636.2	223469.4	4545.8	248621.0	253166.8
2003	0.0	0.0	0.0	0.0	0.0	529066.2	248051.0	4545.8	276469.4	281015.2
2004	0.0	0.0	0.0	0.0	0.0	587263.5	275336.7	4545.8	307381.0	311926.9
2005	0.0	0.0	0.0	0.0	0.0	651862.5	305623.7	4545.8	341693.0	346238.8
2006	0.0	0.0	0.0	0.0	0.0	723567.4	339242.3	4545.8	379777.3	384325.1
2007	0.0	0.0	0.0	0.0	0.0	803159.9	376559.0	4545.8	432492.0	464394.8
TOTAL	131739.0	7465.2	91343.1	97400.7	91343.1	7302283.4	3435420.9	104382.0	3675516.8	3807255.8

INTERNAL RATE OF RETURN = 80.193 ANUAL PC

06.08.82

JIRDA SUGAR FA[illegible]RY STUDY
UNIDO

CASE D1.- ALCOHOL PLANT

NUMBER OF PERIODS PER YEAR	1
START OF STUDY	1983
PROJECT LIFE	25 YEARS
STARTUP	1985

INVESTMENTS AND INITIAL EXPENSES

DESCRIPTION	DATE	AMOUNT	INV AMT	INV DEP
FIXED ASSET	1983	8325.	*-L	*-L
-	1984	6160.	*-L	*-L
WORKING CAPITAL	1985	2736.	*-K	*-K

SALVAGE VALUE	R	R.RATE ANUALPC
833.		
616.		

--UNIT.COST--		
IN.VAL	INCR	K
40.9	11.0	A
-	11.0	A
32.8	11.0	A
-	11.0	A
315.	11.0	A
349.1	11.0	A
87.5	11.0	A
48.9	11.0	A
-	11.0	A

--UNIT.PRICE-		
IN.VAL	INCR	K
.470	11.0	A
-	11.0	A

06.05.82

JIBOA SUGAR F[illegible]TORY STUDY
UNIDO
****

OPERATING COSTS
****

DESCRIPTION	PERIOD IN.DATE	PERIOD FIN.DATE	AMOUNT IN.VAL	AMOUNT INCR K
MOLASSE	1985		16.6	
-	1986	*	18.4	
CLEAR JUICE	1985		91.0	
-	1986	*	90.0	
LABOUR	1985	*	1.0	
RAW MATERIAL	1985	*	1.0	
MAINTE. MATERIAL	1985	*	1.0	
BAGASSE	1985		19.5	
-	1986	*	20.6	

INCOME - PRODUCTION AND SALES
****

DESCRIPTION	PERIOD IN.DATE	PERIOD FIN DATE	AMOUNT IN.VAL	AMOUNT INCR K
ALCOHOL	1985		10130.	
-	1986	*	11256.	

TAX RATE	0.00	ANUAL PC
LOSS CARRY FORWARDS	0	YEARS
AVERAGE COST OF MONEY	17.00	ANUAL PC
AVERAGE INTEREST OF MONEY	17.00	ANUAL PC

JIRDA SUGAR FACTORY STUDY
UNIDO

INVESTMENTS RESUME

T	FIXED ASSET	WORKING CAPITAL	TOTAL
1983	8325.	0.	8325.
1984	6160.	0.	6160.
1985	0.	2736.	2736.
1986	0.	0.	0.
1987	0.	0.	0.
1988	0.	0.	0.
1989	0.	0.	0.
1990	0.	0.	0.
1991	0.	0.	0.
1992	0.	0.	0.
1993	0.	0.	0.
1994	0.	0.	0.
1995	0.	0.	0.
1996	0.	0.	0.
1997	0.	0.	0.
1998	0.	0.	0.
1999	0.	0.	0.
2000	0.	0.	0.
2001	0.	0.	0.
2002	0.	0.	0.
2003	0.	0.	0.
2004	0.	0.	0.
2005	0.	0.	0.
2006	0.	0.	0.
2007	0.	0.	0.
TOTAL	14485.	2736.	17221.

JIBDA SUGAR FAC[illegible]Y STUDY
UNIDO

OPERATING COSTS RESUME

T	MOLASSE	CLEAR JUICE	LABOUR	RAW MATERIAL	MAINTE. MATERIAL	BAGASSE	TOTAL
1983	0.	0.	0.	0.	0.	0.	0.
1984	0.	0.	0.	0.	0.	0.	0.
1985	679.	2657.	315.	349.	88.	905.	4992.
1986	835.	3277.	350.	388.	97.	1118.	6064.
1987	927.	3637.	368.	430.	108.	1241.	6732.
1988	1029.	4037.	431.	477.	120.	1378.	7472.
1989	1142.	4481.	478.	530.	133.	1529.	8294.
1990	1268.	4974.	531.	588.	147.	1697.	9206.
1991	1408.	5521.	589.	653.	164.	1884.	10219.
1992	1562.	6129.	654.	725.	182.	2091.	11343.
1993	1734.	6803.	726.	805.	202.	2321.	12591.
1994	1925.	7551.	806.	893.	224.	2577.	13976.
1995	2137.	8382.	894.	991.	248.	2860.	15513.
1996	2372.	9304.	993.	1100.	276.	3175.	17220.
1997	2633.	10327.	1102.	1221.	306.	3524.	19114.
1998	2922.	11463.	1223.	1356.	340.	3912.	21216.
1999	3244.	12724.	1358.	1505.	377.	4342.	23550.
2000	3601.	14124.	1507.	1670.	419.	4820.	26141.
2001	3997.	15678.	1673.	1854.	465.	5350.	29016.
2002	4436.	17402.	1857.	2059.	516.	5938.	32208.
2003	4924.	19317.	2061.	2284.	573.	6592.	35751.
2004	5466.	21441.	2288.	2536.	636.	7317.	39683.
2005	6067.	23800.	2540.	2815.	705.	8121.	44048.
2006	6735.	26418.	2819.	3124.	783.	9015.	48894.
2007	7476.	29324.	3129.	3468.	869.	10006.	54272.
TOTAL	68521.	268773.	28712.	31920.	7975.	91714.	497515.

JIBOA SUGAR [illegible]TORY STUDY
UNIDO

INCOMES RESUME

T	ALCOHOL
1983	0.
1984	0.
1985	4761.
1986	5972.
1987	6518.
1988	7235.
1989	8031.
1990	8914.
1991	9895.
1992	10984.
1993	12192.
1994	13533.
1995	15021.
1996	16674.
1997	18508.
1998	20544.
1999	22804.
2000	25312.
2001	28096.
2002	31167.
2003	34617.
2004	38425.
2005	42652.
2006	47344.
2007	52552.
TOTAL	481672.

JIBOA SUGAR F…TORY STUDY
UNIDO

INVESTMENT CASH-FLOW ANALISYS (WITHOUT FINANCING)

T	INVESTM	INCOME	SALVAGE VALUE	EXPENSES	INVESTM DEPREC.	PROFIT AFT.TAX	OPERAT. C.FLOW	PRESENT NET VAL
1983	8325.	0.	0.	0.	0.	0.	0.	0.
1984	6160.	0.	0.	0.	0.	0.	0.	-1210.
1985	2736.	4761.	0.	4992.	630.	-861.	-231.	-3591.
1986	0.	5872.	0.	6064.	630.	-822.	-192.	-5833.
1987	0.	6518.	0.	6732.	630.	-843.	-213.	-7709.
1988	0.	7235.	0.	7472.	630.	-867.	-237.	-9279.
1989	0.	8031.	0.	8294.	630.	-893.	-263.	-10593.
1990	0.	8914.	0.	9206.	630.	-922.	-292.	-11694.
1991	0.	9895.	0.	10219.	630.	-954.	-324.	-12617.
1992	0.	10984.	0.	11343.	630.	-989.	-360.	-13391.
1993	0.	12192.	0.	12591.	630.	-1029.	-399.	-14040.
1994	0.	13533.	0.	13976.	630.	-1073.	-443.	-14586.
1995	0.	15021.	0.	15513.	630.	-1122.	-492.	-15046.
1996	0.	16674.	0.	17220.	630.	-1176.	-546.	-15433.
1997	0.	18508.	0.	19114.	630.	-1236.	-606.	-15760.
1998	0.	20544.	0.	21216.	630.	-1302.	-673.	-16036.
1999	0.	22804.	0.	23550.	630.	-1376.	-746.	-16271.
2000	0.	25312.	0.	26141.	630.	-1458.	-829.	-16470.
2001	0.	28096.	0.	29016.	630.	-1550.	-920.	-16640.
2002	0.	31187.	0.	32206.	630.	-1651.	-1021.	-16785.
2003	0.	34617.	0.	35751.	630.	-1763.	-1133.	-16911.
2004	0.	39425.	0.	39693.	630.	-1888.	-1258.	-17019.
2005	0.	42652.	0.	44048.	630.	-2026.	-1396.	-17113.
2006	0.	47344.	0.	46894.	630.	-2180.	-1550.	-17195.
2007	0.	52552.	4185.	54272.	630.	-901.	2465.	-17266.
TOTAL	17221.	481672.	4185.	497515.	14485.	-28879.	-11658.	-17266.

INTERNAL RATE OF RETURN ************ ANNUAL PC

DISCOUNTED PAY BACK = 327.312 YEARS

MINIMUM PROJECT LIFE ************ YEARS

06.08.82

JIBUA SUGAR F[illegible]TORY STUDY
UNIDO

SENSITIVITY TO THE CLEAR JUICE PRICE

JUICE PRICE	I.R.R	PAY-BACK	MINIMUM LIFE
32.80	*	327.312	*
34.44	*	836.229	*
36.08	*	*	*
37.72	*	*	*
39.36	*	*	*
41.00	*	*	*
42.64	*	*	*
44.28	*	*	*
45.92	*	*	*

SENSITIVITY TO THE ALCOHOL PRICE

ALCOHOL PRICE	I.R.R	PAY-BACK	MINIMUM LIFE
.470	*	327.312	*
.588	13.753	35.478	41.631
.705	22.848	12.341	10.022
.823	30.017	7.634	3.647
.940	36.427	5.719	2.079
1.058	42.403	4.675	1.615
1.175	48.074	4.012	1.427
1.293	53.503	3.565	1.326
1.410	58.726	3.232	1.264
1.528	63.768	2.976	1.222
1.645	68.647	2.791	1.192
1.763	73.378	2.622	1.168
1.880	77.974	2.489	1.150
1.998	82.446	2.378	1.136
2.115	86.802	2.282	1.124
2.233	91.051	2.199	1.113

06.08.82

JIRDA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE INVESTMENT IN FIXED ASSET

INVESTM. FACTOR	I.R.R	PAY-BACK	MINIMUM LIFE
1.000	*	327.312	*
1.050	*	339.248	*
1.100	*	351.185	*
1.150	*	363.122	*
1.200	*	375.058	*
1.250	*	386.995	*
1.300	*	398.932	*
1.350	*	410.868	*
1.400	*	422.805	*

JIBOA SUGAR FACTORY STUDY
UNIDO

CASE D2.- ALCOHOL PLANT + SUGAR FACTORY

NUMBER OF PERIODS PER YEAR	1	
START OF STUDY	1983	
PROJECT LIFE	25	YEARS
STARTUP	1983	

INVESTMENTS AND INITIAL EXPENSES

DESCRIPTION	DATE	AMOUNT	INV AMT	INV DEP	SALVAGE VALUE	R	R.RATE ANUALPC
FIXED ASSET	1983	50989.	*-L	*-L	5099.		
-	1984	6160.	*-L	*-L	616.		
WORKING CAPITAL	1983	5511.	*-K	*-K			
-	1985	2420.	*-K	*-K			

JIBOA SUGAR FACTORY STUDY
UNIDO

EQUITY

DESCRIPTION	DATE	AMOUNT
EQUITY	1983	4816.0

LOANS

DESCRIPTION	DATE	AMOUNT	INT.RATE ANUAL PC	PARAMETERS K	PG	P1	PA	RET. PER.
BANK LOAN	1983	43345.0	17.00	AK	4	1	1	6
SHORT LOAN	1984	4271.9	20.00	AK	1	1	1	2
-	1985	67.7	20.00	AK	0	1	1	2

JIBUA SUGAR F[illegible]TORY STUDY
UNIDO

OPERATING COSTS

DESCRIPTION	PERIOD IN.DATE	PERIOD FIN.DATE	AMOUNT IN.VAL	AMOUNT INCR	K	UNIT.COST IN.VAL	UNIT.COST INCR	K
CANE SUGAR	1983	1984	400.			24.6	11.0	A
-	1985	*	450.			-	11.0	A
RAW MATERIAL	1983	1984	1.0			98.	11.0	A
-	1985	*	1.0			486.	11.0	A
MAINTE. MATERIAL	1983	1984	1.0			170.	11.0	A
-	1985	*	1.0			293.	11.0	A
LABOUR	1983	1984	1.0			915.	11.0	A
-	1985	*	1.0			1409.	11.0	A

INCOME - PRODUCTION AND SALES

DESCRIPTION	PERIOD IN.DATE	PERIOD FIN DATE	AMOUNT IN.VAL	AMOUNT INCR	K	UNIT.PRICE IN.VAL	UNIT.PRICE INCR	K
CRISTAL SUGAR	1983	1984	30760.			.50	11.0	A
-	1985	*	27540.			-	11.0	A
RAW SUGAR	1983	1984	10480.			.39	11.0	A
-	1985	*	8856.			-	11.0	A
ALCOHOL	1985	*	11256.			.47	11.0	A

TAX RATE	0.00	ANUAL PC
LOSS CARRY FORWARDS	0	YEARS
AVERAGE COST OF MONEY	17.00	ANUAL PC
AVERAGE INTEREST OF MONEY	17.00	ANUAL PC

JIBOA SUGAR FA[illegible]ORY STUDY
UNID[illegible]

INVESTMENTS RESUME

T	FIXED ASSET	WORKING CAPITAL	TOTAL
1983	50989.	5511.	56500.
1984	6160.	0.	6160.
1985	0.	2420.	2420.
1986	0.	0.	0.
1987	0.	0.	0.
1988	0.	0.	0.
1989	0.	0.	0.
1990	0.	0.	0.
1991	0.	0.	0.
1992	0.	0.	0.
1993	0.	0.	0.
1994	0.	0.	0.
1995	0.	0.	0.
1996	0.	0.	0.
1997	0.	0.	0.
1998	0.	0.	0.
1999	0.	0.	0.
2000	0.	0.	0.
2001	0.	0.	0.
2002	0.	0.	0.
2003	0.	0.	0.
2004	0.	0.	0.
2005	0.	0.	0.
2006	0.	0.	0.
2007	0.	0.	0.
TOTAL	57149.	7931.	65080.

JIBOA SUGAR FAC[illegible]Y STUDY
UNIDO

INTERNATIONAL BANK LOANS

T	LOANS	LOAN INTEREST	LOAN AMORT.	AMORT. + INTEREST	UNPAID BALANCE
1983	43345.0	0.0	0.0	0.0	43345.0
1984	0.0	7368.7	0.0	7368.7	43345.0
1985	0.0	7368.7	0.0	7368.7	43345.0
1986	0.0	7368.7	0.0	7368.7	43345.0
1987	0.0	7368.7	0.0	7368.7	43345.0
1988	0.0	7368.7	7224.2	14592.9	36120.8
1989	0.0	6140.5	7224.2	13364.7	28896.7
1990	0.0	4912.4	7224.2	12136.6	21672.5
1991	0.0	3684.3	7224.2	10908.5	14448.3
1992	0.0	2456.2	7224.2	9680.4	7224.2
1993	0.0	1228.1	7224.2	8452.3	0.0
1994	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0
2004	0.0	0.0	0.0	0.0	0.0
2005	0.0	0.0	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0	0.0
2007	0.0	0.0	0.0	0.0	0.0
TOTAL	43345.0	55264.9	43345.0	98609.9	0.0

JIBOA SUGAR FACTORY STUDY
UNIDO

SHORT LOAN

T	LOANS	LOAN INTEREST	LOAN AMORT.	AMORT. + INTEREST	UNPAID BALANCE
1983	0.	0.	0.	0.	0.
1984	4272.	0.	0.	0.	4272.
1985	68.	854.	0.	854.	4340.
1986	0.	868.	2170.	3038.	2170.
1987	0.	434.	2170.	2604.	0.
1988	0.	0.	0.	0.	0.
1989	0.	0.	0.	0.	0.
1990	0.	0.	0.	0.	0.
1991	0.	0.	0.	0.	0.
1992	0.	0.	0.	0.	0.
1993	0.	0.	0.	0.	0.
1994	0.	0.	0.	0.	0.
1995	0.	0.	0.	0.	0.
1996	0.	0.	0.	0.	0.
1997	0.	0.	0.	0.	0.
1998	0.	0.	0.	0.	0.
1999	0.	0.	0.	0.	0.
2000	0.	0.	0.	0.	0.
2001	0.	0.	0.	0.	0.
2002	0.	0.	0.	0.	0.
2003	0.	0.	0.	0.	0.
2004	0.	0.	0.	0.	0.
2005	0.	0.	0.	0.	0.
2006	0.	0.	0.	0.	0.
2007	0.	0.	0.	0.	0.
TOTAL	4340.	2156.	4340.	6496.	0.

JIRDA SUGAR FACTORY STUDY
UNIT

OPERATING COSTS RESUME

T	CANE SUGAR	RAW MATERIAL	MAINTE. MATERIAL	LABOUR	TOTAL
1983	9840.	98.	170.	915.	11023.
1984	10922.	109.	189.	1016.	12236.
1985	13639.	486.	293.	1409.	15827.
1986	15140.	539.	325.	1564.	17568.
1987	16605.	599.	351.	1736.	19501.
1988	18654.	665.	401.	1927.	21646.
1989	20705.	738.	445.	2139.	24027.
1990	22983.	819.	494.	2374.	26670.
1991	25511.	909.	548.	2635.	29604.
1992	28317.	1009.	609.	2925.	32860.
1993	31432.	1120.	675.	3247.	36475.
1994	34890.	1243.	750.	3604.	40487.
1995	38728.	1380.	832.	4001.	44941.
1996	42988.	1532.	923.	4441.	49884.
1997	47717.	1700.	1025.	4929.	55371.
1998	52965.	1887.	1139.	5472.	61462.
1999	58792.	2095.	1263.	6073.	68223.
2000	65259.	2325.	1402.	6741.	75727.
2001	72437.	2581.	1556.	7483.	84057.
2002	80405.	2865.	1727.	8306.	93304.
2003	89250.	3180.	1917.	9220.	103567.
2004	99067.	3530.	2128.	10234.	114959.
2005	109965.	3918.	2362.	11360.	127605.
2006	122061.	4349.	2622.	12609.	141642.
2007	135487.	4828.	2911.	13996.	157222.
TOTAL	1263960.	44505.	27065.	130358.	1465888.

JIRDA SUGAR FACTORY STUDY
UNIDO

INCOMES RESUME

T	CRISTAL SUGAR	RAW SUGAR	ALCOHOL	TOTAL
1983	15380.	3982.	0.	19362.
1984	17072.	4420.	0.	21492.
1985	16966.	4146.	5290.	26403.
1986	18832.	4602.	5872.	29307.
1987	20904.	5109.	6519.	32531.
1988	23203.	5671.	7235.	36109.
1989	25756.	6294.	8031.	40081.
1990	28589.	6987.	8914.	44490.
1991	31733.	7755.	9895.	49384.
1992	35224.	8609.	10984.	54816.
1993	39099.	9555.	12192.	60846.
1994	43400.	10607.	13533.	67539.
1995	48174.	11773.	15021.	74968.
1996	53473.	13068.	16674.	83215.
1997	59355.	14506.	18508.	92369.
1998	65884.	16101.	20544.	102529.
1999	73131.	17873.	22804.	113807.
2000	81175.	19839.	25312.	126326.
2001	90105.	22021.	28096.	140222.
2002	100016.	24443.	31187.	155646.
2003	111019.	27132.	34617.	172767.
2004	123230.	30116.	38425.	191772.
2005	136785.	33429.	42652.	212867.
2006	151832.	37106.	47344.	236282.
2007	168533.	41188.	52552.	262273.
TOTAL	1578868.	396335.	482201.	2447405.

JIBOA SUGAR F[illegible]ORY STUDY
UNI[illegible]

INVESTMENT CASH-FLOW ANALISYS (WITHOUT FINANCING)

T	INVESTM	INCOME	SALVAGE VALUE	EXPENSES	INVESTM DEPREC.	PROFIT AFT.TAX	OPERAT. C.FLOW	PRESENT NET VAL
1983	56500.	19362.	0.	11023.	0.	8339.	8339.	8339.
1984	6160.	21492.	0.	12236.	2125.	7132.	9257.	6407.
1985	2420.	26403.	0.	15927.	2392.	8183.	10575.	5016.
1986	0.	29307.	0.	17569.	2392.	9346.	11739.	4525.
1987	0.	32531.	0.	19501.	2392.	10638.	13030.	4989.
1988	0.	36109.	0.	21646.	2392.	12071.	14463.	6207.
1989	0.	40081.	0.	24027.	2392.	13662.	16054.	8010.
1990	0.	44490.	0.	26670.	2392.	15428.	17820.	10262.
1991	0.	49384.	0.	29604.	2392.	17308.	19786.	12649.
1992	0.	54816.	0.	32860.	2392.	19564.	21956.	15679.
1993	0.	60846.	0.	36475.	2392.	21979.	24371.	18677.
1994	0.	67539.	0.	40497.	2392.	24660.	27052.	21780.
1995	0.	74968.	0.	44941.	2392.	27636.	30026.	24941.
1996	0.	83215.	0.	49884.	2392.	30939.	33331.	28119.
1997	0.	92369.	0.	55371.	2392.	34605.	36997.	31283.
1998	0.	102529.	0.	61462.	2392.	38675.	41067.	34408.
1999	0.	113807.	0.	68223.	2392.	43192.	45584.	37475.
2000	0.	126326.	0.	75727.	2392.	48206.	50599.	40469.
2001	0.	140222.	0.	84057.	2392.	53772.	56165.	43380.
2002	0.	155646.	0.	93304.	2392.	59950.	62343.	46199.
2003	0.	172767.	0.	103567.	2392.	66808.	69200.	48921.
2004	0.	191772.	0.	114959.	2392.	74420.	76812.	51543.
2005	0.	212867.	0.	127605.	2392.	82869.	85262.	54062.
2006	0.	236282.	0.	141642.	2392.	92248.	94641.	56479.
2007	0.	262273.	13646.	157222.	2392.	108374.	118697.	58793.
TOTAL	65080.	2447405.	13646.	1465888.	57149.	930083.	995163.	58793.

