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A CASE STUDY ON THE ESTABLISHMENT OF EXPORT-ORIENTED OILSEED PROCESSING INDUSTRIES IN DEVELOPING COUNTRIES 1/

prepared by

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for presentation

at the Interregional Seminar on the Generalized System of Preferences (G.S.P.) for Asian and Latin American Countries organized by the UNCTAD Secretariat

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Introduction

The Second General Conference of UNIDO, held in Lima, Peru, in March 1975, declared that in view of the low share of developing countries in total world industrial production, their share should be increased to the maximum possible extent and to at least twenty-five per cent of the total world industrial production by the year 2000.

The General Assembly of the United Nations, at its seventh special session in September 1975, endorsed the Lima Declaration and Plan of Action on Industrial Development and Co-operation and UNIDO was directed to establish a system of consultations in the field of industry between developed and developing countries.

The vegetable oil industry as a basic agro industry was selected by UNIDO for discussion at a First Consultation Conference held in Madrid, Spain, from 12 to 16 December 1977. One hundred and forty participants from developing and developed countries exchanged views on the global development of the vegetable oil industry and particularly considered the prospects for the growth of the vegetable oils and fats industry up to 2000 throughout the world. Forms of international co-operation were discussed that might be needed to establish new production capacity in developing countries and the action required to follow up the First Consultation Meeting was outlined.

The Meeting concluded that because of the near saturation of the oils and fats market in some developed countries, the further market development would take place mainly in developing countries. Meaningful efforts should be made to secure a substantial increase in the production of oil bearing raw materials in developing countries for subsequent processing and install relevant processing capacities. To facilitate vegetable oil industry development in developing countries, industrialists from developed countries could increasingly import processed goods from developing countries but would continue to replace and expand existing equipment as indicated by market factors. Any increase in the processing capacity would have to be based on normal techno-economic viability considerations.

The Meeting further concluded that co-operation between developed and developing countries should be established in order to permit an increase of oil bearing raw material production, prepare feasibility studies, increase primary and secondary processing capacities in developing countries, ensure product quality, assist in organizational and managerial aspects and in equipment manufacture and strengthen research and development. It was considered desirable to strengthen international co-operation in its various forms with regard to appropriate vegetable oil industry development.

The Meeting considered it appropriate to carry out relevant surveys and studies in the oil bearing raw material sector, the infrastructural requirements and to collect as much as possible specific information about the situation in developing countries as the basis for efficient vegetable oil industrialization. Increased technical co-operation between the developing and developed countries and among the developing countries is needed on all the technical and economic aspects involved in the improvement and expansion of the developing countries' vegetable oil and related industries including feedstuff production and equipment manufacture.

In the light of the conclusions and recommendation of the First UNIDO Consultation Conference, this paper was prepared. It is oriented towards the establishment of a vegetable oil export industry in developing countries and deals with the main aspects to be considered in this context from a practical point of view but does not claim to be exhaustive.

I. The market and its impact on a processing industry

1. When considering the establishment of an industry an industrialist should carefully study and evaluate three important factors that doubtlessly are the key for the processing industry's success or failure. These factors are in the order of priority a) the market for the products to be produced; b) the processing technology to be applied for the production of the products in demand from suitable raw materials; and c) the availability of the required raw materials.

2. The first step is a market evaluation study that has to result in the definition of the type of product in demand, the required quantity and particular quality and last but not least the market price structure and visible price development trends.

3. As a second step, the most suitable processing technology needs to be considered that permits the production of the type, quantity and quality of the products in demand from suitable raw materials at production costs that are in line with the product market price structure.

4. Only as a third step the raw material availability has to be reviewed and measures be envisaged that guarantee the timely correct supply of the required raw materials with regard to quantity and quality. The storage facilities needed in this context and transport means and ways are to be defined and the resulting financial implications considered.

5. The considerations mentioned under paragraphs 1 to 4 above, admittedly, are of a theoretic nature but they very clearly show the importance of the market influence on the processing industry. Any industrial production has in the first instance to be market-oriented in order to be successful. It is the market that dictates every detail of an industrial production and not the raw materials that might be available for processing. Experience has taught that a purely raw material oriented processing industry will fail sooner or later because of marketing problems.

6. Considering these facts it goes without saying that the setting-up and operation of an export industry is by far more problematic than an industrial production for domestic markets although the market orientation principle is equally valid. The international market follows different rules and regulations that are generally more complicated, the risk is higher for an industrialist and requires a considerable amount of overall flexibility.