INTERNAL RATE OF RETURN = 27.852 ANNUAL PC

DISCOUNTED PAY BACK = 8.159 YEARS

MINIMUM PROJECT LIFE = 0.000 YEARS

06.08.82

JIBOA SUGAR FACTORY STUDY
UNIDO

SENSITIVITY TO THE CANE SUGAR PRICE

CANE PRICE	I.R.R	PAY-BACK	MINIMUN LIFE
24.60	27.852	8.159	0.000
25.83	26.454	8.960	0.000
27.06	25.057	9.928	0.000
28.29	23.655	11.116	0.000
29.52	22.243	12.615	0.000
30.75	20.813	14.564	0.000
31.98	19.355	17.224	0.000
33.21	17.858	21.126	0.000
34.44	16.306	26.307	0.000

SENSITIVITY TO THE SUGAR PRICE

CRISTAL SUGAR	RAW SUGAR	I.R.R	PAY-BACK	MINIMUN LIFE
.200	.152	*	*	*
.250	.190	*	229.406	*
.300	.228	7.613	74.693	0.000
.350	.266	13.782	36.316	0.000
.400	.304	18.722	18.691	0.000
.450	.342	23.301	11.467	0.000
.500	.380	27.852	8.159	0.000
.550	.418	32.566	6.237	0.000
.600	.456	37.575	4.968	0.000
.650	.494	42.989	4.073	0.000
.700	.532	48.911	3.409	0.000
.750	.570	55.443	2.896	0.000

JIBOA SUGAR FA[illegible]ORY STUDY
UNIDO

SENSITIVITY TO THE ALCOHOL PRICE

ALCOHOL PRICE	I.R.R	PAY-BACK	MINIMUN LIFE
.470	27.852	8.159	0.000
.588	29.890	7.217	0.000
.705	31.845	6.498	0.000
.823	33.730	5.923	0.000
.940	35.555	5.465	0.000
1.058	37.329	5.078	0.000
1.175	39.056	4.759	0.000
1.293	40.743	4.486	0.000
1.410	42.391	4.247	0.000
1.528	44.006	4.036	0.000
1.645	45.588	3.856	0.000
1.763	47.141	3.697	0.000
1.880	48.666	3.554	0.000
1.998	50.165	3.425	0.000

SENSITIVITY TO THE INVESTMENT IN FIXED ASSET

INVESTM. FACTOR	I.R.R	PAY-BACK	MINIMUN LIFE
1.000	27.852	8.159	0.000
1.050	26.910	8.685	0.000
1.100	26.047	9.223	0.000
1.150	25.254	9.777	0.000
1.200	24.520	10.350	0.000
1.250	23.839	10.935	0.000
1.300	23.204	11.548	0.000
1.350	22.611	12.173	0.000
1.400	22.055	12.823	0.000

JIBOA SUGAR FACTORY STUDY
UNIDO

EQUITY CASH-FLOW ANALISYS (WITH FINANCING)

T	INVESTM	EQUITY	LOANS	LOAN INTEREST	LOAN AMORT.	INCOME	EXPENSES	INVESTM DEPREC.	PROFIT AFT.TAX	OPERAT. C.FLOW
1983	56500.0	4816.0	43345.0	0.0	0.0	19362.4	11023.0	0.0	8339.4	8339.4
1984	6160.0	0.0	4271.9	7368.7	0.0	21492.3	12235.5	2124.5	-236.5	1858.1
1985	2420.0	0.0	67.7	8223.0	0.0	26402.7	15827.3	2392.4	-40.0	2352.3
1986	0.0	0.0	0.0	9236.6	2169.8	29307.0	17568.4	2392.4	1109.7	3502.1
1987	0.0	0.0	0.0	7802.6	2169.8	32530.8	19500.9	2392.4	2834.9	5227.3
1988	0.0	0.0	0.0	7369.7	7224.2	36109.1	21646.0	2392.4	4702.2	7094.5
1989	0.0	0.0	0.0	6140.5	7224.2	40081.2	24027.0	2392.4	7521.2	9913.6
1990	0.0	0.0	0.0	4912.4	7224.2	44490.1	26670.0	2392.4	10515.3	12907.6
1991	0.0	0.0	0.0	3684.3	7224.2	49384.0	29603.7	2392.4	13703.6	16096.0
1992	0.0	0.0	0.0	2456.2	7224.2	54816.2	32860.1	2392.4	17107.5	19499.9
1993	0.0	0.0	0.0	1228.1	7224.2	60846.0	36474.7	2392.4	20750.8	23143.2
1994	0.0	0.0	0.0	0.0	0.0	67539.1	40486.9	2392.4	24659.8	27052.1
1995	0.0	0.0	0.0	0.0	0.0	74968.4	44940.5	2392.4	27635.5	30027.9
1996	0.0	0.0	0.0	0.0	0.0	83214.9	49884.0	2392.4	30938.6	33330.9
1997	0.0	0.0	0.0	0.0	0.0	92368.5	55371.2	2392.4	34605.0	36997.3
1998	0.0	0.0	0.0	0.0	0.0	102529.1	61462.0	2392.4	38674.7	41067.1
1999	0.0	0.0	0.0	0.0	0.0	113807.3	68222.8	2392.4	43192.1	45584.4
2000	0.0	0.0	0.0	0.0	0.0	126326.1	75727.4	2392.4	48206.3	50598.7
2001	0.0	0.0	0.0	0.0	0.0	140221.9	84057.4	2392.4	53772.2	56164.6
2002	0.0	0.0	0.0	0.0	0.0	155646.4	93303.7	2392.4	59950.3	62342.7
2003	0.0	0.0	0.0	0.0	0.0	172767.5	103567.1	2392.4	66808.0	69200.4
2004	0.0	0.0	0.0	0.0	0.0	191771.9	114959.5	2392.4	74420.0	76812.4
2005	0.0	0.0	0.0	0.0	0.0	212866.8	127605.0	2392.4	82869.4	85261.8
2006	0.0	0.0	0.0	0.0	0.0	236282.1	141641.6	2392.4	92248.2	94640.6
2007	0.0	0.0	0.0	0.0	0.0	262273.2	157222.1	2392.4	108373.7	116697.0
TOTAL	65080.0	4816.0	47684.6	57421.1	47684.6	2447404.8	1465887.7	57149.0	872661.9	937741.9

INTERNAL RATE OF RETURN = 45.560 ANUAL PC

7.3.1. Alternative "A"

Alternative A.1

In this case the only cash flows to have been taken into account are the marginal amounts arising from the implementation of this alternative.

There is an Internal Rate of Return of 32.7% on the marginal investment with a pay-back of 6.2 years and a net present value of $ U.S. 10,041,000.

Alternative A.2

In this case the project is studied globally:

An Internal Rate of Return of 40.2% is achieved with a pay-back of 4.3 years and a net present value of $ U.S. 105,123,000.

The Internal Rate of Return on equity capital is 144.5%.

7.3.2. Alternative "B"

Alternative B.1

The analysis of the marginal cash flows gives an Internal Rate of Return of 35.9% with a pay-back of 7.1 years and a net present value of $ U.S. 35,574,000.

Alternative B.2

The analysis of the project overall gives an Internal Rate of Return on the investment of 40.3% with a pay-back of 4.9 years and a net present value of $ U.S. 134,104.000.

The Internal Rate of Return on equity capital is 104.2%.

7.3.3. Alternative "C"

Alternative C.1, Alcohol plant of 90,000 litres daily capacity, operating 239 days per year.

In this case, the alcohol plant was studied separately.

It yields us an Internal Rate of Return on the investment of 12.2% with a pay-back of 41.2 years and a net present value of minus $ U.S. 9,711,000.

Alternative C.2

In this case the project was studied as a whole, i. e., sugar plant, alcohol plant with a daily capacity of 90,000 litres, and the board plant.

An Internal Rate of Return on the investment of 40.4% is obtained, with a pay-back of 5.7 years and a net present value of $ U.S. 294,759,000.

The Internal Rate of Return on equity capital is 80.2%.

7.3.4. Alternative "D"

Alternative D.1, Alcohol plant of 60,000 litres daily capacity, operating 187 days per year.

This gives a negative Internal Rate of Return on investment, with a pay-back of 327.3 years and a net present value of minus $ U.S. 17,266,000.

Alternative D.2

This time the project was studied as a whole, i.e., including both the sugar plant and the alcohol plant with a daily capacity of 60,000 litres operating 187 days per year.

An Internal Rate of Return on the investment of 27.8% was achieved, with a pay-back of 8.2 years and a net present value of $ U.S. 58,793,000.

The Internal Rate of Return on equity capital is 45.5%.

SENER

7.4. SENSITIVITY ANALYSES

The computer output marshalls all the sensitivity analyses made. Below is a summary table from which one can see, for Alternatives A.2, B.2, C.2, D.2, C.1 and D.1, how the Internal Rate of Return (I.R.R.) varies when one of the base data is varied.

Variation	A.2	B.2	C.2	D.2	C.1	D.1
	I.R.R	I.R.R	I.R.R	I.R.R	I.R.R	I.R.R
Cane price + 40%	25.9	26.7	31.71	16.3	-	-
Sugar price - 40%	10.9	12.7	26.2	7.6	-	-
Sugar price + 40%	76.9	74.7	58.9	48.9	-	-
Fixed Capital Investment + 40%	38.9	37.7	33.1	22.1	9.7	*
Board price - 60%	-	-	31.1	-	-	-
Alcohol price + 25%	-	-	41.6	29.9	23.0	13.7
Alcohol price + 125%	-	-	45.9	37.3	47.9	42.4
Juice Costs + 20%	-	-	-	-	0.3	*

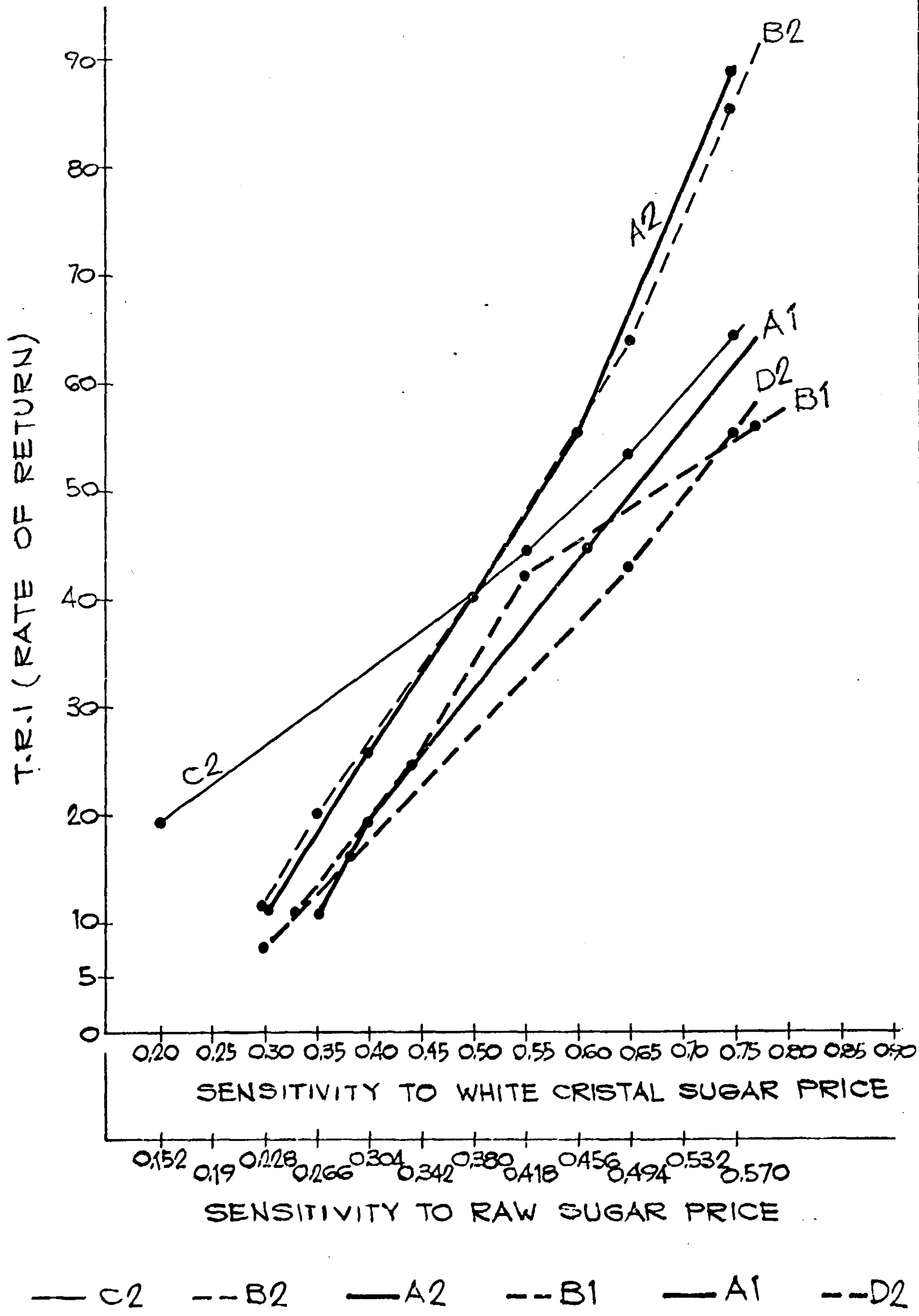
* Denotes a clearly negative Internal Rate of Return.

Looking at this summary table, one may note that investment has little effect on the Internal Rate of Return except in the alcohol plants (C.1, D.1).

All the alternatives are highly sensitive to variations in the sugar price and in the alcohol price.

There follow below a number of graphs which present the analyses of sensivity to the variables which have the strongest effect; each of them plots the Internal Rate of Return of the various alternatives against the value assumed for the variable in question.

SENER		TQ-5043
APROB. POR:		HOJA SIGUE EN
		REV. /



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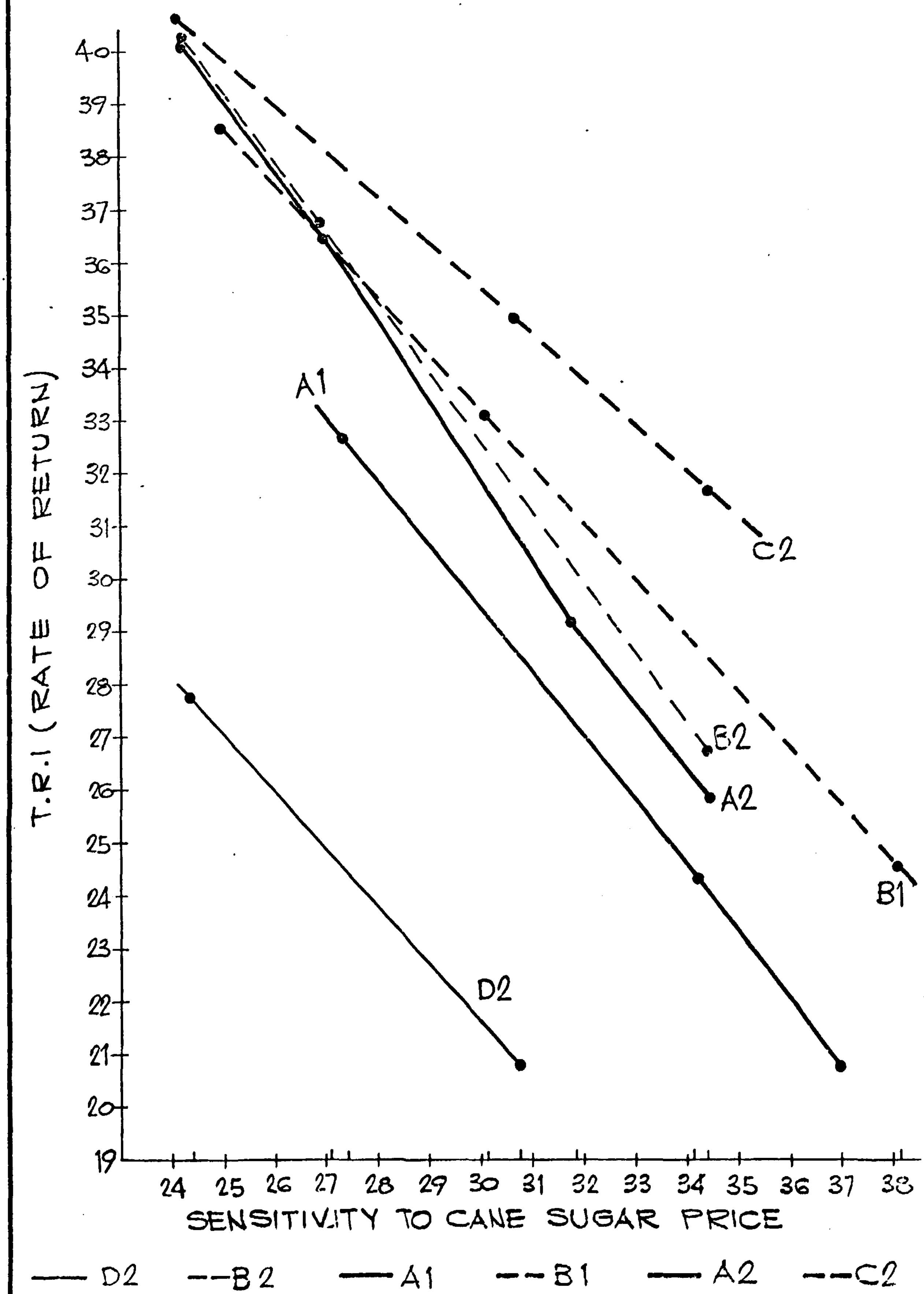
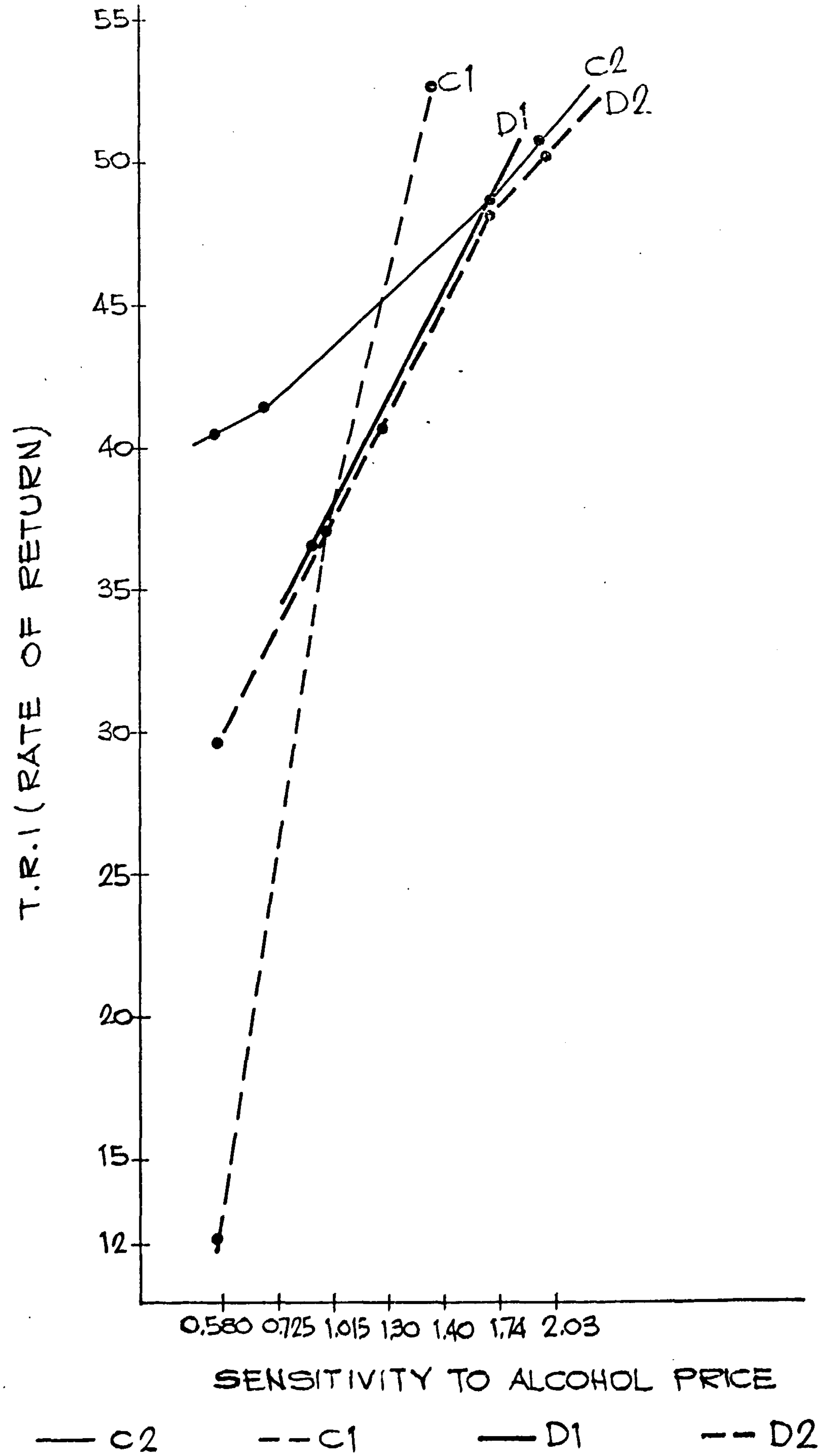
APROB. POR:		HOJA SIGUE EN
		REV. /




T.R.I (RATE OF RETURN)
55
50
45
40
35
30
25
20
15
12
C1
C2
D1
D2
0,580
0,725
1,015
1,30
1,40
1,74
2,03
SENSITIVITY TO ALCOHOL PRICE
C2
C1
D1
D2

7.5 CONCLUSIONS

From the economic standpoint, all the alternatives except D show, at a first approximation, similar profitability. Alternative D shows a substantially lower profitability because of the poor profitability of the 60,000 litre distillery.

This 60,000 litres a day distillery shows a negative return and to cross the threshold rate of return according to the analysis (17%), it would be necessary to set the price of alcohol at an initial level of $ 0.778 per litre.

Using the export price of alcohol put forward in El Salvador, which was not however supported by any market study, one attains an Internal Rate of Return of only 13.7%.

Alternative C gives a profitability similar to Alternatives A and B, but on the basis of a longer grinding season dealing with much more sugar cane. If the length of the season is reduced in Alternative C to that used for the other two , it gives us a much lower Internal Rate of Return, for which reason, added to the short term difficulty of obtaining 900,000 short tons of sugar cane, it would seem appropiate to leave Alternative C out of account.

Taking the satellite plants in Alternative C one at a time, we see that the distillery with a daily capacity of 90,000 litres a day is not profitable on its own. As far as the board plant is concerned, no separate profitability study was made for it since there seemed to be no reasonable market to absorb its output.

In view of the foregoing discussion, it seems advisable from the economic and financial standpoint, in relation to the sugar cane production which it is planned to achieve in the near future in the hinterland of the JIBOA complex,to embark only on Alternatives A and B.

8. SOCIAL EVALUATION OF THE PROJECT

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The economy of El Salvador is to a substantial degree an open one. In 1974, the share of goods and services in G.D.P. was 36%. However, one must bear in mind that 70% of exports were concentrated on three commodities : coffee (63.6%), cotton (7.1%) and sugar (2.2%).

El Salvador's import capacity therefore depends to a large extent on the export of those products (coffee, cotton and sugar). For that reason any investment project which is undertaken to increase production of any of those products (and with it export capacity) is in principle attractive from the point of view of the foreign trade sector.

Over recent years, sugar exports have diminished, principally, owing to the decline in cane production, which in turn has meant a declive in sugar production. Accordingly, any increase in the production of sugar in excess of growth in the country's home consumption would imply an increase in export capacity.

In 1980, sugar cane production ranked fourth in El Salvador behind coffee, cotton and maize, production attaining 6% of the total for the agricultural sector.

In 1981, sugar cane production in El Salvador amounted to 2,400,000 short tons. In Alternative B an increase in cane production by 222,000 short tons is proposed, which means a 9.25% increase over cane production in 1981. It is also proposed that this increase take place gradually over 5 years and only in the hinterland of JIBOA. To achieve this increase in production it is necessary for the area devoted to cane growing to increase by 2,857 ha.

This increase in sugar cane growing area implies in turn an increased need for agricultural labour amounting to 1,428 jobs for 6 months in the year.

Given the increase in unemployment from which El Salvador, in common with most countries, is suffering at the present time, this Project, like other similar ones which could be carried out on an integrated basis in El Salvador, optimising existing sugar plant productivity and developing the agricultural sector, could be of great benefit to the country.

As regards the possibility of producing fuel alcohol from sugar juice in order to reduce petroleum imports and consequently foreign exchange requirements, that will be viable as soon as the exchange savings it produces exceed foreign currency earnings from the export of sugar which could be made with the same juice.

In any case, it does appear advantagerous for the country to manufacture alcohol from the molasses left over from sugar production. However, given that the surplus molasses from JIBOA will not meet the input requirements of the proposed alcohol plant, it would be more advisable to send this surplus molasses to some other alcohol plant operating in the country.

To sum up the points made above, it is considered that this Project would be of benefit to El Salvador, especially if it were accompaied by measures of the same kind for the rest of the country's sugar industry.

9. FUTURE CONSTRAINTS ON THE VIAB PROJECT

9. FUTURE CONSTRAINTS ON THE VIABILITY OF THE PROJECT

9.1 IMPLEMENTATION PLAN

The Implementation Plan proposed by SENER for the JIBOA project is enclosed.

This schedule is set out on the assumption that the full completion of the complex will be carried out by the various stages which we recommend in our report.

The schedule has been divided into two parts which are quite distinct although they have a common calendar.

On one side the curve of crop figures is presented indicating the total cane tonnage expected in the periods shown.

Inmediately underneath a bar graph sets out the most important steps it is suggested would have to be taken in order to carry out the various stages of the extension.

This schedule also includes indications of the time scale within which decisions must be taken in relation to the completion of the complex.

It can be seen that there are basically two key decision points coinciding with the two steps of which it is considered that the project should consist.

The first key point coincides exactly with the expansion of the sugar plant to a capacity of 5,000 short tons of sugar cane per day, i. e., the expansion refered to in our study as Alternative "A".

We have related this point to the begining of the 1984 season (November 1983), for we assume that a crop of 520,000 short tons (468,000 tonnes) will be technically attainable by that date.

The second key point coincides with the expansion of the sugar plant to a capacity of 6,400 short tons per day which is the figure envisaged by Alternatives "B" and "C" of our study.

The bar graph explains the significance of each step to be taken, so we shall not repeat that here. However, a couple of clarifications are in order:

- It has been assumed that tenders are invited for the basic engineering design work for all stages at once up to full completion of the project, and that that work is contracted on that basis.

- That will mean that the project has an overall philosophy and design approach and that succesive expansions can be planned for within an orderly and global framework. This will avoid some stages of the expansion getting in the way of others, especially as regards the construction and siting of buildings, common services, etc., and this in turn will result in a better economic outturn overall.

- Moreover, while the relative simplicity of expanding as far as Alternative A is clearly appreciated, it is nevertheless considered advisable, for the reasons already noted, that the project be carried out as decribed in the schedule.

- Finally, it is worth emphasizing that the crop envisaged in the attached graph for Alternative A is 468,000 tonnes of sugar cane (520,000 short tons).

  At point 6.2.1 of this report, it is said that Alternative "A" is to be considered for 450,000 short tons of cane input upwards. As we have implied, this figure has been set for the purposes of the graph at 520,000 short tons of cane, equivalent to a grinding season lasting 104 days.

The only disadvantage to be noted with regard to this first expansion is the very short period available in which to take delivery of the necessary equipment, especially the boiler referred to in our study.

This disadvantage can be overcome by defining steam requirements at the outset and giving the boiler the emergency treatment required.

Technical constraints

In our judgment there is no technical drawback to the development of Alternatives A, B or C which we propose for the JIBOA factory.

The legal position in regard to the by-products of the sugar and alcohol plants, i. e., the cane and vinasse plants, is regulated in El Salvador by the Public Health Code and its appendices, published in 1959.

Articles 112 through 148 in Chapter IV of that Code set out the rules to be followed; for our purposes, the problem which may arise at the JIBOA factory is that of vinasse fermentation, on account of the nuisance which may be caused to inhabitants of the area by the smells produced by this process.

SENER

As we agreed in conversation with representatives of the Ministry of Development, we include in the Appendix a summary of Spanish legislation on the purification and discharge of effluent.

SENER

9.2. COMMERCIAL CONSTRAINTS

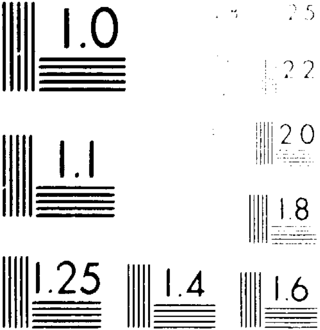
We summarise below the constraints imposed by the assumed trend of the market.

As regards the market for sugar, it would seem to be implicit that the forecast increase in sugar production will probably demand a significant commercial campaign in other consumer countries if the surplus over home market requirements is to be placed at profitable prices. It is particularly the United States market, the main recipient of Salvadorian sugar exports, where obstacles, based on quality, may be put in the way of sugar imports.

The fuel alcohol market will not in our view present any significant obstacles to the profitability of the distillery, provided always that production is directed to home consumption as a substitute for gasoline. The trend of demand for this purpose is scarcely likely in the medium term to alter its upward course, which will moreover be stimulated by positive factors such as release of foreign exchange, the country's development in itself, and so forth. Also, the rising trend of alcohol prices could stabilise and balance foreign currency earnings from sugar exports when sugar prices are low or on a downward trend.

We see no reasonable prospect of placing 60,000 tonnes of bagasse board on the market at competitive prices unless there is a drastic change in present wood consumption habits in El Salvador and neighbouring countries . Even on the most favourable assumptions home demand for the new factory's product could not be expected to exceed 23,400 tonnes per annum by 1990.

Finally, it is a basic assumption that the Government of El Salvador will continue to dev   p agro-industry on a rational and intensive bas , and that as a result sufficient sugar cane will be available to provide the grist requirements forecast in the Implementation Plan.


1.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

9.3 ECONOMIC AND SOCIAL CONSTRAINTS

In general terms we can state that all those events which alter the real situation or the values assumed for economic parameters taken as the basis for the economic and financial evaluation, may have repercussions on the viability of the project.

The fall of sugar prices on the world market, a highly inflationary climate, social conflicts directly or indirectly affecting agricultural producers, transportation sectors and the continuity of production and maintenance at the factory, any of these would be an adverse factor for the profitability hoped for.

If sugar cane processing capacity were for any reason reduced to the point where fixed costs or outstanding liabilities were not being covered, the benefits of the project would be seriously restricted.

All those constraining factors have been studied in greater detail in the series of sensitivity analyses set out in section 7.4.

10. SUMMARY AND CONCLUSIONS

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It is our intention to present together here some of the most important conclusions which have emerged separately in the previous chapters.

These conclusions are derived from various views of the problem as it appeared from the standpoint of the project team which carried out this Evaluation. Nevertheless, we believe that they can form a basis for sound decision-making.

The proposals and the outline plan for an industrial complex which are set out in the Preliminary Study, a study which we see as a positive, imaginative and forward-looking contribution, must, in our opinion, overcome three important dificulties:

a) Technological difficulties:

- The "TILBY" separation system has not given sufficient proof of its operational worth, and we have reasonable doubts as to its capacity to carry out the separation to the required technical specification.

- The COMRIND which comes out of the TILBY machines contains about 4.4% sugar. After being subjected to the sugar extraction processes proposed in the Preliminary Study, the residual sugar content of the product is still sufficiently high for the usability of the extracted COMRIND as a raw material for board production to be problematic.

  The board produced with this raw material has been shown to be below normal market quality, for the fibre used as the base for the product shows the onset of sugar fermentation.

- The information we have acquired in our dealings with processors specialised in the concentration and incineration of vinasse leads us to conclude that the extraction of potassium sulphate from vinasse is not sufficiently welitried on a commercial scale.

  We honestly do not dare to recommend the use of these technologies in the short run for fear of adding unnecesary elements of risk to JIBOA.

b) Market dificulties:

- In order for the 220,000 litres per day distillery to work at full design capacity over 220 days per annum it would need to absorb all the molasses produced in El Salvador, and in addition to that would be importing nearly 38,000 tonnes per annum. That level of importation would cancel out the foreign exchange savings for whose sake the fuel alcohol is being produced.

- Forecasts indicate that the production of 60,000 tonnes of particle-board would involve processing all the bagasse available in El Salvador and importing remaining requirements, thus aggravating the foreign exchange problem.

- Equally, on the most optimistic assumptions, home demand for board is predicted to reach only 23,000 tonnes per annum by 1990. One would have to take immense steps, therefore, to stimulate the small home consumption of this product and to overcome the competition of the relative specialisation of the rest of Central America in the production of plywood.

c) Sugar cane production difficulties:

- The sharp increases in sugar cane production do not seem very realistic to us. They would create among sugar cane growers hopes of short-term profits, which would be frustrated by the inability of the agricultural, road and labour infrastructures to produce those profits.

We could obviate these difficulties and restructure a future optimisation plan for JIBOA on the following bases:

1. Sugar production is profitable, fits in with the aim of the Government of El Salvador to promote agro-industry and is in fact an important source of foreign exchange.

2. El Salvador is situated in the premier exporting region of the world, but has been gradually losing its markets, apart from the United States market, since the middle of the 1970's. But they could be recovered, given the political will to relaunch the sugar industry, which should in our view be envisaged on the basis of minimising production costs, since a small cost advantage in relation to prices which move quite independently of such costs can entail a substantially increased income for the country.

3. In order to optimise production costs we propose the implementation of the following improvements in the JIBOA and its hinterland:

- Selection of appropiate varieties of sugar cane, a method already tried in recent years in the San Miguel centre, and training of agricultural producers in rational techniques for obtaining improved yields.
  - Devotion of attention to the impact which cane polarization has on the output of the factory.
  - Irrespective of the extensions which are proposed below, the existing plant should extend the evaporation area and, if increased white sugar production is wanted, it would be sensible to expand the striking section.

  The amount of molasses obtained is above average for El Salvador so it would be a good thing to reduce it in order to improve present yields.

- Following the analyses and studies presented in the preceding chapters, we are of the opinion that the advantageous course for the JIBOA factory , and the one which is line with the Implementation Plan we set out in Chapter 9, would be basically to produce sugar in the short and medium term, and to leave product diversification for a more favourable point in the future. Such a diversification would have room for the alterations embodied in Alternative D.

  This sugar production should in our opinion take place in parallel with the growth of cane sugar supply in the hinterland of the factory and the modifications mentioned should be carried out gradually and in step with the fulfilment of the sugar cane production plan set out.

  Our proposals involve two motifications being carried out at separate times: the first would equip JIBOA for a capacity of 4,500 tonnes per day and the second would bring it up to 5,760 tonnes per day. From the very start of the plan it is important that sufficient enginering design work is carried out to ensure that no costly oversights occur and no abortive works are undertaken.

- Our economic studies show that these extensions involve acceptable, and fairly similar, internal rates of return and pay-back in real terms. The economic viability of the Plan holds up until the sugar price drops to about $ 0,37 per kilogram. Increases in the cane price of 40% would involve a decrease in the internal rate of return of between 45 and 55%, deppending on which alternative is considered provided that the sugar plant is brought into the calculation.

- As far as by-products are concerned, we would venture to suggest a few possible outlets.

The excess bagasse, once the factory has been modified and is self-sufficient in energy, could be supplied to the San Francisco board plant to improve its current profitability and to eliminate its possible under-utilisation.

A similar solution could be found for excess molasses at JIBOA. If it were transported to the recently acquired 60,000 litres per day distillery, that would extend production there to a nearly year-round basis which would result in its achieving a higher level of profitability.

In the unlikely event of the amount of cane sugar in the area of the JIBOA factory rising to 900,000 tonnes per annum in the medium term, the quantity of molasses produced, which would then be double the present figure, could make it possible to open another distillery of 60,000 litres per day capacity if the state of the market for alcohol so allowed.

As a footnote we could add that a realistic, Government-sponsored plan for the planting and management of Melia could perhaps satisfy more profitably, and at a better quality, the needs which the 60,000 tonnes per annum board plant was designed to meet.

- To restate in conclusion the theme which the project team has followed in its evaluation of the Preliminary Study, we would underline that this work has been founded on the criteria of realism and of technical and economic and financial workability, with the investment, where that has been necessary, being proposed on a gradual basis and on the smallest scale consistent with the objective to be achieved within the framework of UNIDO cooperation in the promotion of El Salvador's Sugar Cane Industry.

APPENDIX I

SENER

APPENDIX I

APPENDIX I

"TERMS OF REFERENCE FOR BASIC ENGINEERING INTERNATIONAL BID".

1. PROJECT.

JIBOA Sugar Mill.

2. TITLE

Basic Engineering Design for the new industrial facilities to be integrated in the JIBOA Sugar Mill, located at San Vicente, El Salvador.

3. BACKGROUND

A feasibility study has been made on the industrial complex to be associated to the JIBOA Sugar Mills. Several alternatives have been considered, including:

a) Maximum cane treatment capacity up to the agricultural limits of the available zone.

b) Maximum White Sugar Production up to the explotation limits.

c) Ethyl Alcohol Production, through fermentation of molasses and raw cane juice.

d) Installation of a Bagasse Based particle Board plant.

e) Expansion of the utility systems and auxiliary services required at the complex.

(The final selection between the different alternatives considered, is pending on Client's decision).

4. OBJECTIVE

The purpose of the present "Terms of Reference" is to establish the required information and Basic data, that allow experienced engeneering firms to Bid on the provision of the Process Technology and Basic Engineering for the Project.

The selected engineering firms shall provide a Process Engineering Package including a definite project scope, process, civil and mechanical specifications, operating manuals,detailed capital cost estimates and project schedules and shall prepare the "Terms of Reference" for the Bids for a contract on the detail engineering, equipment and materials supply, construction and erection for the proposed facilities, on a lump-sum" Basis.

5. SCOPE AND CONTENT OF WORK

In order to attain this objective and in accordance with the procedures and standards established by UNIDO and the Client, the selected Contractor shall carry out the following Basic Engineering Services:

- Process Block Diagrams, showing material and energy Balances for every section of the Plant and their inter-relation with the existing facilities.

- Detailed description of the proposed process.

- Techno-economic justification for the design alternatives.

- Basic Process Package for the new facilities, to a degree of detail and content equivalent (as a minimun) to SENER's Work Procedure MT-Y22 : "TYPICAL CONTENT

OF A PROCESS BOOK" Ref. 1 Sept. 1.981 attached.

- Mechanical Specifications to be followed during the detail Engineering of the project and requirements to be complied with for the supplies and erection job.
- Summary on Environmental Impact, and effluent treatment.
- Process Guarantees (Production, efficiency, effluent, ect) and methods of determination.
- Basic Project Schedules.
- Detailed estimate of investment cost for Budgetary project control.
- Operating manuals.
- "Terms of Reference" for the "lump-Sum" Contract Bidding of the projects facilities which includes detail engineering services, equipment and materials supply, construction, erection, commisioning and startup of the required installations.

5.1. Description of Facilities

The present description corresponds to Alternative "C" of the study (the most complex alternative presented in the report). Should the definite solution chosen be, one of the other alternatives, the present description would have to be modified accordingly.

The project includes the following facilities:

A) Expansion of the present sugar mill installations, including the cane handling, storage, sugar extraction and juice purification treatment from the present capacity of 3.400 T.M.c/day to 5.760 T.M. c/day.

B) Expansion of the sugar recovery system from purified juice so that sugar production reaches equivalent capacity of procesing 4.500 T.M. c/d instead of the existing 3.400 T.M. c/day capacity.

C) Installation of a new dehydrated ethyl alcohol plant of 90.000 l/day production capacity. This plant will use as feedstock the raw molasses produced in "B", plus the cane juice in excess produced in "A" over that consumed in "B" (equivalente of 1.260 T.M.c/day)

D) Installation of a new particle Board plant, of 60.000 T.M./day capacity. This plant will use as raw material the excess bagasse produced in "A" (not consumed in steam generation).

E) Effluent treatment, particularly by evaporation of the distillation vinasses produced in "C".

F) Modification of the existing utility systems and auxilliary services, adapting them to the new requirements of the complex.

5.2. Design Philosophy

The following design philosophy shall be considered for the project:

1) Process plants shall be designed in a way that shall be able to operate independently (except"A" and "B" which shall operate jointly). Common pieces of equipment shall be allowed as long as this does not compro-

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mise the autonomous operation of each process plant and shall result in a substantial saving in capital costs.

2) Maximun reliability of the facilities under all operational conditions.Special care is to be given to minimun operation capacity.

3) Facilities shall be designed to be integrated in the existing sugar mill complex using minimun plot-space coupled with maximun accessibility. Special attention shall be given to the accesibility of all equipment for inspection and maintenance.

4) Low investment cost.

5) Minimun maintenance requirements due to careful design of all equipment, such as materials of construction, corrosion allowances, equipment accesibility, etc.

6) Maximun energy efficiency.

7) Fase of operation [illegible] different facilities, including simple proced[illegible] for startup and shut down.

8) Good analytic control of the processes.

9) Maximun standardization of components, for the new facilities, trying to be compatible with the existing installation.

10) Degree of automatism and control instrumentation compatible with the situation in El Salvador.

11) Maximum safety measures.

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5.3. Design Data

A. Raw Material

Basic Raw Material for the plant shall be sugar cane of the following average composition:

	Min.	Max.	Design
Fibre content	11	15	14
Pol on cane	9	14	12

Cutting and loading in the field

Crop

Manual	* To be filled in by Client.
Mechanical Whole Cane	
Mechanical Cane in Pieces	
Cane Burning	
Trash	
Leaves and points	

Cane Transportations Means:

Carts	Dimensions	* By Client
Trucks		
Raylway		

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B) Final Products

Sugar.

- Saccharose content	99,7	98,5 (min)

Expedition.

- Bag size 100 lb
- Pallets
- Truck %
- Railway %

) * By Client

Ethyl Alcohol.

- Grade	99,5 GL	(min.)
- Total acidity	30 mg/l	(max.)
- Specific gravity(15ºC)	0,794	(max.)

Expedition.

- Barrels
- Tank Trucks
- Railway

) * By Client

Particle Board.

- Characteristics
- Expedition

) * By Client

C) Site Conditions

Basic Site Conditions to be considered in the design including:

- Meteorological data.
- Soil conditions
- Applicable codes.

are listed in the attached document "PROJECT BASIC DATA", to be fulfilled by the Client prior to the release of Bid requests.

General data on existing installations should be included such as:

- General lay-out drawing of the Sugar Mill.
- Plot Plans.
- Plant P & I Diagrams
- Equipment Specifications.

D. Utilities

Basic Data on Utilities of the existing installation are listed in the said document "PROJECT BASIC DATA", to be fullfilled by the Client.

E. Design Requirements

Clients Requirements on design of the project, regarding:

- Civil Work.
- Architecture.
- Mechanical Equipment.
- Boiler and Heat exchange equipment.

- Vessel and Tank sizing.
- Electricity.
- Instrumentations.

Are to be fulfilled by the Client following the attached document "BASIC PROJECT DATA".