II. The "two market situation"

7. The general considerations as outlined under paragraphs 1 to 6 are particularly valid for the vegetable oil industry and receives even greater importance if one reviews the international market situation for vegetable oils and fats and protein oil cakes and meal.

8. The oilseed processing industry necessarily has to produce two different products, namely the vegetable oil and the protein meal/cake. It is often wrongly taken for granted that the main product is the oil and the by-product is the meal or cake. One should be aware of the fact that both products are main products that have to be effectively marketed in order to maintain an economically efficient industrial production. This situation results in the fact that an oilseed processing industry has to enter two different markets with its products. The two markets follow independent rules and hardly any relation exists between them.

9. There are very few exemptions to the "two market situation", namely only those industries that process oil bearing raw materials with no protein component. This is in the first instance the palmoil industry. It is not difficult to realize that a large supply of oil that is not connected with a relevant supply of protein meal has to disturb the market supply balance of the two products in favour of the oil. This fact has some bearing on the vegetable oil industry in general and makes valid market evaluations as the basis for the setting-up and operation of an export oriented vegetable oil industry even more difficult.

10. The vegetable oil industry as a basic agro-industry necessarily stimulates to a great extent the agriculture as it provides the market for agricultural raw materials (oilseeds). But it also stimulates the setting-up of related industries that again provide the market for its products. In this connexion the strong links have to be pointed out that exist between the vegetable oil industry and the animal feed industry a very important raw material component of whioh are protein oakes and extracted meal.

III. The market for the products produced by the vegetable oil industry

11. In developed countries the per capita consumption level of 20 to 25 kg per year is already extremely high. A further increase of the per capita income will hardly lead to any substantial increase in consumption of oils and fats. It can safely be assumed that the markets of the developed countries in general is very close to saturation.

12. From the individual consumption view point, the market demand in developed countries has been experiencing a continuous change towards soft oils with predominantly unsaturated fatty acid molecular structures. This is partly due to the growing availability of "soft" oils (soyabean oil) but also greatly influenced by the belief that saturated fatty acid fats may cause a health problem.

13. In the developing countries the up-ward change of the per-capita consumption of oils and fats in line with the population growth is a powerful determinant of an increasing demand for vegetable oils and fats. In many developing countries the level of effective demand for fats and oils is rising faster that the rate of domestic supplies. This is partly due to a steadily rising income of the population, the growth of the population and an oilseed processing industry that requires technical updating and economic and organizational improvement. Last but not least, existing oilseed production potentials are not yet fully utilized.

14. While there is no question about the high and increasing market demand for vegetable oils in developing countries, the individual demand is more difficult to assess and requires case by case investigation. Traditional eating habits play an important role, the climatic conditions and also the packaging and distribution requirements.

15. When investigating a market one should be aware of the fact that with the aide of modern technology, nearly all vegetable oils are substitutable to a very high degree both for each other and also for animal fats and marine oils. The consumer and particularly the manufacturer of food products using vegetable oil normally has a wide choice and will, therefore choose the readily available product with the most reasonable price.

16. A new set of variables comes into play when considering the markets for oil cakes and protein meal. Substitution, although possible, is constrained by the nutritional requirements of the feedstuff industry. The demand for cakes/meal is, threfore, dependent on the demand in consuming countries for lifestock production and finally meat consumption. Again, in both developing and developed countries the determining factors are income in conjunction with population levels.

17. In the developed countries, the oilseed protein feed market still has an increasing tendency but is characterized by an extreme sensitivity with regard to quality and price. Exports of oilseed protein to the developed countries have to oompete with soyabean meal which is predominantly produced in developed countries and which still is the market price indicator.

18. In the developing countries hardly any large scale animal feed industry exists. However, measures have been taken in most of them to improve the lifestock production sector which necessitates the industrial production of mixed compounded animal feed. As a first step the poultry farming sector is rapidly increasing which goes along with an increased demand of animal feed and subsequently oilseed protein meal.

19. In conclusion it needs to be pointed out that a vegetable oil export industry to be set up or in operation in developing countries will have to very carefully consider exports to developed countries prior to entering the very competitive international hard currency market. An industry will have to be especially designed to meet these requirements. However, there is a very good opportunity for exports from one developing oountry to another in oase special agreements can be entered into that form the basis for mutual trade benefits. All developing countries with a vegetable oil industry potential and interested in exports of vegetable oils and fats as well as oilseed protein products should, therefore, be encouraged to conclude relevant co-operation agreements among themselves in order to oreate the basis for modern vegetable oil industrialization based on mutually benefioial international trade.