SENER	DESIGN SPECIFICATION	EL-21
REAL. POR	BASIC DATA FOR PROJECTS	PAG. 1 SIGUE EN
APROB. POR.		REV. /

REV. Nº	DATE	DESCRIPTION AND Nº OF REVISED PAGE	PREPARED BY	APPROVED BY

INDEX

SUBJECTS PAGES

1. BACKGROUND

At the bidding stage, this document having been filled out by the Client as seems most appropiate internally, shall be distributed to the tender so that the bases for estimation and evaluation of work are uniform and clearly explicit.

It will be the general objective to have the "Basic Data", or such document as is agreed upon to cover all data possible, incorporated into the contract to be signed by the Client in the form of a technical appendix thereto.
Whatever their specific application, the questionnaries on "Basic data for design" shall collect for each chapter modifications indicated and suggestions made by each tenderer, deriving form experience in their use.

During the progress of the Contract, "Basic data for design" shall be the basic point of reference to establish or set on hand evaluations or additional cost estimates for the project.

2. OBJECTIVE

Hereunder basic data are set forth on the treatment of bids, and contracts and for their appropiate fulfilment, grouping together the information required during all stages of the Project (Detailed Engineering,Design,Acquisition of materials, Construction,etc...)

It is intended to organize with complete clarify, on the basis of such information, the starting point, initial conditions and data required to evaluate, tender and develop the Project, with a minimum of undifined or unforessen points, and it shall be always used except where the Client refers to or produces a document of his own replacing or improving it. The information indicated does not pretend to be exhaustive, and questionnaires and data requirements may be adapted to the actual requirements of each Bid or Contract, and it shall equally be used internally to define or make assumptions as to the starting criteria for the data that the Client, the Process Licensee, etc.. may not be in condition to fulfil or clarify.

Before sending it to the Client, data already known shall be filled out crossing out inapplicable data, eliminating pages not required and grouping the rest to suit the work in question.

3. INSTRUCTIONS FOR FILLING OUT

A. Ieave spaces blank where appropiate and/or cross out words in brackets not included in answer to question put.

B. Answer all questions as exactly as possible.

C. If you do not have the information, enter "Not known"

D. As the form has been prepared to cover a great number of different cases, some questions will have no applica tion. If such is the case put "non-applicable" or cross out the question.

E. To fill in and cross out, preferably use red ink (never blue).

4. BASIC DATA FOR DESIGN

4.1 General

Name of Client ______________________

Name of Project (Unit) ______________________

____

Location of Plant ______________________

Types of partial units ______________________

Client's Project No. ______________________

SENER's Project No. ______________________

Measuring system to be in (metric) - (English) units

If another system is used, it is to be: __________

4.2 Codes and Standards

The plant shall be designed using the codes and standards indicated below:

4.2.1 Specific codes and standards

Pressure vessels: (ASME VIII Div-1) (Ad. Merkblätter) (Bequinor Code). Spanish Pressure Vessel Regulation

Electricity: (CEI)(VDE)(MEC)(Spanish regulatior

Exchangers : TEMA

Steel structure : (Spanish Regulations: MV and EM 62)

Storage tanks : (API-650) (API-620) (UNE 62004)

Pumps : (API-610) (________)

Compressors : (API-817 and API-618).

Ductwork : (ASA) (API) (DIN)

Turbine : (API-611 and API-612).

Reinforced concrete : (E-73 of Spanish MV)

N-B. The codes and standards mentioned are given merely for guidance. The Bidder is to indicate in each case the particular code or standard he proposes to follow, which shall be one of those specified above or some other equivalent code or standard which is applied and recognised internationally.

4.2.2 General Codes and Standards

	Law for the Protection of the Environment (BOE No. 98/22-4-75)
	Labour Regulations on Health and Safety at Work.
(Contamination, Security, Noise, etc.)	Regulations on Safety in Oil Refineries and Petroleum Product Storage Depots (BOE. no.290/31-12-75)
	Regulations for the Storage of Dangerous Chemicals (Bequinor)

NOTES (+) ______________________________

N.B. The codes and standards mentioned are given merely for guidance. The Bidder is to indicate in each case the particular code or standard he proposes to follow, which shall be one of those specified above or some other equivalent code or standard which is applied and recognised internationally.

4.3 Data on climate

4.3.1 Air temperature with dry bulb

a) Highest temperature recorded __________ ºC-F

b) Average maximum temp. in summer __________ "

c) Average temperature in summer __________ "

d) Average yearly temperature __________ "

e) Minimum temperature recorded __________ "

f) Average/minimum tem. in winter __________ "

g) Average temperature in winter __________ "

h) __________ __________ "

4.3.2 Relative Humidity

a) Yearly average __________ "

b) Average in summer __________ "

c) Average in winter __________ "

d) Temperature on wet bulb

- yearly average __________ "
- average in summer __________ "
- average in winter __________ "

ED-Z1	DESIGN SPECIFICATION	SENER
PAG. 12 SIGUE EN	BASIC DATA FOR PROJECTS	REAL. POR
REV. /		APROB. POR.

4.3.3 Temperature of project for air cooling shall be bas d on ______ ºC-ºF

4.3.4 Wind

a) Prevailing direction of the wind is ______

b) Velocity of wind for design of structures and containers is ______ km/h - (mph).
This velocity is based on windgusts

Design shall be carried out as per norm MV-101 of the Spanish Ministry of Housing. If desired otherwise, please indicate shape factors and wind pressure at different heights.

____

____

c) Velocity of wind for thermodynamic calculation of coils of storage tanks.

____

____

____

4.3.5 Precipitation

a) Maximum rainfall recorded over one hour ______ l/m2-mm-inch

b) Maximum rainfall recorded over 12 hours ______ l/m2-mm-inch

c) Maximum depth of snow recorded ______ cm.-feet

Coefficient ______ (Kg/cm2)-(lb/feet^2)

4.3.6 Earthquakes

a) Provision for earthquake shall be (shall not be) made in the Project.

b) If required, they shall be made according to seismoresistant standard PDS-1-1974.If required otherwise, please indicate coefficients to be used.

____

____

4.3.7 Other data

____

____

4.4 Soil

4.4.1 Compression strength of soil is _____ kg/cm2 -PSF at _______ metres - feet below existing ground level.

- Supply of results of geotechnical measurements, stratigraphic profiles, laboratory tests, final consultancy report on investigation.

4.4.2 Maximum depth of frost below ground level is _______ metres-feet.

4.4.3 Groundwater table is _______ metres-feet below ground level

4.4.4 There are (are not) existing foundations in process area.

4.4.5 Give details of characteristics of soil and settlement values for the various loads:

____

____

____

4.5 Water

4.5.1 Data

	Cooling Water (circulating)	Boiler Feed Water	Raw Water for	Water	Water
Source					
Return					
Supply pressure at ground level					
Return pressure at ground level.............					
Supply temperature (design of exchangers)					
Maximum return temp.					
Flow available .					
Total hardness in CO3 Ca ppm					
Calcium in CO3 Ca ppm					
Magnesium in CO3 Ca ppm					
Total alkalinity in CO3 Ca ppm					
Sulphates in SO4 ppm					
Chlorides in Cl ppm					
Silica in SiO2 ppm					
Turbidity in SiO2 ppm					
Dissolved organic material in O2 ppm					
______________ ppm					
pH					

4.5.2 Type of treatment for cooling water

____

____

4.5.3 Type of treatment for boiler feedwater _____

____

____

4.5.4 An (additional) (complete) system for water treatment shall be designed for ______________

____

consisting of ______________________

____

4.5.5 Data for design of cooling tower: temperature of wet bulb ____(ºC) (ºF); storage capacity of cold water pool ______________

____

4.6 Electric power

4.6.1 Standards

In addition to Standards indicated under 4.2.1, the following local norms shall be applied. If no indication is made Spanish Electrotechnical Regulations and UNE and IEC standards shall be applied

4.6.2 Characteristics of electric power supply. Main system

The number of main supply feeds shall be__ each of them with the following characteristics:

- nominal voltage ______________ V
- frequency ______________ Hz
- number of phases ______________
- maximum fluctuation of voltage foreseen:
  + __________% - __________%
- maximum drop in voltage admitted at start- up point under most unfavorable conditions
  __________%.
- Conditions for neutral(directly to ground) (grounding through resistance) (insulated)
- In case of insulated neutral (yes) (no) is there protection against single phase grounding
- Symmetrical short-circuit power:
  Maximum ________ MVA
  Minimum ________ MVA
- Power available for continuous service ____ KVA
- Maximum power available for short time periods
  ______ KVA
- Number of power supply cuts during the year
  ______
- Maximum duration ______________
- Automatic reconnection: (yes) (no)
- The connection shall be (by overhead line)(by cable)(underground), from(supply company's network)(another board already in the plant)(an existing transformer), the point of delivery being ______________

____

4.6.3 Characteristics of electric power supply

Emergency system

An emergency system shall be provided (yes) (no) (according to judgement of successful bidder).

Power supply shall be effected by means of (generators) (Outside auxiliary feeds).

If generators are used, connection in parallel with the main distribution system (may) (may not) be made. Interchange of power with main distribution system (is) (is not) permitted.

If auxiliary feeds exist, their characteristics must be indicated and the same applies to main feeds.

In any case it shall be indicated what services and to which extent are required for emergency feed or if that is left to the judment of the successful bidder.

4.6.4 Voltage Levels

Receivers (receptores)/Services	Voltage (V)	Phases
Motors: P KW		
KW P KW		
KW P KW		
Lighting		
Control circuits for boards		
Potable PTs for driving power and welding		
Instrumentation:		
• alternating current.....		
• direct current		

4.6.5 Limits of supply

Please list clearly equipment or activities excluded from supply (if there are any):

Please indicate which prices of equipment or existing materials are to be altered or made by the sucessful bidder

4.6.6 Other Characteristics

Power supply in plant shall be (neutral directly to ground) - (neutral to ground through a resistance) - (insulated).

Cable run shall be in(cradles)(tubes) - (tenches)-(ducts)

Lighting installation shall be made: (in tubes) (with reinforced cable). Type of lighting shall be (incandescent) - (mercury vapour)- (mixed light) (fluorescent).

Illumination levels desired in the different areas of the plant shall be:

(as per table enclosed by client) - (according to standard or recommendation) ______________

____

____

(Alarm sirens) - (paging system) - (Loudspeakers) (Telephone system) form part of the project.

4.7 Steam and condensate

4.7.1 In Boiler plant

STEAM	MAXIMUM		NORMAL		MINIMUM	
	kg/cm^2 PSIG	ºC ºF	kg/cm^2 PSIG	ºC ºF	kg/cm^2 PSIG	ºC ºF
High pressure						
Medium pressure						
Low pressure						
Exhaust						

4.7.2 In process area

STEAM	MAXIMUM Kg/cm^2 ºC PSIG + ºF	NORMAL Kg/cm^2 ºC PSIG ºF	MINIMUM Kg/cm^2 ºC PSIG ºF	QUANTITY AVAILABLE (tonnes/h) (1000lb/h)
High pressure				
Medium pressure........				
Low pressure				
Exhaust				
______				
______				
______				

4.7.3 The condensate of ______________ will be discharged to ______________

The condensate of ______________ will be discharged to ______________

The condensate of the whole plant is to be recovered except for ______________

Condensates derived from ______________ ______________ shall be considered oily.

These oily condensates are to be passed to ______________

Condensate available at battery end

TYPE OF CONDENSATE Battery End Cond. FLOW AVAILABLE

	kg/cm2	PSIG	ºC	ºF	(tons/h)	1000 lb/h

Conditions at battery end for return of condensate

TYPE OF CONDENSATE Battery End . Condensate

	kg/cm2	PSIG	ºC	ºF

4.7.4 Other data

4.8 Fuel

4.8.1 Fuel oil

	FROM	START-OFF
º API		
Viscosity _______(SSU)		
(ºE) a ______ (ºC) _____ (ºF) ..		
Lower calorific value		
(BTU/lb) (Kcal/kg)		
Flow available		
Pressure		
Battery end feed minimum		
Pressure		
Battery end feed normal		
Pressure		
Battery end feed maximum.......		
Feed temperature at Battery end		
Pressure in battery end return collector		
% of sulphur by weight.........		
ppm vanadium by weight.........		
ppm sodium by weight...........		
H/C ratio		

4.8.2 Other data on fuel oil

4.8.3 Fuel gas

Specific gravity ....
Average molecular weight ....
Net calorific value normal ....
(Kcal/kg (BTU/lb) minimum
Supply pressure maximum
(kg/cm^2) (psig) normal
Available flow (m^3/h) (scfa) ....
% of SIR by volume ....
(gr/m^3) (grains/1000 cf) of sulphur
Diolefin content ....

4.8.4 Other date (supply analysis of fuel-gas or H/C ratio and percentages of water and nitrogen)
....
....
....

4.8.5 Bagasse

4.9 Air and inert gas

4.9.1 Data

	AIR OF PLANT	AIR OF INSTRUM	INCRT GAS
Available flow (M^3/h) (scfm)			
Pressure in L.B.............			
Oil free			
Is an additional system to be planned?			
Does not exist; A complete system is to be planned			
Dewpoint does not exist.....			

Data on new systems if required:

4.9.2 Other data

4.10 Costs of use of services and depreciation calculations

SERVICES	COSTS
HP steam	per/tonne
MP steam	"
LP steam	"
Exhausted steam	"
LP condensate	"
Raw water (agua bruta)	per/m^3
Treated water for boilers	"
Cooling water (x)	"
Plant compressed air	"
Electricity	per KWh
Fuel oil	per/tonne
Fuel gas	"

DEPRECIATION PERIODS

Minor equipment	years
Major equipment	"
Interest per annum	%

NOTE: In calculating price of services not marked thus (+) it has been assumed that there is no recovery i.e. price of LP steam is calculated assuming that condensate is not recovered.If it is to be recovered, price of the latter should be deducted.

4.11 Storage capacity and means of loading

4.11.1 Liquids and gases

Please indicate on the following table minimum storage capacities for services, raw materials and products, as well as for those of intermediate tonnage.

Also indicate if arrival and despatch of products is by means of pipeline, truck, etc.

Product	Capacity	Min. no. of deposits	Means of loading or unloading

4.11.2 Solids and aggregates

Product	Capacity	Construction and ways of loading and unloading

4.11.3 Indicate below temperatures to which the various products must be refrigerated for storage.

4.12 Plant and pavement elevation

4.12.1 Present ground level at aproximately __________ meters-feet above sea level.

4.12.2 Plant elevations have been established with reference to ______________________________
which is ______________________________

Should earth movements be required to level the plant site, are there difficulties in finding near-by dumping sites?

Please indicate locations and distance from plant.

4.12.3 Please indicate below elevations of the new plant area taking as reference the above mentioned level.

a) Lowest ground level

b) Highest existing ground level

c) Maximum elevation of levelled ground

d) Maximum elevation of paved surface.

4.12.4 For new installations please supply a topographic drawing of area at a scale of not less than 1:2.000 with contour lines at 1 m. intervals

4.12.5 The bidder shall set the datum line at a height of __________ (m) (inches) above the elevation of the levelled ground.

4.12.6 Upper elevation of foundations in general and upper elevation of the floors of buildings shall be ____

____

4.12.7 <u>Pavement</u>

DESCRIPTION OF AREA

Types of pavement ......
Design load ....
or

- Thickness of concrete
- Mat data
- Layers of reinforcement

4.12.8 Other data

4.13 Drainage and sanitation

4.13.1 The following drainage systems shall be installed: (clean water) (oily water) (sanitary drainage) (chemical drainage) (__________).

4.13.2 The clean water drainage system shall collect rain water from (roads) - (tank areas) (________).

This water shall be conveyed to (the river) (the sea) - (thedrainage system) (____________).

4.13.3 The oily water system shall collect waste water from (rainwater in process area) - (from machines and equipment) - (tank areas) (____________________)

This water shall be conveyed to the (existing drains(an existing oil separator) (a new oil separator to be planned (______________________).

Ductwork shall be of: (cast iron) (clad steel) (concrete).

4.13.4 Sanitary drainage system shall discharge into (existing system) (septic pit to be designed).

Tubes shall be of (stoneware) (concrete) (____)

Water from septic pit shall be conveyed to (river) (the sea) (existing sewerage system) (____)

4.13.5 Chemical drain shall collect the following effluents ______________________________

____

by means of ductwork of ______________________
they shall be conveyed to ______________________

____

4.14 Buildings and Structures

4.14.1 New buildings in general

Indicate whether requirements are to be defined by successful bidder and the type of construction (concrete, steel structure, according to sucessful Bidder's judgement, etc.).

	Decided by SENER	Number of Employees	Total area m^2 sq.ft	See Note 1	Construction and Remarks
Administration					
Technical Offices					
Warehouse (storage rooms)					
Workshop					
Laboratory					
Cafeteria					
Locker-rooms					
Fire protection					
First aid station					
Customs					
__________					
__________					

NOTE: (1) In this colum please indicate requirements for heating (C), air-conditioning (AA), mechanical ventilation (V) or pressurization (P).

4.14.2 <u>Industrial Buildings</u>

Indicate type of construction (concrete, steel structure or at successful bidder's judgement)

	Defined by	See Note 1	Construction and Remarks
Control room			
Electricity room			
Boiler room			
Compressor room			
________________			
________________			
________________			

NOTE: (1) In this column please indicate requirements/ by marking for heating (C), air-conditioning (AA), mechanical ventilation (V) or pressuri zation (P).

4.14.3 Indicate requirements regarding air-conditioning, heating, etc. ______________________________

____

4.14.4 Heavy structures, including pipework cradles shall be of (concrete) (steel and welded) (steel and screwed) - (________________________________)

4.14.5 Specify finishings of buildings, woodwork , ceilings, false ceilings, etc. ______________________

____

4.14.6 Road crossings of ductwork shall be done with (protective pipes) (concrete bridges) (at the successful bidder's judgement).

4.14.7 Main and secondary roads shall be of (concrete) (flexible pavement) (at sucessful bidders judgement) and their widths are as indicated below:

____

4.14.8 Tank berms shall be of (earth) (concrete) (at successful bidder's judgement).

4.15 General location of equipment

4.15.1 Will the bidder be supplied with a layout drawing?

4.15.2 Has the client design specification or special recommendations concerning safe distances for the location of equipment on or (off site), or is the successful Bidder's judgement to be taken?

____

____

4.15.3 Is the Client specifying certain dimensions for within plant and off-site, or are these to be eccording to sucessful Bidder's judgement?

____

____

4.15.4 Has the client his own design specifications or special recommendations for fire protection, in particular per fixed systems for units either within the plant on off-site, orare these to be established by the succesful Bidder in accordance with relevant codes?

____

____

4.15.5 Has the Client preferences for location of machinery (pumps, compressors and air refrigeration) within or outside the plant units? Will these be sited according to the successful bidder's judgement?

____

4.15.6 Has the Client special recommendations for the service points (air, steam, water) or are they to be . according to the successful bidder's judgement? ______________

4.15.7 Does the client prefer one or more control areas or is this to be according to the succesful bidder's judgement.

____

4.15.8 Is any existing equipment, instrument or panel to be used?

4.15.9 Other data

4.16 Pumps and compressors

4.16.1 Main pumps shall be operated by means of (motor) (turbine) and stand-by pumps by (motor) (turbines)

4.16.2 It (is) (is not) required that each pump has a stand-by pump.

4.16.3 It shall (be) (not be) permissible to use one stand-by pump for two other pumps.

4.16.4 Please indicate hereunder all available data on type of compressors and blowers, stand-by units, type of driving engines, etc.

4.16.5 Other data

4.17 Instrumentation

4.17.1 Main instrumentation shall be (electronic) (pneumatic) with (pneumatic) - (____________) control valves.

4.17.2 Electronic instrumentation shall be (intrinsically safe certified by (PTE) (BS) (CSA) (______) (with flameproofing when required).

4.17.3 Panel instrumentation shall be of (high density): (low density). The main panel shall (not) have a semigraph. Alarms (shall be concentrated in annunciator cabinet(armarios anunciadores) (shall be located with the panel instruments).

4.17.4 If data logger is required, please describe its function: ____________________________________

4.17.5 If a process computer is required, please describe its function ____________________________

4.17.6 Flow-meters shall be installed at battery end for the following auxiliary services or product lines (mark with X the column corresponding to desired type).

SERVICE	INDICATION	RECORDING	INTEGRATION	REMARKS
HP, LP and MP steam				
Condensate				
Raw water				

4.17.7 Level indicators on tanks in storage area shall be (local) (centralized).

4.18 Miscellaneous

4.18.1 Preference as to type of insulation and weather protection:

Heat: ______________________________

Cold: ______________________________

4.18.2 Are installations with cathodic protection required? (yes) (no). Indicate scope __________

APPENDIX II

ANEXO II

LEGISLACION ESPAÑOLA SOBRE DEPURACION Y VERTIDO DE AGUAS RESIDUALES

PROYECTO Nº: DP/ELS/78/001
REFERENCIA SENER: PQ-3040
FECHA: Junio 1982

LEGISLACION ESPAÑOLA SOBRE DEPURACION Y VERTIDO DE AGUAS RESIDUALES

1. GENERAL

Queremos adjuntar al estudio de viabilidad del complejo Jiboa algunas normas vigentes en nuestro país sobre el asunto de referencia con el objetivo de intentar que les sea de utilidad.

Sin embargo, queremos hacerle las siguientes puntualizaciones.

1º) La legislación española vigente en la actualidad es muy extensa, depende de muchos departamentos ministeriales y es complicada, tanto es asi que en estos momentos la Administración está escribiendo una nueva Ley de Aguas que concretaría y simplificaría más el tema haciéndolo más acorde con el momento presente. En cuanto esta Ley salga a la luz se la suministraremos.

2º) Por lo anteriormente expuesto, hemos creido mejor, en vez de suministrarle copia de todos los textos legales, incluirles:

a) Sener, tiene normalizados los documentos que hay que realizar para cumplir con los Organismos oficiales por lo que hemos creido de interes mandarle el correspondiente a "Depuración y vertido de aguas residuales".

b) Asimismo les incluimos copia resumen de los principales textos legislativos.

3º) Si una vez leido esto quieren completar algún tipo de información, no duden en pedirnosla, que se la suministraremos.

3.3 Depuración y vertido de aguas residuales

3.3.1 Introducción

Esta separata tiene por objeto informar sobre la reglamentación en vigor aplicable a los proyectos de DEPURACION Y VERTIDO DE AGUAS RESIDUALES, que deben ser realizados para la obtención de la correspondiente autorización de vertido.

Efectivamente, cualquier proyecto de instalación, ampliación y traslado de industrias que generen aguas residuales de cualquier tipo, deberá contar con la debida autorización oficial, antes de su puesta en marcha y para ello deberá cumplir con la legislación vigente.

Por otra parte, antes de la realización del proyecto se requiere una ó más reuniones entre la Propiedad y la Comisaría de Aguas para establecer con precisión los niveles de emisión de contaminantes y las líneas generales del sistema de depuración y vertido que se vaya a presentar a las autoridades para su aprobación

Estas reuniones son siempre necesarias, pués las autorizaciones de vertido se conceden en España, caso por caso, siguiendo determinados criterios; de forma parecida a lo que ocurre en Gran Bretaña ó Finlandia, y no es suficiente el estudio, por cuidadoso que sea, de la legislación actual para obtener los niveles precisos de emisión, pués los únicos standards de calidad que figuran en la legislación son los niveles de inmisión en el caudal receptor del efluente.

Para la realización en la DPP de un proyecto de tratamiento de aguas residuales puede consultarse al Consultor de Medio Ambiente (Sr. Diez Roche) y eventualmente a la Sección Nuclear de la DIN (Sr. De Francisco).

3.3.2 Solicitud de Autorización

Para la obtención de la autorización del vertido deberá prepararse una "Solicitud para vertido de aguas residuales" que deberá presentarse a la Comisaría de Aguas de la Confederación Hidrográfica de la cuenca a la que se vierte, en el caso de vertido en un cauce continental ó bién en la Jefatura de Costas y Puertos (Dir. General de Puertos y Señales Marítimas) en el caso de vertido en el mar, acompañándola con el proyecto por triplicado.

El proyecto de depuración y vertido de aguas residuales se presentará en forma de Memoria Descriptiva que cubrirá los siguientes conceptos:

1º) Antecedentes del proyecto, justificando el interés de la instalación de la planta origen del vertido.

2º) Objeto del proyecto, que será la obtención de la oportuna aprobación de la Comisaria de Aguas, mostrando que la depuración prevista cumple los límites legales exigidos por la Administración, que se citarán.

3º) Producción de efluentes, donde se describirán aquellas áreas de proceso, origen de los ver tidos, con los caudales y composiciones de los mismos.

4º) Tratamiento de efluentes, donde se describirá el sistema propuesto, indicando los equipos que lo integran, así como su funcionamiento, todo ello de acuerdo con la documentación gráfica que se menciona más abajo.

5º) Características del vertido final después del tratamiento, indicando el caudal y la composición del mismo.

6º) Presupuesto de ejecución material, con presupuestos parciales desglosados por partidas.

7º) Documentación gráfica. Se prepararán los siguientes planos:

- Plano de situación (de la planta en su área geográfica).
- Planta general.
- Diagrama general de flujo de agua.
- Balance de agua en el proceso.
- Red de puntos de producción, recogida y distribución de efluentes (tuberías de drenaje, de impulsión, arquetas, tanques de acumulación, etc.).

3.3.3 Legislación

La normativa española sobre vertido de aguas residuales en los cauces públicos es amplia y dispersa.

Para ilustrar sobre su amplitud, hay que considerar que desde 1879 en que se publica la Ley de

Aguas, hasta la fecha (Marzo 1981) existen 34 normas legales, de diferente rango relacionadas con el tema.

Para ilustrar sobre su dispersión, hay que considerar que estas 34 normas legales emanan de cinco departamentos ministeriales (Presidencia del Gobierno, Ministerio de Industria, Obras Públicas, de Agricultura y del Interior) y que en las autorizaciones de vertidos deben actuar, a un nivel ú otro, los organismos siguientes: la Comisaría de Aguas correspondiente, la Jefatura Provincial de Sanidad, el Servicio Nacional de Pesca Fluvial y Caza, y la Delegación de Industria.

Las citadas normas se relacionan a continuación, por orden cronológico, agrupadas según el ministerio del que emanan y según el receptor final sea un río ó el mar. Los textos de las mismas se adjuntan en el punto 3.3.5. Anexos.

3.3.3.1 Normas para prevenir la contaminación de las aguas continentales.

Normas que afectan a varios departamentos ministeriales

(3111) Ley de Aguas del 13 Junio 1879 (Gaceta de 19-6-79). Art. 219 y 220.

(3112) Real Decreto del 16 Noviembre de 1900 por el que se aprueba el Reglamento sobre enturbiamiento é infección de aguas públicas y sobre aterramiento y ocupación de sus cauces con los líquidos procedentes del lavado de minerales ó con los residuos de las fábricas. ("Gaceta" del 18-11-1900). Art. 1 a 37.

(3113) Real Decreto del 12 Mayo de 1905 (Ministerio de Fomento) sobre procedimiento para la explotación y beneficio de minerales cobrizos ("Gaceta" de 13-5-05).

(3114) Orden de 16 Octubre 1906 (Ministerio de Fomento) sobre limpieza de cauces con sedimentos minerales ("Gaceta" de 26-10-06).

Normas de Presidencia del Gobierno

(3121) Decreto de 25 Junio 1954 por el que se dictan normas para conceder autorizaciones destinadas a ampliar industrias cuyas aguas residuales no sean depuradas antes de ser vertidas a los cauces públicos ("B.O.E." de 5-7-54). Art. 1.

(3122) Decreto de 30 Noviembre 1961, que aprueba el Reglamento de Actividades Molestas, Insalubles, Nocivas y Peligrosas (B.O.E. de 7-12-61). Art. 16 y 17.

(3123) Decreto 93/1968, de 18 Enero, sobre prohibición del uso de detergentes no biodegradables (B.O.E. de 29-1-68).

(3124) Decreto 3.157/1968 de 26 Diciembre por el que se modifica el Decreto 93/1968, de 18 Enero, sobre prohibición del uso de detergentes no biodegradables (B.O.E. de 30-12-68).

Normas del Ministerio de Industria

(3131) Decreto de 23 Agosto 1934, por el que se aprueba el Reglamento de Policía Minera y Metalúrgica (B.O.E. de 29-8-34). Art. 226.

(3132) Decreto de 9 Agosto 1946, por el que se aprueba el Reglamento General para el Régimen de la Minería (B.O.E. de 8-9-46). Art. 129.

(3133) Decreto 1.775/1967, de 22 Julio, sobre el régimen de instalación, ampliación y traslado de industrias (B.O.E. de 25-7-67). Art. 10.

(3134) Orden de 24 Febrero 1969, por la que se dictan normas complementarias de los Decretos 93/1968, de 18 Enero y 3157/1968, de 26 Diciembre, sobre prohibición del uso de detergentes no biodegradables.

Normas del Ministerio de Obras Públicas

(3141) Decreto de 14 Noviembre 1958, por el que se aprueba el Reglamento de Policía de Aguas y sus Cauces (B.O.E. de 2-12-58). Art. 11.

(3142) Orden de 4 Septiembre 1959 por la que se reglamenta el vertido de aguas residuales (B.O.E. de 10-9-59).

(3143) Circular, de la Dirección General de Obras Hidráulicas, de 21 Junio de 1960, sobre Instrucciones y Valoración de las diversas características que corresponden a las aguas de los cauces públicos según su clasificación establecido por O.M. de 4 Septiembre 1959.

(3144) Orden de 9 Octubre de 1962, por la que regulan la aplicación de la Orden de 4 de Septiembre de 1959 que regulaba el vertido de aguas residuales (B.O.E. de 23-10-62, 31-10-62 y 23-12-62).

(3145) Decreto del 25 Mayo 1972, por el que se modifican los capitulos IV y V del Reglamento de Policia de Aguas y sus cauces, del 14 Noviembre 1958.

(3146) Orden del 14 Abril de 1980 por la que se regulan medidas para corregir la contaminación de las aguas (B.O.E. de 23-4-80).

Normas del Ministerio de Agricultura

(3151) Ley de 20 Febrero 1942, sobre Pesca Fluvial (B.O.E. de 8-3-42). Art. 6.

(3152) Decreto de 13 Mayo 1953, por el que se dan normas para protección de la riqueza piscicola (B.O.E. de 2-6-53).

(3153) Decreto de 3 Julio 1953, sobre masas de agua protegidas (B.O.E. de 14-7-53).

(3154) Orden de 4 Julio 1958 sobre instalaciones de almazaras para neutralizar y eliminar alpechines en las aguas que viertan a los rios (B.O.E. de 24-7-58).

(3155) Decreto 2237/1966 de 13 Agosto, por el que se modifican los articulos 15 a 21 del Reglamento para aplicación de la Ley de Pesca Fluvial aprobado por Decreto de 6 Abril 1943 (B.O.E. de 10-9-66).

Normas del Ministerio de la Gobernación

(3161) Decreto de 12 Enero 1904 por el que se dan instrucciones generales de Sanidad ("Gacetas" del 22 y 23-1-04) Ar. 131 a 145.

(3162) Real Decreto de 9 Febrero 1924 sobre reglamento de Sanidad Municipal ("Gaceta" de 17-2-25). Art. 10.

(3163) Ley de Sanidad Local de 25 Noviembre 1944 fijando las bases para la organización de la Sanidad. Base 27 y 28.

3.3.3.2 Normas para prevenir la contaminación de las aguas del mar.

Normas de Presidencia del Gobierno

(3211) Decreto de 30 de Noviembre 1961 que aprueba el Reglamento de Actividades Molestas, Insalubles y Peligrosas. (B.O.E. de 7-12-61). Art. 16.

(3212) Orden del 1 Junio 1963 sobre contaminación de las aguas de mar por hidrocarburos (B.O.E. de 6-6-63).

(3213) Orden de 27 Mayo 1967 por la que se dictan normas sobre prohibición de vertidos al mar de productos petrolíferos ó residuos contaminados procedentes de fábricas ó industrias de todas clases. (B.O.E. de 1-6-67).

(3214) Orden de 21 Agosto 1967 por la que se establecen medidas para evitar la contaminación de aguas y playas por accidentes en los terminales de tuberias de carga y descarga de productos petroliferos. (B.O.E. de 24-8-67).

(3215) Ley 7/1980 del 10 Marzo sobre protección de las Costas Españolas (B.O.E. de 14-3-80).

(3216) Instrucción del 27 Febrero 1980, ratificando convenio del 4-6-74 sobre prevención de la contaminación marina de origen terrestre (B.O.E. de 21-1-81).

(3217) Real decreto nº 1088 del 23 Mayo 1980 por el que se aprueba el Reglamento para la ejecución de la Ley 28/1969 de 26-4-69 sobre costas. (B.O.E. de 13-6-80)

Normas del Ministerio de Obras Públicas

(3221) Resolución de la Dirección General de Puertos y Señales Martitimas por la que se aprueban las "Normas provisionales para el proyecto y ejecución de instalaciones depuradoras y de vertido de aguas residuales al mar en las costas españolas. (B.O.E. de 20 Junio 1969).

(3222) Resolución por la que se autoriza la ampliación de la central termoeléctrica de Soto de Ribera. (B.O.E. 52 de 1-3-79). Pág. 5455.

(3223) Resolución por la que se autoriza a FENOSA la instalación de la central térmica de Páramo del Sil. (B.O.E. 43 de 19-3-1979). Pág. 4439.

3.3.4 Utilización de las Normas y Reglamentos

A continuación se indica cual de toda esta legislación debe considerarse, en los aspectos "cualitativo" y "cuantitativo".

Se entiende por caracter cualitativo el de aquellas normas que definen el problema y reglamentan los procedimientos administrativos, sin definir standards de calidad ó regulaciones de concentraciones máximas admisibles. La definición de dichos standards ó regulaciones aparece en las normas que se denominan de caracter cuantitativo.

3.3.4.1 Normas de caracter "Cualitativo".

- La Orden de 4 Septiembre de 1959, del Ministerio Obras Públicas, por la que se reglamentó el vertido en aguas residuales (B.O.E. nº 217 de 10-9-59). (En adelante esta norma se denomina 3142).

- La Orden de 9 Octubre de 1962, del Ministerio de Obras Públicas, por la que se aprueban las normas complementarias que regulan la aplicación de la de 4 de Septiembre de 1959 que reglamentaba el vertido de aguas residuales (B.O.E. nº 254 de 23-10-62). Esta Orden fué previamente promulgada con fecha 23 de Marzo de 1960 (B.O.E. nº 80 de 2-4-60). El Ministerio de Agricultura solicitó la nulidad de pleno derecho de la misma por entender que vulneraba los preceptos de la vigente Ley de Pesca Fluvial de 20 de Febrero de 1942. La Presidencia del Gobierno, con fecha 20 de Marzo de 1962 (B.O.E. nº 74 de 27 de Marzo de 1962), declaró nulas de pleno derecho siete normas del total de 13 de que constaba la citada orden, por lo que fué redactada y promulgada de nuevo el 9 de Octubre de 1962. (En adelante esta norma se denomina 3144).

3.3.4.2 Normas de caracter "Cuantitativo".

- La circular de la Dirección General de Obras Hidráulicas de 21 de Junio de 1960, sobre Instrucciones y Valoración de las diversas características que corresponden a las aguas de los cauces públicos según su clasificación establecida por Orden Ministerial de 4 de Septiembre de 1959. (En lo que sigue se denomina 3122).

3.3.4.3 Caracteristicas de las Normas.

Definición de aguas residuales

En la legislación española que se comenta no aparece definición de polución sino de aguas residuales. En 3142 se consideran aguas residuales "aquellas que de algún modo producen enturbiamiento ó infección de las aguas públicas". En

3144 la definición parece más completa y se consideran aguas residuales "las que de algún modo produzcan alteraciones perjudiciales en las características físicas, químicas, bacteriológicas y biológicas de las aguas públicas a las cuales aquellas vierten y las que arrastran ó llevan en suspensión cuerpos sólidos" (Norma segunda).

Policía general

Del estudio de las normas 3142 y 3144 puede deducirse que la legislación española se ha centrado fundamentalmente en las normas administrativas que deben seguirse para lograr las autorizaciones de vertido, que se basan en las clasificaciones previas de los cauces públicos (que se describe más adelante) y de los propios vertidos (en inocuos, sospechosos y nocivos). Hay que indicar que no se ha llegado a la unificación administrativa en un sólo organismo que entienda del problema, como ya se ha mencionado anteriormente, ni tampoco a una unificación legislativa, ya que según la orden 3144, hay que tener en cuenta no sólo ésta sino además:

- El Reglamento de Policia de Aguas y sus cauces, de 14 de Noviembre de 1958 (norma 3141).
- La Orden ministerial de 4 de Septiembre de 1959 (norma 3142).
- Ley de 20 de Febrero de 1942 (sobre riqueza piscícola) (norma 3151).
- El Real Decreto de 16 de Noviembre de 1900 (sobre enturbiamiento é infección de aguas públicas) (norma 3112).

Medidas concretas

a) Clasificación de los cauces

La clasificación española de los cauces públicos se basa en el uso existente, de acuerdo con cuatro grupos:

- Cursos de agua protegidos.
- Cursos de agua vigilados.
- Cursos de agua normales.
- Cursos de agua industriales.

Las definiciones dadas para cada uno de estos grupos en 3142 son un tanto ambiguas, pero pueden completarse de lo que se infiere en 3144. De esa forma las definiciones pueden ser como sigue:

- Cursos de agua protegidos.

  Aquellos en que circulen aguas destinadas al abastecimiento de aguas a poblaciones.

- Cursos de agua vigilados.

  Aquellos que se aprovechan para "pesca, riegos, abrevaderos, industrias de caracter especial, etc.". (3144).

- Cursos de agua normales.

  Los que se aprovechan para "usos hidroeléctricos, usos industriales, etc." (3144).

- Cursos de agua industriales.

  No aparecen definidos en 3142. En 3144 puede leerse: "Los cursos de aguas industriales podrán en principio admitir cualquier grado de impurificación, por estar utilizadas en su totalidad para usos ó aprovechamientos en los que no se precisa especial calidad en las aguas, pudiendo incluso autorizarse el no establecimiento de sistemas purificadores".

  La clasificación definitiva de todos los ríos españoles, según los cuatro grupos citados, deberá aparecer en el B.O.E. de la provincia correspondiente según 3142.

b) Inventario

Según el artículo octavo de 3142, "en el plazo de un año se procederá a formar por los Servicios Hidráulicos un censo de las entidades ó particulares que viertan directa ó indirectamente sus aguas residuales en cauces públicos (...). En la medida que estos casos vayan ultimándose se publicarán en el B.O. de la provincia correspondiente (...). Los censos se recogerán agrupados:

- Vertidos debidamente autorizados y en los que se hayan cumplido las condiciones de tratamiento impuestas en la autorización.

- Vertidos autorizados, pero en los que no se hubiesen cumplido las condiciones fijadas al autorizar el vertido.

- Vertidos no autorizados, con indicación del tiempo que viene realizándose".

El autor no tiene conocimiento si dicho censo de vertidos haya sido realizado, que según la ley debia estar concluido el 10 de Septiembre de 1960.

c) Autorización de vertidos

Se destaca a continuación lo más importante sobre autorizaciones de vertidos entre lo que aparece en 3142 y 3144. Al lector interesado se le remite a la lectura completa de los dos textos legales citados.

- "Se prohibe el vertido directo ó indirecto en un cauce público ó canal de riego, de aguas residuales cuya composición quimica ó contaminación bacteriológica puedan impurificar las aguas con daño para la salud pública ó para los aprovechamientos inferiores, tanto comunes como especiales" (Art. 1 de 3142).

- Si no se produce el daño a que se refiere el Art. 1 de 3142, los Servicios Hidraulicos del Ministerio de Obras Públicas autorizarán el vertido, según los requisitos establecidos, "fijando en cada caso los limites máximos de impurificación tolerada" (Art. 2 de 3142). Según esto la legislación española no utiliza standards fijos de calidad. sino que se rige por una situación caso por caso como ocurre en Inglaterra ó Finlandia. Sin embargo, parece que no es así según lo dispuesto en 3122 en que se establecen standards fijos.

- Si se modifican el caudal ó los limites de impurificación autorizados será necesaria una autorización complementaria (Art. 4 de 3142).

- El incumplimiento de lo autorizado para el vertido "llevará consigo la causa de caducidad de la concesión de aguas públicas otorgada" (Art. 5 de 3142), aparte de las multas correspondientes y de las sanciones de caracter criminal que puedan derivarse (Art. 8 de 3142).

- No aparece nada en la legislación española sobre plazos determinados para la autorización de vertidos, ni de revisiones posteriores a la autorización.

d) Medidas financieras

En la legislación actual no hay previstas medidas de ayudas, créditos ó incentivos financieros para las empresas en su lucha contra la contaminación, como existen en otros paises.

e) Standards de calidad

En 3143 se dan los standards de calidad para los tres primeros grupos de cauces públicos según la clasificación de 3142 y 3144, esto es para los cauces de aguas protegidos, vigilados y normales. Estos standards se han copiado en la Tabla III.

Con respecto a las concentraciones máximas permisibles para los distintos contaminantes hay que acogerse a lo establecido en 3122 y que aparecen en la Tabla IV. En dicha Tabla se comparan las regulaciones españolas con lo que puede considerarse una regulación media internacional.

Hay que advertir que para establecer las concentraciones máximas permisibles no se distingue entre los distintos cursos de agua a los que pueda realizarse el vertido. Además, como ya se ha indicado, parece existir una contradicción entre 3122, al imponer standards fijos y 3142, que preconiza una situación caso por caso. Por último de la comparación establecida se deduce una mayor rigidez por parte de la legislación española.

3.3.5 Anexos

Textos de las normas sobre aguas residuales, que se adjuntan.

NOTA IMPORTANTE: Antes de preparar el proyecto y la solicitud de autorización, conviene consultar otro proyecto realizado en SENER y para el que se obtuvo la autorización solicitada.

La realización de proyectos realizados en SENER correspondientes a esta materia es la siguiente:

- Planta de Detergentes de PROCTER & GAMBLE en Córdoba.

Anexo II

9.1.3. REFERENCIAS DE TEXTOS LEGISLATIVOS Y REGLAMENTACIONES (AGUAS POTABLES Y DE PISCINAS)

Fecha	B.O.E.	Naturaleza	Objeto	Organismo
1960	—	Orden de 31-5-60	Reglamentación del funcionamiento de las piscinas públicas.	Ministerio de la Gobernación
1967	23-10	Decreto 2.484/1967	Código alimentario	Presidencia del Gobierno
1972	8-11	Decreto 3.069/1972	Regulación de las aguas de bebida envasadas	Presidencia del Gobierno
1973	16-4	Orden de 11-4-73	Bases técnicas y métodos a observar en estaciones depuradoras de moluscos	Presidencia del Gobierno
1974	13-9	Decreto 2.519/1974	Entrada en vigor, aplicación y desarrollo del Código Alimentario Español	Presidencia del Gobierno
1974	2-10	Orden de 28-7-74	Pliego de prescripciones técnicas generales para tuberías de abastecimiento de aguas	Ministerio de Obras Públicas
1975	12-3	Decreto 407/1975	Reglamentación tecnicosanitaria para elaboración y venta de bebidas refrescantes	Presidencia del Gobierno
1975	29-3	Decreto 607/1975	Regulación de las especificaciones microbiológicas a las que han de ajustarse las aguas medicinales envasadas.	Ministerio de la Gobernación

Anexo II

5.2. Legislación de aguas residuales

5.2.1. VERTIDOS A CAUCES PÚBLICOS
(Resumen de los principales textos legislativos)

Reglamento de Policía de Aguas y sus cauces

Aprobado por decreto de 14 de noviembre de 1958, del Ministerio de Obras Públicas

. . . .

Capítulo II
Policía de los cauces

. . . .

Art. II. *Aguas residuales.*—En virtud de lo dispuesto en el Real Decreto de 21 de marzo de 1895, sobre defensa de las aguas contra contaminaciones y el Real Decreto de 16 de noviembre de 1900, sobre enturbiamiento e infección de aguas públicas, se prohibe el vertido, en un cauce público, de aguas residuales cuya composición química o contaminación bacteriológica pueden impurificar las aguas con daño para la salud pública.

Sin perjuicio del cumplimiento de lo dispuesto en la Ley del 20 de febrero de 1942, y Reglamento de 6 de abril de 1943, cuando una Confederación o Servicio Hidráulico tenga conocimiento que tal hecho ocurre en su jurisdicción, exigirá de la empresa o empresas responsables de ello, que eviten el vertido en cuestión, o que antes de efectuarlo, las aguas sean depuradas, a cuyo efecto, aquellas empresas vendrán obligadas a presentar a la Confederación o Servicio Hidráulico correspondiente, un proyecto de depuración, suscrito por un técnico autorizado, que se someterá a información pública e informes de la Junta y Jefatura Provincial de Sanidad y del encargado de la confrontación; aprobado el proyecto e instalado el sistema de depuración, se autorizará el vertido.

El establecimiento de una industria cualquiera que origine materias residuales que puedan impurificar las aguas de un cauce público, será objeto de previo informe, por parte de la Jefatura Provincial de Sanidad y Jefatura del Servicio Piscícola, además del del Servicio Hidráulico correspondiente. Del mismo modo se procederá para el establecimiento de Sanatorios, Asilos, Residencias, hoteles o edificios similares, cuyas materias residuales puedan contaminar las aguas, sin perjuicio del cumplimiento de lo dispuesto por el artículo sexto de la Ley de 20 de febrero de 1942 y concordantes de su Reglamento. Tales establecimientos deberán ser autorizados por los Servicios Hidráulicos o, en su defecto, adoptar a su costa las medidas de purificación que aquéllos consideren indispensables.

(Los capítulos IV, Contravenciones y sanciones y V, Procedimiento, quedan modificados por decreto 1.375/1972, del M. de O.P., de fecha 25 de mayo de 1972, B.O.E. del 6.6.72)

Orden de 4 de setiembre de 1959, del Ministerio de Obras Públicas, por la que se reglamenta el vertido de aguas residuales

Ante el crecimiento y gravedad de las impurificaciones de los ríos con motivo de la mayor industrialización del país, se hace necesario completar el Reglamento de Policía de Aguas y sus cauces, aprobado por Decreto de 14 de noviembre de 1958, especialmente por lo que se refiere a la aplicación del artículo 11 del mismo, en relación con las aguas residuales de los distintos aprovechamientos hidráulicos.

La presente Orden ministerial parte del concepto mismo de aguas residuales que el Reglamento citado ofrece, según el cual se consideran como tales a diferencia de las simplemente usadas, aquéllas que de algun modo producen enturbiamiento o infección de las aguas públicas, distinguiendose de este modo los distintos vertidos de las mismas según produzcan o no daños, tanto a la salud pública como a los aprovechamientos inferiores.

Se aplica en todo caso un criterio flexible de modo que el grado de impurificación no viene determinado con carácter absoluto, sino siempre en función, no sólo del caudal circulante en el punto de vertido, sino también de las caracteristicas mismas del curso de agua en que el mismo se verifica. A tal fin se procede a una clasificación sistemática de los cauces públicos, cuya finalidad es, además de permitir que la acción del Estado se realice de acuerdo con unos criterios planificados y de conjunto, la de facilitar en todo momento a los mismos administrados el conocimiento de las caracteristicas de los distintos cursos de agua y, consecuentemente, la clase de aprovechamiento que en los mismos pueden establecerse.

Se estructura igualmente el sistema de autorizaciones de vertidos de aguas residuales, ya existente, y a tal fin se crea el Censo de Aguas Residuales que, de acuerdo con los principios de desconcentración administrativa, ha de ser llevado a cabo por los Servicios Hidráulicos, y cuya finalidad es la de permitir conocer en todo momento el grado de impurificación y las posibilidades de explotación que un determinado curso de agua ofrece.

En su virtud, este Ministerio ha tenido a bien disponer:

Art. 1.º Se prohibe el vertido directo o indirecto en un cauce público o canal de riego, de aguas residuales cuya composición química o contaminación bacteriológica puedan impurificar las aguas con daño para la salud pública o para los aprovechamientos inferiores, tanto comunes como especiales.

Art. 2.º En los casos en que el vertido de aguas residuales no produzca los daños a que se refiere el artículo anterior, los Servicios Hidráulicos del Ministerio de Obras Públicas autorizarán tal vertido, previa información pública y con los informes exigidos en el párrafo 3 del artículo 11 del Reglamento de Policía de Aguas y sus cauces, aprobado por decreto de 14 de noviembre de 1958, fijando en cada caso los límites máximos de impurificación tolerada, en relación con el caudal circulante en el punto vertido.

Art. 3.º Si las aguas vertidas produjesen daño, las autorizaciones que en tal caso se otorguen estarán sometidas a los mismos trámites señalados en el caso precedente, fijándose además, en este supuesto, no sólo el grado máximo de impurificación permitida, sino también el tratamiento a que han de someterse las aguas o las obras a construir antes de proceder al vertido.

Art. 4.º En los dos supuestos a que se refieren los artículos anteriores, cualquier alteración en el caudal de las aguas vertidas o en el grado de impurificación de las mismas por encima de los limites autorizados, habrá de ser notificada a los Servicios Hidráulicos para obtener la correspondiente autorización complementaria.

Art. 5.º Toda concesión de aguas públicas o autorización de aguas privadas, dentro del ámbito encomendado al Ministerio de Obras Publicas de acuerdo con la letra c) del artículo 1.º del Reglamento de Policía de Aguas y sus cauces que en lo sucesivo se otorgue, llevará consigo la correspondiente autorización para verter las aguas residuales que puedan producirse. A tal fin, junto a la solicitud de concesión o de autorización, se acompañará descripción de las características de las aguas vertidas, y, *en su caso, proyecto de depuración suscrito por un técnico autorizado*. Los Servicios Hidráulicos recabarán de oficio los informes que el artículo II del Reglamento de Policía de Aguas y sus cauces, y en la concesión o autorización que se otorgue se señalará, cuando proceda, el tratamiento que a las aguas residuales haya de darse o las obras que hayan de construirse.

El incumplimiento de las condiciones de vertido, o la alteración en el caudal de las aguas vertidas o en el grado de impurificación de las mismas por encima de los límites autorizados, llevará consigo la causa de caducidad de la concesión de aguas públicas o de autorización de aguas privadas otorgada por el Ministerio de Obras Públicas, siguiéndose por los Servicios el oportuno expediente para la declaración de la misma, sin perjuicio de las sanciones por contravención grave, que le serán impuestas a tenor de lo que se indica en el artículo octavo de la presente Orden.

Art. 6.º A los fines que la presente orden se refiere, los Servicios Hidráulicos procederán a clasificar en el plazo de seis meses, los cauces de sus respectivas jurisdicciones en los siguientes grupos:

1.º Cursos de agua protegidos.
2.º Cursos de agua vigilados.
3.º Cursos de agua normales.
4.º Cursos de agua industriales.

Se clasificarán como protegidos los cursos en que circulen aguas *destinadas al abastecimiento de agua potable* a poblaciones, y requieran esta especial protección como vigilados aquellos cuyas aguas vayan destinadas a otros aprovechamientos que puedan resultar perjudicados, y como normales los que, en principio, puedan ceder sus aguas para cualquier uso de tipo común.

Los Servicios Hidráulicos llevarán a cabo la anterior clasificación teniendo en cuenta el caudal medio de las condiciones de uso de los distintos cursos de agua, y a tal fin solicitarán, previamente, los informes pertinentes. Esta clasificación será sometida, durante el plazo de un mes, a información pública que, una vez ultimada, se remitirá al Ministerio de Obras Públicas con propuesta razonada, publicándose la resolución que éste adopte, con la clasificación definitiva, en el *Boletín Oficial del Estado* y en el «Boletín de las provincias afectadas».

Art. 7.º Los Servicios Hidráulicos podrán proponer al Ministerio de Obras Públicas, de oficio o previa justificada y aceptada propuesta de los interesados, la modificación de la clasificación anterior, que será sometida a información pública. En todo caso, aprobada tal modificación, será publicada en la misma forma que el artículo anterior señala.

Art. 8.º En el plazo de un año se procederá a formar por los Servicios Hidráulicos un censo de las entidades o particulares que viertan directa o indirectamente sus aguas residuales en cauces públicos, clasificándose según el grado de impureza en el punto de desagüe, en función de la clasificación que el artículo sexto recoge de los cursos de agua en:

1.º Entidades o particulares que producen vertidos inocuos.
2.º Entidades o particulares que producen vertidos sospechosos.

3.º Entidades o particulares que producen vertidos nocivos.

En la medida que estos casos vayan ultimándose, se publicarán en el *Boletín Oficial* de la provincia correspondiente para conocimiento de los interesados y rectificación, si ha lugar, según las alegaciones que presenten.

a) Vertidos debidamente autorizados y en los que se hayan cumplido las condiciones de tratamiento impuestas en la autorización.

b) Vertidos autorizados, pero en los que no se hubiesen cumplido las condiciones fijadas al autorizar el vertido.

c) Vertidos no autorizados, con indicación del tiempo que viene realizándose.

Los vertidos autorizados que no hubiesen cumplido las condiciones fijadas al autorizarlos, se atendrán a lo que señalen dichas condiciones en caso de incumplimiento, y de no especificarse nada de ellas, se les concederá un plazo de seis meses para normalizar su situación a partir del momento en que oficialmente, por el Servicio, se les conmine a hacerlo. A los vertidos no autorizados se les señalarán cuando proceda, las condiciones y tratamiento a que habrán de someterse sus aguas residuales, fijándoles el plazo en que habrán de realizarlo. En todos estos casos, el incumplimiento de los plazos o condiciones será clasificado de contravención grave y sancionado con las multas establecidas en el capítulo cuarto del Reglamento de Policía y sus cauces, independientes de las sanciones de carácter criminal que en cada caso puedan derivarse y de la responsabilidad civil relativa a la reparación de daños causados o a la indemnización procedente de ellos, por lo cual, los Servicios pasarán el tanto de culpa a los tribunales de justicia, cuando corresponda, y a los Gobernadores civiles cuando en ejercicio de la potestad que les confiere el artículo 33 del Decreto de 10 de octubre de 1958, deban proceder a la clausura o modificación de la industria causante. Al propio tiempo los Servicios darán cuenta de la infracción a los organismos y dependencias ministeriales a que pueda afectar la impurificación sancionada para que, a su vez, si lo estiman oportuno, puedan proceder a la aplicación de la reglamentación de sus competencias.

Los vertidos comprendidos en el grupo *a)* se inscribirán en el censo con carácter definitivo, y los de los otros dos grupos con carácter provisional hasta que se cumplan las condiciones impuestas. Comprobado su cumplimiento y previos los informes que el artículo II del Reglamento de Policía de Aguas y sus cauces señala, se procederá a la inscripción definitiva de estos últimos, y de no cumplirse dichas condiciones, se atendrá a lo que señale el condicionado en caso de incumplimiento, debiendo de todas formas considerarse caducadas las autorizaciones de vertido en que no se hayan cumplido las condiciones impuestas en el plazo de un año desde que se formuló la inscripción provisional.

Art. 9.º La formación de estos censos se considerará como servicio preferente de entre los que tiene a su cargo la Policía Fluvial, organizada por Orden ministerial de 11 de enero de 1958.

Art. 10. A los fines establecidos en la presente Orden, se crea en cada Servicio Hidráulico un censo de Aguas residuales correspondiente a cada curso de agua. En tales censos se inscribirán las autorizaciones a que el artículo octavo se refiere en la forma señalada en el mismo. Las autorizaciones que en lo sucesivo se otorguen se inscribirán de oficio con carácter provisional, inscripción que se elevará a definitiva conforme vayan cumpliéndose las

condiciones de tratamiento impuestas a las aguas residuales, y en su caso, reconocidas las obras ordenadas.

Instruciones y valoración de las diversas características que corresponden a las aguas de los cauces públicos según su clasificación establecida por O.M., de 4 de setiembre de 1959.
(Junio de 1960)

Instrucciones generales

1.ª La valoración de las diversas características de las aguas de un cauce público, tiene que efectuarse aguas abajo de una población (Artículo 5.º de la O.M. de 23 de marzo de 1960) (1).

2.ª El caudal de un cauce público que ha de tomarse en consideración cuando se trate de cursos de agua correspondientes al grupo primero de la clasificación establecida será el caudal medio que circule en los períodos de estiaje normal. Cuando se trate de cauces públicos correspondientes a los grupos 2.º y 3.º de dicha clasificación será el deducido como más frecuente de entre los aforados en el cauce receptor durante los últimos cinco años (Artículo 10 de la O.M. de 23 de marzo de 1960) (1).

3.ª La comprobación de los efectos de una polución se efectuará según dispone el artículo II de la citada Orden Ministerial de 23 de marzo de 1960 (1).

4.ª Los frascos utilizados para la toma de muestras serán nuevos, en vidrio blanco, con tapón esmerilado o con tapón de corcho nuevo.

Deben mantenerse dichos frascos una hora en ebullición con agua, y secados posteriormente.

Estos frascos deberán ser tratados por 2 cm^3 de solución saturada de permanganato potásico, y escurridos, después se dejarán 10 min en contacto con 10 cm^3 de ácido sulfúrico del comercio, y enjuagados abundantemente con agua corriente hasta que desaparezca toda acidez, valorada con papel tornasol. Después serán enjuagados varias veces con agua destilada fresca.

5.ª En el momento de la toma de muestras, los frascos serán enjuagados tres veces con agua que se ha de analizar, y después se llenan hasta el borde. Será tapado el gollete con papel pergamino, cuidadosamente atado.

6.ª En el caso de toma de muestras de un río, de un depósito, de una cisterna, el frasco será sumergido a una cierta distancia del fondo y de la superficie, bastante lejos de las orillas o bordes, evitándose poner en suspensión materias del fondo. Si se usa un vaso intermedio, este será lavado y enjuagado cuidadosamente.

La mezcla de varias tomas recogidas así, puede dar la toma media.

7.ª En el caso de una bomba, las tomas se efectuarán al final de una prueba de bombeo ininterrumpido, de una duración de 30 h, o al fin de la última jornada de una serie consecutiva de tres días de bombeo durante 10 h de bombeo.

8.ª En el caso de una toma de agua que sale de un grifo, es indispensable dejar correr el agua durante un tiempo mínimo de 10 min.

9.ª El volumen necesario para un análisis completo de agua es aproximadamente de 5 l.

(1) Ver los artículos correspondientes de la O.M. del 9 de octubre de 1962, que sustituye a la de 23 de marzo de 1960, cuyas normas fueron, en parte, anuladas por disposición de la Presidencia del Gobierno, con fecha 20 de marzo de 1962.

10.º Las muestras tomadas deben llevarse con toda rapidez al laboratorio de análisis.

11.º Cuando se trate de hallar dosis de aluminio, hierro, arsénico, cromo y cobre, tomar el agua en un frasco de tapón esmerilado que contenga 2 cm^3 de ácido clorhídrico puro y concentrado, que será sustituido por ácido nítrico cuando se trate de manganeso.

En el caso de plomo puede utilizarse tanto el ácido clorhídrico como el nítrico.

Valoración de las diversas características de un agua

Características organolépticas:

Color	Grupo 1.º	Incoloro y transparente
	Grupo 2.º	Incoloro y transparente
	Grupo 3.º	Incoloro y transparente
Sabor	Grupo 1.º	Agradable
	Grupo 2.º	Agradable
	Grupo 3.º	Indiferente
Olor	Grupo 1.º	Inodoro
	Grupo 2.º	Inodoro
	Grupo 3.º	Inodoro

Características físico-químicas:

Temperatura	Grupo 1.º	Menor de 25 °C
	Grupo 2.º	Menor de 25 °C; en ríos salmoneros, menor de 20 °C
	Grupo 3.º	Menor de 30 °C
pH	Grupo 1.º	Comprendido entre 6,5 y 8,7
	Grupo 2.º	Comprendido entre 5,3 y 9
	Grupo 3.º	Comprendido entre 5 y 10
Enturbiamiento	Grupo 1.º	Menor que 1.º de sílice
	Grupo 2.º	Comprendido entre 1,5º y 4º de sílice
	Grupo 3.º	Menor de 6º de sílice
Dureza	Grupo 1.º	Menor de 20º
	Grupo 2.º	Menor de 30º
	Grupo 3.º	Menor de 40º
Materias en suspensión	Grupo 1.º	Menor de 30 mg/litro
	Grupo 2.º	Menor de 60 mg/litro
	Grupo 3.º	Menor de 100 mg/litro
Radiactividad	Grupo 1.º	Negativa
	Grupo 2.º	Menor de 10,7 microcuries por mililitro o cm^3
	Grupo 3.º	Variable según destino
Resistividad	Grupo 1.º	Mayor de 1 500 ohm. cm^2/cm a 18º
	Grupo 2.º	Mayor de 750 ohm. cm^2/cm a 18º
	Grupo 3.º	Variable, según destino

Características químicas:

Agresividad	Grupo 1.º	Negativa
	Grupo 2.º	Indicios
	Grupo 3.º	Variable, según pH y dureza
D. B. O.	Grupo 1.º	Menor de 10 mg/l de oxígeno
	Grupo 2.º	Menor de 15 mg/l de oxígeno
	Grupo 3.º	Menor de 30 mg/l de oxígeno
Oxígeno disuelto	Grupo 1.º	Mayor de 5 mg/l
	Grupo 2.º	Mayor de 3 mg/l
	Grupo 3.º	Mayor de 1 mg/l

Anexo II

Nitrógeno (NH_3)	Grupo 1.°	Menor de 0,5 mg/l
	Grupo 2.°	Menor de 1 mg/l
	Grupo 3.°	Según destino
Nitrógeno (nitratos) ...	Grupo 1.°	Menor de 100 mg/l de (NO_3)
	Grupo 2.°	Menor de 200 mg/l de (NO_3)
	Grupo 3.°	Según destino
Cloruros	Grupo 1.°	Menor de 250 mg/l de (Cl)
	Grupo 2.°	Menor de 400 mg/l de (Cl)
	Grupo 3.°	Según destino

Sustancias tóxicas e indeseables:

Arsénico	Grupo 1.°	Menor de 0,2 mg/l de As
	Grupo 2.°	Menor de 4 mg/l de As
	Grupo 3.°	Según destino
Cromo	Grupo 1.°	Menor de 0,05 mg/l en Cr
	Grupo 2.°	Menor de 0,2 mg/l en Cr
	Grupo 3.°	Según destino
Cianuros libres	Grupo 1.°	Menor de 0,01 mg/l en (CN)
	Grupo 2.°	Menor de 0,1 mg/l en (CN)
	Grupo 3.°	Según destino
Fluoruros	Grupo 1.°	Menor de 1,5 mg/l en F
	Grupo 2.°	Menor de 10 mg/l en F
	Grupo 3.°	Según destino
Plomo	Grupo 1.°	Menor de 0,1 mg/l en Pb
	Grupo 2.°	Menor de 0,5 mg/l en Pb
	Grupo 3.°	Según destino
Selenio	Grupo 1.°	Menor de 0,05 mg/l en Se
	Grupo 2.°	Menor de 0,4 mg/l en Se
	Grupo 3.°	Según destino
Cobre	Grupo 1.°	Menor de 0,05 mg/l en Cu
	Grupo 2.°	Menor de 3 mg/l en Cu
	Grupo 3.°	Según destino
Manganeso	Grupo 1.°	Menor de 0,05 mg/l en Mn
	Grupo 2.°	Menor de 0,4 mg/l en Mn
	Grupo 3.°	Según destino
Hierro	Grupo 1.°	Menor de 0,1 mg/l en Fe
	Grupo 2.°	Menor de 5 mg/l en Fe
	Grupo 3.°	Según destino
Cinc	Grupo 1.°	Menor de 5 mg/l en Zn
	Grupo 2.°	Menor de 15 mg/l en Zn
	Grupo 3.°	Según destino
Putrescibilidad	Grupo 1.°	Sin decolorar el azul de metileno a los 7 días a 30 °C
	Grupo 2.°	Sin decolorar el azul de metileno a los 5 días a 30 °C
	Grupo 3.°	Según destino
Materia orgánica	Grupo 1.°	Menor de 2 mg/l
	Grupo 2.°	Menor de 4 mg/l
	Grupo 3.°	Según destino
Fenoles	Grupo 1.°	Menor de 0,001 mg/l en Fenol
	Grupo 2.°	Menor de 0,002 mg/l en Fenol
	Grupo 3.°	Según destino
Aceites y grasas	Grupo 1.°	Negativo
	Grupo 2.°	Indicios
	Grupo 3.°	Menor de 0,5 g/l

Características biológicas:

Grupo 1.º Exenta de gérmenes patógenos
Grupo 2.º Exenta de gérmenes patógenos de carbunco bacteriano, carbunco sintomático, tuberculosis, tifus y paratifus
Grupo 3.º Según destino

Instrucciones particulares

Cuando se trata de cauces públicos que deben ser clasificados en los grupos 1.º ó 2.º los valores máximos y mínimos aceptables son los indicados en las valoraciones expuestas.

En cuanto a las valoraciones máximas o mínimas de las aguas públicas clasificadas en el 3.º Grupo, aquéllas se ponderarán según el uso posterior de dichas aguas en cada caso particular, pues no pueden establecerse unas normas rígidas dada la diversidad de utilizaciones que pueden experimentar.

Decreto de la Presidencia del Gobierno 2.414/1961, de 30 de noviembre, por el que se aprueba el Reglamento de Actividades Molestas, Insalubres, Nocivas y Peligrosas

Reglamento de Actividades Molestas, Insalubres, Nocivas y Peligrosas.

Título I.—Intervención administrativa en las actividades molestas, insalubres, nocivas y peligrosas.

Capítulo III.—De las actividades reguladas por este Reglamento.

Sección 2.ª Actividades insalubres y nocivas

Minas, aguas residuales

Art. 16.—Para autorizar nuevas explotaciones mineras o cualesquiera otras actividades calificadas como nocivas que por su emplazamiento afecten a aguas continentales, que hayan de verter en las mismas aguas residuales con carácter previo, se aplicarán las disposiciones vigentes relativas a Pesca Fluvial y a Policía de Aguas, contenidas en la Ley de 20 de febrero de 1942, en el Real Decreto de 16 de noviembre de 1900, Decreto de 14 de noviembre de 1948 y demás disposiciones complementarias.

Depuración

Estas actividades, entre las que figuran las industrias del papel, celulosas, azucareras, curtidos, colas, potásicas, talleres de flotación para el beneficio y concentración de minerales, fábricas de gas y productos secundarios de la industria del coque, de sosa, textiles y anexas, etc., deberán estar dotadas de dispositivos de depuración mecánicos, químicos o fisicoquímicos, para eliminar de sus aguas residuales los elementos nocivos que puedan ser perjudiciales para las industrias situadas aguas abajo o en la proximidad del lugar en que se efectúe el vertido, o para las riquezas piscícola, pecuaria, agrícola o forestal.

Otras soluciones

No obstante, cuando la importancia y las condiciones especiales que concurran en el caso lo aconsejen, podrán adoptarse soluciones de alejamiento de estas aguas residuales nocivas, siempre que con ello no se produzcan ninguno de los daños antes indicados.

Peligro de contaminación de aguas

Art. 17.—La instalación de nuevas «actividades» insalubres o nocivas, que por su emplazamiento o vertido de aguas residuales supongan un riesgo de contaminación o alteración de las condiciones de potabilidad de aguas destinadas al abastecimiento público o privado, no podrá autorizarse si no se han cumplido las condiciones señaladas en el «Reglamento de Policía de Aguas y sus Cauces» y demás disposiciones aplicables. Los mismos requisitos serán exigidos respecto de las que impliquen un peligro sanitario para las aguas destinadas a establecimientos balnearios.

Queda prohibido a los establecimientos industriales que produzcan aguas residuales, capaces por su toxicidad o por su composición química y bacteriológica de contaminar las aguas profundas o superficiales, el establecimiento de pozos, zanjas, galerías o cualquier dispositivo destinado a facilitar la absorción de dichas aguas por el terreno, así como también queda prohibido su vertimiento en los ríos o arroyos sin previa depuración.

Se considerará desaparecido el citado riesgo de contaminación y, por tanto, se podrá autorizar el uso de pozos absorbentes con el citado fin, cuando éstos se sitúen a 500 o más metros de todo poblado, y un estudio geológico demuestre la imposibilidad de contaminación de las capas acuíferas freáticas y profundas.

Solamente será tolerado el vertimiento sin previa depuración en los cursos de agua de los líquidos sobrantes de industrias o los procedentes del lavado mineral, cuando el volumen de éstos sea por lo menos veinte veces inferior al de los que en el estiaje lleva el curso de agua o cuando aguas abajo del punto de vertido no exista poblado alguno a una distancia inferior a la necesaria para que se verifique la autodepuración de la corriente.

En el supuesto de que varíen proporciones de los líquidos residuales respecto al volumen del curso de agua, de forma que aumente el peligro de nocividad o insalubridad, la referida tolerancia, quedará sin efecto, debiéndose, no obstante, oír a la Entidad o persona interesada, a fin de que exponga las razones que crea asistirle en su favor.

Depuración

De no concurrir las circunstancias señaladas en el párrafo anterior, las aguas residuales habrán de ser sometidas a depuración por procedimientos adecuados, estimándose que éstos han tenido plena eficacia cuando las aguas, en el momento de su vertido al cauce público, reúnan las condiciones siguientes:

a) Cuando el agua no contenga más de 30 mg de materias en suspensión por litro.

b) Cuando la demanda bioquímica de oxígeno medida después de cinco días de incubación a 20° no rebase la cifra de 10 mg por litro.

c) Cuando antes y después de siete días de incubación a 30° no desprenda ningún olor pútrido o amoniacal.

d) Su pH deberá estar comprendido entre 6 y 9.

En ningún caso, las aguas residuales depuradas natural o artificialmente, deberán añadir a los cauces públicos componentes tóxicos o perturbadores en cantidades tales que eleven su composición por encima de los siguientes límites, ya que éstos condicionan la posibilidad de ser utilizadas sin riesgo de intoxicación humana.

Límites de toxicidad

Plomo (expresado en Pb), 0,1 mg por litro.
Arsénico (expresado en As), 0,2 mg por litro.
Selenio (expresado en Se), 0,05 mg por litro.
Cromo (expresado en Cr hexavalente), 0,05 mg por litro.
Cloro (libre y potencialmente liberable, expresado en Cl), 1,5 mg por litro.
Acido cianhídrico (expresado en CN), 0,01 mg por litro.
Fluoruros (expresado en F), 1,5 mg por litro.
Cobre (expresado en Cu), 0,05 mg por litro.
Hierro (expresado en Fe), 0,1 mg por litro.
Manganeso (expresado en Mn), 0,05 mg por litro.
Compuestos fenólicos (expresado en Fenol), 0,001 mg por litro.

Orden de 9 de octubre de 1962, del Ministerio de Obras Públicas, por la que se aprueban *las normas complementarias que regulan la aplicación* de la de Obras Públicas de 4 de setiembre de 1959 que reglamentaba el vertido de aguas residuales

Resumen de las normas complementarias:

Primera.—De acuerdo con lo señalado en el número primero del artículo cuarto del Decreto de 8 de octubre de 1959 sobre Comisarías de Aguas, en relación con los artículos segundo, tercero y decimoprimero del Reglamento de Policía de Aguas y sus Cauces, y de acuerdo también con lo que establece la Orden ministerial de 4 de setiembre de 1959 *que reglamenta el vertido de* aguas residuales, corresponde a dichas Comisarías conocer de los asuntos referentes a esta materia propios de la competencia del Ministerio de Obras Públicas, con arreglo a las disposiciones vigentes, las que resolverán, previo informes de las Jefaturas del Servicio Nacional de Pesca Fluvial y Caza, de acuerdo con lo establecido en la Ley de 20 de febrero de 1942 y Reglamento de 6 de abril de 1943, y de las Jefaturas Provinciales de Sanidad, conforme lo determina el artículo II del Reglamento de Policía de Aguas y sus Cauces, de 14 de noviembre de 1958, y de las Delegaciones Provinciales de Industria, según establece el Decreto de 30 de noviembre de 1961, que reglamenta la instalación de actividades molestas, insalubres, nocivas y peligrosas.

Segunda.—A los efectos señalados en el artículo primero de la Orden de 4 de setiembre de 1959, se entenderán por aguas residuales las que de algún modo, produzcan alteraciones perjudiciales en las características físicas, químicas, bateriológicas y biológicas de las aguas públicas a las cuales aquéllas vierten y las que arrastran o llevan en suspensión cuerpos sólidos.

Se entenderá por vertido directo el realizado inmediatamente sobre un curso de aguas, cauce público o canal de riego, y por vertido indirecto, el que no reúna esta circunstancia, como el realizado en azarbes, canales de desagües y pluviales, etcétera.

Tanto para la calificación de las aguas *residuales* a los *efectos señalados* en este artículo, como en relación con todo lo referente a las solicitudes y autorizaciones que de su vertido se hagan según establecen los artículos tercero y quinto de esta Orden, las Comisarías de Aguas, de acuerdo con lo que establecen el artículo 39 de la Ley de Procedimiento y el artículo II del Reglamento de Policía de Aguas y sus cauces, solicitarán preceptivamente informe de la Jefatura Provincial de Sanidad y del Servicio Nacional de Pesca Fluvial y Caza correspondiente.

Anexo 11

Tercera.—En las solicitudes de autorización para nuevos vertidos, produzcan o no daño, se hará expresa mención de los siguientes extremos:

a) Corriente de agua en la que ha de realizarse el vertido.

b) Término municipal en el que haya de establecerse, así como también aquellos otros datos necesarios que permitan identificar el punto concreto del mismo.

c) Volúmenes medio y máximo en litros por segundo de las aguas residuales vertidas.

d) Velocidad máxima de las mismas.

e) Procedencia del vertido.

f) Naturaleza y composición de las aguas residuales.

g) Si el vertido arrastrase o llevase en suspensión sustancias sólidas, el grado máximo de enturbiamiento previsible.

h) Proyecto de depuración o corrección de las aguas residuales, cuando *estas operaciones fueran necesarias, suscrito por un técnico autorizado,* de acuerdo con lo que establece el artículo II del Reglamento de Policía de Aguas y sus Cauces. En tales casos se procurará disminuir el caudal instantáneo de las aguas vertidas.

i) Naturaleza jurídica de las aguas vertidas, acreditando la propiedad, si son privadas, o la concesión e inscripción en el Registro del Aprovechamiento de Aguas públicas, si tuvieran este carácter.

Tales datos técnicos se harán constar en los libros del censo de aguas residuales de la Comisaría de Aguas, añadiéndose una referencia a la clase y naturaleza de los aprovechamientos inferiores que hayan de utilizar las aguas que discurren por el cauce receptor.

Cuarta.—Las Comisarías de Aguas podrán autorizar el vertido de aguas residuales cuando el tratamiento propuesto de las mismas fuese técnicamente suficiente; en caso contrario, señalarán las modificaciones oportunas, que deberán ser recogidas, en su nuevo proyecto, el cual someterá el solicitante a su debida aprobación, siguiendo a su vez los trámites, señalados en el apartado tercero del artículo segundo de esta Orden. Estas autorizaciones no eximirán a los concesionarios del pago de los daños y perjuicios que puedan ocasionar a la riqueza piscícola afectada.

Quinta.—Todo aquel que realice vertido de aguas residuales está obligado a mantener las aguas del cauce que las recibe en el grado de pureza que se señale en la autorización otorgada.

A tal efecto, las autorizaciones de vertido deberán, valorando la corriente receptora aguas abajo del punto de vertido, determinar expresamente las condiciones extremas que se autorizan sobre las características siguientes, que pueden ser completadas con otras **específicas en casos especiales**.

A) *Características organolépticas:*

a) Color.

b) Sabor.

c) Olor.

B) *Características fisicoquímicas:*

a) Temperatura.

b) pH.

c) Enturbiamiento.

d) Dureza.
e) Materia en suspensión.
f) Radiactividad.

C) *Características químicas:*
a) Agresividad.
b) D.B.O.
c) Oxígeno.
d) Nitrógeno (NH_3)
e) Nitrógeno (nitratos).
f) Cloruros (Cl).
g) Sustancias tóxicas.
h) Putrescibilidad.
i) Materia orgánica.
j) Fenoles.
k) Aceites y grasas.

D) Características biológicas.

Sexta.—Las Comisarías de Aguas, con el personal de la Guardería Fluvial a sus órdenes, comprobarán especial y periódicamente el grado de conservación de las aguas que discurren aguas abajo del punto de vertido de acuerdo con las condiciones fijadas en la autorización.

Si la práctica demostrase ser insuficiente el tratamiento autorizado, en relación con la impurificación de las aguas del cauce receptor, las Comisarías de Aguas, a fin de conseguir las condiciones señaladas en el apartado anterior, podrán obligar al que realice vertido a ejecutar las obras y llevar a cabo el tratamiento complementario necesario para el logro de aquel fin.

Séptima.—Las disposiciones que sobre vertido de aguas residuales establecen tanto el Reglamento de Policía de Aguas y sus Cauces como la Orden ministerial de 4 de setiembre de 1959, serán de aplicación para todos los casos en que se produzcan vertidos, independientemente de que los mismos sean consecuencia o no de una concesión o autorización administrativa de aprovechamiento de aguas públicas; por tanto, estarán sometidos a las mencionadas normas y deberán proveerse de la correspondiente autorización todas aquellas industrias, establecimientos, granjas, centros de producción, etc., que viertan o pretendan verter aguas residuales en un cauce público por el mero hecho del vertido, o previamente a tramitar ante la autoridad local el oportuno expediente de establecimiento de su nueva actividad.

Octava.—La clasificación de los ríos establecida en el artículo sexto de la Orden ministerial de 4 de setiembre de 1959 se llevará a efecto atendiendo a las dos finalidades señaladas en la exposición de motivos de la mencionada Orden y a la de valoración por la Administración de la graduación real de impurificación de los cursos de aguas, siguiendo también en este caso la tramitación recogida en el artículo II del Reglamento de Policía de Aguas y sus Cauces, y a la que ya se refiere el artículo segundo de esta misma Orden. Para ello el grado de impurificación de dichos cursos se determinará en función del grado que lleven las aguas vertidas y el de las del cauce sobre las que vierten, al objeto de que las características físicas, químicas y biológicas resultantes en el agua pública sean las adecuadas a los fines y empleos que aguas abajo tengan las que discurran por el cauce receptor.

Anexo II

Novena.—El orden establecido en la clasificación de los cursos de agua de que habla el artículo anterior, señalado a su vez según la tramitación recogida en el mismo, se fijará atendiendo al grado de impurificación admitido, en razón de la especial protección gradualmente decreciente que dichos cursos requieren.

En tal sentido, los cursos de agua protegidos, por estar destinados al abastecimiento de agua potable a poblaciones, se someterán a las disposiciones sanitarias sobre la materia y en especial al Real Decreto de 17 de setiembre de 1920.

Los cursos de agua vigilados deberán ser objeto de particular atención por la índole misma de los aprovechamientos de sus aguas, tales como pesca, riegos, abrevaderos, industrias de carácter especial, etc. A tal efecto, las Comisarías de Aguas establecerán las condiciones de autorización a que hace referencia el artículo quinto de la presente Orden, fijadas de acuerdo con las distintas normas técnicas de aplicación, según la naturaleza de los aprovechamientos que se trate de proteger.

Los cursos de agua normales no requerirán protección especial por no exigirlo así los aprovechamientos que existen en los mismos, tales como los hidroeléctricos, usos industriales, etc. Por tanto, de acuerdo con lo establecido en el párrafo segundo del artículo sexto de la Orden ministerial de 4 de setiembre de 1959, podrán en principio ceder sus aguas para otros usos que requieran un tipo de composición de agua común.

Los cursos de aguas industriales podrán en principio admitir cualquier grado de impurificación, por estar utilizadas en su totalidad para usos o aprovechamientos en los que no se precisa especial calidad en las aguas, pudiendo incluso autorizarse el no establecimiento de sistemas purificadores.

Décima.—Para la clasificación de las corrientes de agua, así como para el otorgamiento de las autorizaciones de los vertidos de las residuales, se tendrá en cuenta la importancia del caudal sobre el que viertan éstas. A tal efecto, el caudal tomado en consideración para los cursos de agua correspondientes al grupo primero del artículo sexto de la Orden ministerial de 4 de setiembre de 1959, será el caudal medio que circule en los periodos de estiaje normal, y el de los grupos segundo, tercero y cuarto, el deducido como más frecuente entre los aforados en el cauce receptor durante los últimos cinco años.

Decimoprimero.—El personal de las Comisarías de Aguas está autorizado para recoger muestras de aguas residuales y demás residuos que se consideren necesarios para determinar su grado de impurificación. En cumplimiento de su misión podrán visitar, previo aviso o no, y cuantas veces se estime oportuno, las instalaciones y lugares de vertido, debiendo los titulares del mismo proporcionar la información que se les solicite a fin de facilitar su trabajo.

5.2.2. VERTIDOS AL MAR

Por orden del Ministerio de Obras Públicas, de 29 de abril de 1977 (B.O.E. de 25-6-77) se aprueba la **«Instrucción para vertido al mar, desde tierra, de aguas residuales a través de emisarios submarinos».**

Se definen, en ella, criterios de calidad de las aguas según las características y uso de las zonas receptoras de los vertidos; se establecen límites de los parámetros indicadores de calidad de las aguas receptoras y del efluente antes del vertido, se tipifican los datos y parámetros en que ha de basarse el proyecto del emisario y se cuantifican los procesos de dilución inicial, dispersión superficial y reducción en el tiempo de la actividad de microorganismos y compuestos químicos. Por último, se destaca la importancia de una adecuada elección de los materiales que constituyen el emisario submarino y se recomiendan procedimientos idóneos para la construcción del mismo.

Se transcriben a continuación los artículos relativos a características de las aguas del mar y de los efluentes, así como a los tratamientos que deberán aplicarse.

. . . .

ARTICULO 2.º
Calidad de las aguas del mar

2.1. *Calidad*

La calidad de las aguas del mar ha de referirse a unas condiciones físico-químicas y biológicas, naturales o de origen, a partir de las cuales se puede establecer la incidencia que en las mismas tiene la presencia de sustancias o microorganismos incorporados al medio marino.

La capacidad de recepción de tales sustancias o microorganismos por parte del citado medio está íntimamente relacionada con el mantenimiento de un nivel de calidad determinado, expresado por los límites de unos parámetros indicadores (1).

2.2. *Parámetros indicadores*

Los parámetros indicadores y sus límites se establecen para determinadas zonas en que son prevalentes ciertos usos y/o poseen determinadas características y que se clasifican en:

Zonas de baños.
Zonas de cultivos marinos.
Zonas limitadas.
Zonas especiales.
Otras zonas.

Cuando por la naturaleza del efluente o por las características especiales del medio receptor la Administración lo juzgue conveniente, se podrán imponer además otros parámetros indicadores de la calidad de las aguas, o variar los límites establecidos, realizando para ello las investigaciones oportunas.

(1) El ideal sería poder establecer tales parámetros y sus límites para cada uno de los usos previsibles de las aguas del mar, teniendo en cuenta su incidencia sobre el medio marino y a un nivel tal que no se sobrepase la capacidad de asimilación del mismo.

La realidad es que la fijación de tales parámetros y sus límites es objeto actualmente de vivas polémicas para algunos de ellos (microorganismos, metales pesados), mientras que para otros apenas se han traspasado los límites de las investigaciones previas.

Los parámetros y límites que aquí se definen lo son con las reservas que impone el estado actual de los conocimientos y a la espera de logros ulteriores avalados por las investigaciones pertinentes.

2.2.1. Zonas de baño

Los parámetros indicadores y sus límites son los siguientes:

Parámetros bacteriológicos:

La concentración de E. coli correspondiente a un período de treinta días consecutivos no deberá ser superior a 1.000/100 ml. en más del 10 por 100 de las muestras, ni superior a 200/100 ml, en más del 50 por 100 de las muestras.

Parámetros físicos:

Partículas flotantes, espumas, aceites y grasas no perceptibles.

Color y olor no diferenciales del estado natural.

Transparencia, medida por el disco de Secchi, ≥ 1,5 metros.

Parámetros químicos:

Índice de saturación en oxígeno superior al 80 por 100.

pH comprendido entre 7 y 9 sin sobrepasar en ± 0,5 unidades estos límites.

2.2.2. Zonas de cultivos marinos

Los parámetros indicadores y sus límites son los siguientes:

Parámetros bacteriológicos:

La concentración de E. coli no deberá ser superior a 50/100 ml, en más del 10 por 100 de las muestras, ni superior a 15/100 ml. en más del 50 por 100 de las muestras.

Parámetros físicos:

Los señalados en 2.2.1.

Materias en suspensión, aumento máximo del 20 por 100 sobre las existentes en la zona, siempre que no sean nocivas y se mantenga el índice de saturación de oxígeno establecido.

La temperatura del agua receptora no deberá ser modificada en ningún momento en más de 3 °C sobre su valor natural presente.

Parámetros químicos:

Los señalados en 2.2.1.

Contenido en hidrocarburos, inferior a 10 μg/l

DBO_5, inferior a 10 mg/l

Sustancias tóxicas, metales pesados no superiores a los límites que señala el código alimentario para las aguas de bebida.

Parámetros biológicos:

El sabor, olor y color natural de los recursos marinos para consumo humano no deberán ser alterados.

2.2.3. Zonas limitadas.

En este apartado se comprenden las aguas de los estuarios, rías, calas y demás zonas donde la renovación del agua es muy lenta y donde se manifiestan elevadas concentraciones de flora y fauna marinas.

Además de tener en cuenta los parámetros indicadores de 2.2.1 y 2.2.2 cuando existan tales usos, es preciso establecer parámetros indicadores de la calidad del agua en dichas zonas para prevenir específicamente los efectos de la eutrofización (1).

Se indican a continuación ciertos criterios que pueden servir para señalar que se está alcanzando el umbral de la eutrofización:

Presencia en el agua del mar de sustancias nutrientes del orden de tres a cuatro veces la cantidad existente en las aguas naturales, supuesta conocida ésta.

Más de 20 mg/metros cúbicos de contenido en fósforo y más de 300 mg/metros cúbicos de contenido en nitrógeno.

Presencia anormal de cierta clase de algas y ausencia o disminución de otras (2).

2.2.4. Zonas especiales

Se refiere este apartado a aquellas aguas de acusado valor estético por su color o transparencia, o aquellas zonas de costa asignadas a reservas naturales de alto valor ecológico o paisajístico.

En ellas, y en ausencia de otros usos, son fundamentales los siguientes parámetros:

Parámetros físicos:

Sustancias que ocasionen turbiedad o cambios sensibles de color, ausencia total.

Sólidos flotantes no perceptibles.

Materias en suspensión y sedimentables no detectables.

Olor no perceptible.

Parámetros biológicos:

No deben registrarse cambios sensibles o degradantes en los ecosistemas de la zona.

2.2.5. Otras zonas

Se refiere este apartado a aquellas zonas que no posean en grado determinante los usos o las características que definen alguna de las anteriores zonas.

Como criterio de calidad genérico se establece que las sustancias vertidas no produzcan daños a la flora y fauna existente.

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(1) La eutrofización es un enriquecimiento en nutrientes de las aguas que ocasiona el estímulo de un conjunto de cambios sintomáticos tales como aumento de la producción de algas y macrofitos. Si este enriquecimiento permanece dentro de límites adaptados a las capacidades biológicas del agua, su efecto fertilizante será beneficioso; si es excesivo se producirán efectos degradantes de la calidad del agua del mar y la eutrofización se convertirá en una forma particular de contaminación. Las sustancias nutrientes de efecto más acusado son el nitrógeno y el fósforo.

(2) En el estado actual de conocimientos no es posible establecer tales parámetros y sus límites de forma precisa por cuanto la presencia del fenómeno de eutrofización depende en gran manera: a) de las características físico-químicas del agua, b) de su contenido en sales nutrientes y materias orgánicas, y c) de su productividad biológica o crecimiento de la biomasa en la unidad de tiempo.

Por ello los niveles que se mencionan lo son con las naturales reservas y pendientes de los estudios previos para evaluar los condicionantes a), b) y c) mencionados.

Artículo 3.º

Características del efluente

3.1. *Efluentes urbanos*

Con carácter indicativo y a efectos de establecer un instrumento comparativo entre el efluente y los fenómenos de dilución y dispersión en agua del mar, se establecen a continuación las siguientes cifras medias para un efluente solamente doméstico:

Materia orgánica en suspensión:		
Separable por decantación	270	
No separable por decantación	130	
		400 (mg/l)
Materia inorgánica en suspensión:		
Separable por decantación	130	
No separable por decantación	70	
		200 (mg/l)
Materia orgánica disuelta		330 (mg/l)
Materia inorgánica disuelta		330 (mg/l)
Sales nutrientes		30 p.p.m.
Detergentes		20 p.p.m.
DBO_5		380 (mg/l)
E. Coli		10^8/100 ml

enumeración que comprende nada más que los parámetros más significativos.

3.2. *Efluentes industriales*

Dada la complejidad de su composición, no es posible lograr una tipificación genérica de los vertidos industriales, pudiéndose citar a título indicativo y sin carácter exhaustivo la presencia de los parámetros principales siguientes:

3.2.1. Organolépticos:

Color.
Olor.

3.2.2. Físicos

Temperatura.
Turbiedad.
Materias en suspensión.
Radioactividad.

3.2.3. Químicos:

pH.
Dureza.
Sustancias corrosivas, ácidos o álcalis.
DBO y DQO.

Materia orgánica.
Cloruros, cianuros, sulfuros, fosfatos, nitratos.
Otros compuestos organohalogenados.
Metales pesados.
Fenoles.
Hidrocarburos, grasas, aceites, detergentes.

La concentración con que estos parámetros *(3.2.1, 3.2.2 y 3.2.3)* se encuentran en los efluentes industriales se define en base a:

La concentración derivada del propio proceso productivo.
La concentración resultante después de la aplicación de determinados tratamientos correctivos.
La concentración admisible en el efluente para su vertido (1).

3.3. Clasificación de sustancias

Las sustancias nocivas que pueden estar presentes en los efluentes se clasifican en clase I y clase II. La distribución de estas sustancias en cada clase se hace teniendo en cuenta los siguientes criterios:

a) La persistencia.
b) La toxicidad u otras propiedades nocivas.
c) La tendencia a la bioacumulación.

3.3.1. Clase I:

Sustancias que por su nocividad dan lugar a la adopción de medidas enérgicas para evitar la contaminación del mar por las mismas.

La presencia de sustancias de esta clase en un efluente dará lugar a un estudio especial para determinar si debe prohibirse el vertido o si pueden reducirse la concentración y cantidad de dichas sustancias a límites en que no se produzca contaminación.

Las sustancias de esta clase son:

Compuestos orgánicos halogenados y otras sustancias que puedan formar tales compuestos en el medio marino, con excepción de aquellos que sean biológicamente inocuos o que se transformen rápidamente en el mar en sustancias biológicamente inocuas.
Sustancias que tengan efectos cancerígenos.
Sustancias y desechos radioactivos.
Aceites e hidrocarburos persistentes de origen petrolífero.
Mercurio y sus compuestos.
Cambio y sus compuestos.
Plásticos y otras sustancias sintéticas persistentes que puedan flotar, quedar en suspensión o hundirse en el mar, obstaculizando gravemente cualquier uso legítimo del mismo.

(1) Es la concentración admisible en el efluente para su vertido la que interesa en esta instrucción, ya que es la que condiciona a cualquier otra, pero sería prácticamente imposible tratar de fijarla industria por industria y sustancia por sustancia, tarea ésta que es más propio que sea realizada a nivel individual de la industria que trata de verter o a nivel colectivo cuando por ejemplo se trata del vertido de un polígono industrial.

3.3.2. Clase II:

Sustancias que, si bien presentan caracteres análogos a los de la clase I y deben ser objeto de un control riguroso, son, sin embargo, menos nocivas o se hacen más rápidamente inocuas por un proceso natural.

La concentración de estas sustancias en los efluentes debe ser reducida a niveles que limiten severamente la contaminación de la zona.

Las sustancias de esta clase son:

Compuestos orgánicos del fósforo, silicio y estaño y sustancias que puedan originar tales compuestos en el medio marino, con excepción de aquellos que sean biológicamente inocuos o que se transformen rápidamente en el mar en sustancias biológicamente inocuas.

Antimonio, arsénico, cinc, cobre, cromo, níquel, plata, plomo, selenio y vanadio.

Plaguicidas y subproductos no incluidos en la clase I, ni entre los compuestos orgánicos de la clase II.

Hidrocarburos de origen petrolífero no incluidos en la clase I.

Cianuros y fluoruros.

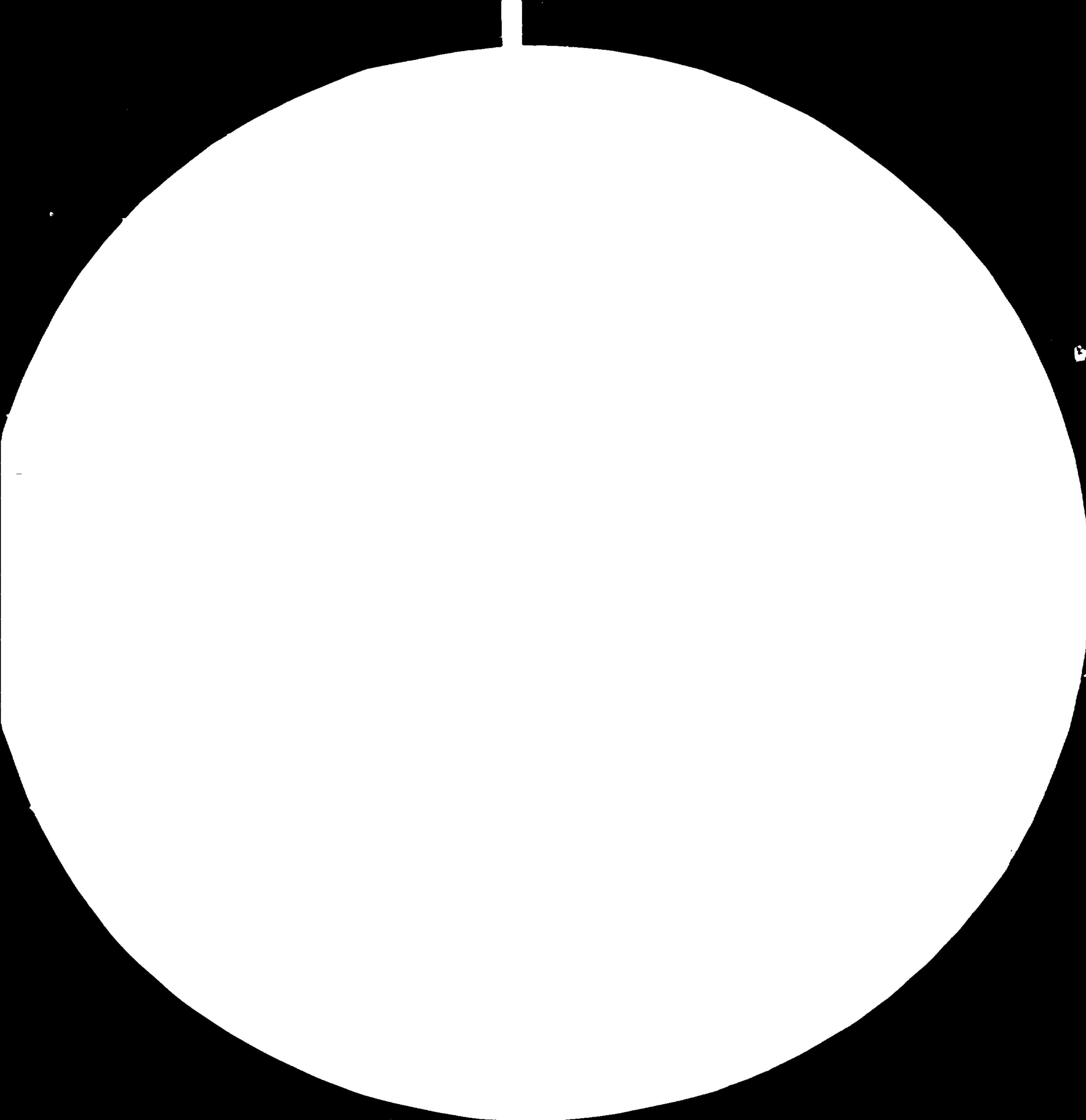
Sustancias productoras de espumas persistentes.

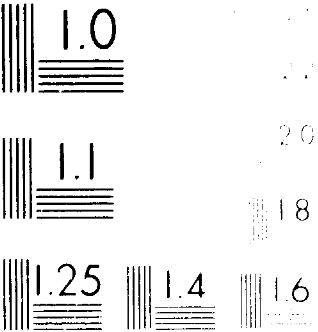
Sustancias que, aun sin tener carácter tóxico, puedan resultar nocivas a la flora y fauna marinas como consecuencia de las cantidades vertidas, o puedan reducir las posibilidades de esparcimiento.

La Administración se reserva la facultad de considerar para cada caso particular de vertido qué componentes del mismo, figuren o no, en la clase II, deben incluirse en la clase I y, por consiguiente, prohibir su vertido o exigir la reducción de su concentración a niveles tan bajos que no puedan producir contaminación de la zona.

A título indicativo se reseña a continuación una serie de parámetros de calidad de las aguas residuales y sus límites respectivos, elaborada por la Dirección General de Sanidad en su informe a la presente instrucción.

Hoja 30




1.0
1.1
1.25
1.4
1.6
1.8
2.0

Parámetro	Unidad de medidas	Concentración a no sobrepasar en más del	
		50 por 100 de muestras	10 por 100 de muestras
Gases y aceites	mg/l	1,0	2,0
Turbidez	UJT	50,0	75,0
pH	Unidades pH	entre 6,0-9,0, en todo momento	
Cadmio	mg/l	0,5	1,0
Cromo total	mg/l	1,5	3,0
Cobre	mg/l	0,5	1,0
Plomo	mg/l	7,5	15,0
Mercurio	mg/l	0,05	0,10
Níquel	mg/l	5,5	11,0
Plata	mg/l	0,025	0,25
Cinc	mg/l	3,5	7,0
Arsenio	mg/l	3,0	6,0
Cianuros	mg/l	5,0	10,0
Cloro residual total	mg/l	1,0	2,0
Compuestos fenólicos	mg/l	0,5	1,0
Amoníaco (como nitrógeno)	mg/l	40,0	60,0
Hidrocarburos clorados	mg/l	0,003	0,006
Toxicidad	ut	7,5	10,0

Artículo 4.º

Tratamientos

En principio no podrá verterse al mar ningún efluente que no haya sido objeto del adecuado tratamiento, entendiendo por tal el preciso para no sobrepasar la capacidad de recepción del medio marino e imposibilitar o restringir sus legítimos usos.

4.1. Efluentes urbanos

En el caso de los efluentes de aguas procedentes de usos domésticos, se definen los siguientes tratamientos:

4.1.1. Tratamiento previo

Se entenderá por tal el tratamiento destinado a la eliminación de las siguientes sustancias:

Materias gruesas flotantes o no.
Materias minerales sedimentables.
Aceites, grasas y espumas.
La eliminación se realiza mecánicamente mediante rejillas, decantadores y raseros.
Las reducciones conseguidas normalmente mediante este tratamiento son:

	Porcentaje
DBO_5	10
Materias en suspensión	20
Coliformes	10

No son admisibles soluciones a base de dilaceración.

4.1.2. Tratamiento primario

Comprende la eliminación de las materias finas en suspensión por procedimientos como:

Sedimentación.
Floculación mecánica o química.
Filtración (arena).
Flotación por aire disuelto.
Las reducciones conseguidas normalmente mediante este tratamiento son:

	Porcentaje
DBO_5	50
Materias en suspensión	70
Coliformes	75

4.1.3. Tratamiento secundario

Comprende la eliminación de materias orgánicas no sedimentables (disueltas, semidisueltas y muy finas), mediante:

Lechos bacterianos.
Fangos activados.
Estanques de oxidación.
Lagunas de estabilización.
Fermentación.
Las reducciones conseguidas normalmente mediante este tratamiento son:

	Porcentaje
DBO_5	80
Materias en suspensión	90
Coliformes	95

4.1.4. Tratamiento terciario

En determinados casos y como complemento de los tratamientos anteriores, para eliminar las sustancias nutrientes (fosfatos, nitratos), las bacterias patógenas, ciertos metales y pesticidas, con procedimientos tales como:

Carbones activos.
Osmosis inversa.
Cloración.
Químicos diversos.

Deben realizarse preferentemente después de los tratamientos anteriores y las reducciones obtenidas dependen de la calidad del efluente, de la naturaleza del tratamiento y del grado de intensidad del mismo. En el caso de la cloración deberá tenerse en cuenta el tiempo mínimo de contacto, su repercusión sobre la flora y fauna marinas y que no se produzcan compuestos tóxicos.

4.2. Efluentes industriales

Se establecen como principios generales de tratamiento de estos efluentes.

a) Reducir el consumo de agua mediante utilización de técnicas industriales nuevas.

b) Reducir las materias nocivas por una mejora de las técnicas de depuración.

c) Reciclar las aguas.

En ciertos casos se tratará de reducir en el efluente la DBO y la DQO, materias en suspensión, ciertas bacterias, en cuyo caso pueden aplicarse los tratamientos descritos anteriormente.

En otros procesos las aguas habrán de sufrir ciertos tratamientos químicos para eliminar de ellos sustancias tóxicas, corrosivas, metales pesados, elementos productores de espumas y colorantes, entre otros.

Para cada industria o grupo de industrias (caso de los polígonos industriales) los tratamientos deberán ser los adecuados para eliminar aquellas sustancias que no deban estar presentes en los efluentes, o para evitar que otras sobrepasen los grados de concentración máximos admisibles fijados.

Para normalizar tanto la toma de muestras como los análisis, y alcanzar resultados concordantes en relación con la eficacia de los tratamientos realizados, se incluirá en la instalación de vertido, siempre que sea posible, una estación para toma de muestras.

5.2.3. VERTIDOS INDUSTRIALES

- **Regulación de la emisión de contaminantes**

Se encuentra en estudio, por el Ministerio de Industria y Energía, la fijación de niveles de emisión de contaminantes de las aguas, exigibles a las industrias.

Este estudio permitirá establecer unos «índices básicos de calidad de efluentes», que tendrán por finalidad definir las exigencias básicas en materia de depuración, para cada una de las distintas actividades industriales, potencialmente contaminadoras, y que se incluirán en el texto de una nueva disposición del Ministerio citado, de próxima promulgación.

5.2.4. REFERENCIAS DE TEXTOS LEGISLATIVOS Y REGLAMENTACIONES (AGUAS RESIDUALES URBANAS E INDUSTRIALES)

Fecha	B.O.E.	Naturaleza	Objeto	Organismo
1958	—	Decreto de 14-11-58	Aprobando Reglamento de Policía de Aguas y sus Cauces.	Ministerio de Obras Públicas
1959	—	Orden de 4-9-59	Se reglamenta más detalladamente el vertido de aguas residuales	Ministerio de Obras Públicas
1960	—	Orden de 23-3-60	Se aprueban normas complementarias que regulan la aplicación de la del 4-9-59	Ministerio de Obras Públicas
1960	—	Circular de 21-6-60	Instrucciones y valoración de las diversas características que corresponden a las aguas de los cauces públicos, según su clasificación establecida por O.M. de 4-9-1959	Dirección General de Obras Hidráulicas
1961	—	Decreto de 30-11-61	Aprueba el Reglamento de Actividades Molestas, Insalubres, Nocivas y Peligrosas	Presidencia del Gobierno
1962	—	Orden de 9-10-62	Normas complementarias que regulan la aplicación de la de Obras Públicas de 4-9-1959	
1966	12-8 10-9	Decreto 2.013/1966 Decreto 2.237/1966	Modificando artículos de la Ley de Pesca Fluvial, de 1943	Ministerio de Agricultura
1967	25-7	Decreto 1.775/1967	Régimen de instalaciones, ampliación y traslado de industrias	Ministerio de Industria

Fecha	B.O.E.	Naturaleza	Objeto	Organismo
1969	20-6	Orden de 23-4-69	Normas provisionales para el proyecto y ejecución de instalaciones depuradoras y de vertido de aguas residuales al mar en las costas españolas	Ministerio de Obras públicas
1971	18-1	Decreto 3.787/1970	Requisitos mínimos de infraestructura en los alojamientos turísticos	Ministerio de Información y Turismo
1972	14-4	Decreto 888/1972	Se crea la Comisión *Interministerial para el* Medio Ambiente	Presidencia del Gobierno
1972	6-6	Decreto 1.375/1972	Se modifican los capítulos IV y V del Reglamento de Policía de Aguas y sus Cauces	Ministerio de Obras Públicas
1973	10-3 21-5	Orden de 21-2-73 Orden de 17-5-73	Relativas a medidas contra la contaminación de los ríos guipuzcoanos	Presidencia del Gobierno
1974	16-1	Orden de 9-1-74	Norma Tecnológica de la edificación NTE-ISD/1974 - «Instalaciones de salubridad: depuración y vertido»	Ministerio de la Vivienda
1975	21-11	Ley de 19-11-75, n.º 42/75	Recogida y tratamiento de desechos y residuos sólidos urbanos	Jefatura del Estado
1977	4-2	Decreto 3.263/1976 (título IV)	Reglamentaciones técnico-sanitarias. Mataderos, Centros de contratación, almacenamiento y distribución de carnes y despojos	Presidencia del Gobierno

Fecha	B.O.E.	Naturaleza	Objeto	Organismo
1977	16-3	Decreto 378/197	Derogación parcial del decreto 1.775/1967 sobre instalaciones, ampliaciones y traslados de industrias	Ministerio de Industria
1977	14-6	Decreto 1.310/1977	Actualiza la organización y funcionamiento de la Comisión Interministerial del Medio Ambiente	Presidencia del Gobierno
1977	25-6	Orden de 29-4-77	Instrucción para el vertido al mar, desde tierra, de las aguas residuales, a través de emisarios submarinos	Ministerio de Obras Públicas

5.3. Textos diversos

- **Alojamientos turísticos**

Decreto 3.787/1970, del 19 de diciembre de 1970 (Información y Turismo) sobre requisitos minimos de infraestructura en los alojamientos turísticos.

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Art. 1.º Uno. Quedan sujetos a las prescripciones del presente Decreto todos los establecimientos hoteleros y de alojamiento turístico definidos en los artículos cuarto y quinto de la Ley 48.963, de 8 de julio, cualesquiera que sean su naturaleza y régimen de explotación con una capacidad igual o superior a 50 plazas.

Dos. Asimismo se sujetarán a las prescripciones del presente Decreto, aun cuando no sean objeto de explotación mercantil, los edificios con 10 o más apartamentos y los conjuntos de 10 o más villas o «bungalows» con servicios comunes dentro de una urbanización que constituyan una segunda residencia para sus propietarios o arrendatarios con motivo de sus vacaciones.

Art. 2.º Los alojamientos comprendidos en el artículo anterior estarán dotados de las instalaciones de infraestructura que se relacionan a continuación, sin perjuicio de las exigencias reglamentarias que sean de aplicación en virtud de competencias concurrentes y de los requisitos que se determinan en los reglamentos vigentes para obtener la licencia de apertura y funcionamiento en cada caso.

a) Agua potable.

b) Tratamiento y evacuación de aguas residuales.

c) Electricidad.
d) Accesos.
e) Aparcamiento.
f) Tratamiento y eliminación de basuras.

Art. 3.º Agua potable.

Uno. Será obligatorio que el agua destinada al posible consumo humano reúna las condiciones de potabilidad química y bacteriológica que determinan las disposiciones vigentes.

Dos. En defecto de abastecimiento de agua procedente de una red general de agua potable o cuando existan indicios de que dicha red puede ser fácilmente contaminada, será preceptivo disponer de una instalación automática de depuración, por lo menos bacteriológica, de manera que el agua tratada posea las condiciones previstas en la legislación vigente para el abastecimiento de poblaciones.

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Art. 4.º Tratamiento y evacuación de aguas residuales.

Uno. La evacuación de aguas residuales deberá realizarse en las debidas condiciones técnicas, a través de la red de alcantarillado.

Dos. De no existir dicho alcantarillado o resultar insuficiente para absorber las aguas residuales procedentes de nuevas construcciones, el tratamiento y evacuación de dichas aguas se efectuará mediante estación depuradora —particular o colectiva— de las del tipo de oxidación total con una capacidad de depuración proporcionada al número de plazas del establecimiento o alojamiento de donde aquéllas procedan.

Tres. No eximirá el tratamiento depurador a que se refiere el número anterior el que se empleen emisarios submarinos para la evacuación de las aguas residuales.

Cuatro. En cualquier supuesto, el vertido de aguas residuales tanto al mar como a aguas continentales en parajes, áreas o zonas de utilización turística no podrá efectuarse sin su previa depuración.

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Art. 9.º

Tres. No será en ningún caso dispensable lo preceptuado en los números uno y dos del artículo tercero, en los números tres y cuatro del artículo cuarto y en el número tres del artículo octavo.

- **Contaminación atmosférica**

— La Ley 38/1972 (B.O.E. de 26.12.72) de Protección del Ambiente atmosférico, establece las líneas generales de actuación del Gobierno y servicios especializados de la Administración Pública, para prevenir, vigilar y corregir las situaciones de contaminación atmosférica, cualesquiera que sean las causas que la produzcan.

— El decreto 833/1975 del Ministerio de Planificación y Desarrollo (B.O.E. del 22.4.75) desarrolla la Ley anterior mediante las disposiciones reglamentarias necesarias para la mayor eficacia de su puesta en práctica. Se extractan del mismo los párrafos siguientes:

Anexo IV — Niveles de emisión de contaminantes a la atmósfera...

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Anexo II