IV. The oilseed processing export industry

IV/1 The throughput capacity

20. An oilseed processing factory is one of those industries that has to follow the principles of the up-ward economy of scale. The production capacity should, therefore, be as large as feasible based on modern processing technologies, up-to-date equipment and efficient management.

21. The traditional oilseed processing industry of many developing countries is characterized by many small scale factories solely using the mechanical pressing technology. It may be pointed out in this context that small scale factories can never get successfully engaged in exports. Their products are not competitive with regard to the quantities and uniform quality of the oilseed products in demand of the international market. To cope with the market requirements, priority has to be given to industrial processing operations which have different rules and economic criteria than small scale oil milling activities and clearly point towards large scale production.

22. Large scale operations have a very favourable influence on the production costs of an oilseed processing factory which are an important factor in product price calculations specifically with regard to the vegetable oil market, the price structure of which is not very favourable indeed. Large quantities of products to be shipped also very advantageously effect the freight charges which is another important factor in the overseas trade with partioular emphasis laid on meal shipments.

IV/2 The structure

23. The location of an oilseed prooessing expcrt factory plays a very important role as it has a considerable impact on the transport and storage costs of either raw materials or products. Raw material transport costs are normally higher than product transport costs as the volume and weight of hulls and shells is still included. Despite this fact, an export industry should be located in urban areas with an as effioient as possible infrastructure and easy access to loading and unloading facilities at harbours, railway or truck stations.

24. A vital element in the operation of an oilseed processing export industry is the secured supply of raw materials which has to permit the factory to operate twenty-four hours a day and in an average 300 days per year. The required raw material has, therefore, to be secured by long term contracts with local and - if required - foreign suppliers.

25. Assuming that an oilseed processing factory has a daily throughout capacity of 300 tons of oilseeds, which is only medium size, the required storage capacity will have to be 9000 tons for only one month. Industrialists should. therefore, be aware of the storage cost involved. A disadvantage of an oilseed processing factory is the very limited turnover with only one to approximately five a year, depending on the purchasing contracts, compared with an oil refinery or margarine factory with twenty or more possible turnovers.

26. An oilseed processing factory designed for exports should, if possible, rely on local raw materials. However, raw material imports should be considered in case a local raw material basis can be established of at least twenty five per cent of the required total quantity. Under certain circumstances raw material imports can even be beneficial, namely if an efficient purchasing department is in a position to take advantage of the constantly moving and, therefore, sometimes beneficial market price situation. The conclusion of special purchasing contracts may also be to the advantage of the purchaser if larger quantities are bought.

27. Basically it is the crude vegetable oil that is in demand of an export market and the extracted protein meal. There are possibilities of successfully marketing also cleaned or semi-refined oils but unless special arrangements are made, it is difficult to export fully refined oil which without proper bottling and packaging is liable to rancidity and quality deterioration during the transport and storage period. Although crude oil is the main export product, a factory should have relevant refining facilities in order to be flexible enough to meet sudden market requirements of processed oils.

28. An oilseed processing factory designed for exports for flexibility reasons should always have a certain stable basis of approximately twenty per cent of its products' value in the domestic market and should be

in a position to, within limits, decrease or increase the domestic market sales according to the requirements. This necessitates the technical facilities to modify - if required - the quality of the products produced along with a cost/price adjustment that may be called for.

29. Trade names and brands have become an important element of the export industry in connexion with the product quality. The impact trade names and product brands have on the sales activities and subsequently also the production should not be under-estimated. It is, therefore, important to either create new brands, which is extremely difficult for a producer that is not yet established in the market with his products, or to find a partner willing to lend his brand on terms and conditions. A partnership of this kind on a licence basis even without financial participation can be very useful and mutually beneficial and should, therefore, be carefully considered.

IV/3 The processing technology

30. An export oriented vegetable oil factory is bound to produce quality products with a cost minimum. It is, therefore, essential that the most suitable processing technology has to be applied by having it tailored to its specific requirements. It is normally only a standard technology that is available from relevant equipment producers only generally applicable for "oilseed or vegetable oil processing". Such standard equipment, however, does not normally take care of the particular requirements of special oilseed raw material processing operations unless there are clearly specified.

31. It will exceed the scope of this paper to discuss the specifics of the technology suitable for each type of oilseed raw material and it is, therefore, necessary to limit the discussions to two types of oilseeds namely those with a high oil content and those with a low oil content and generally elaborate on processing methods.

32. All oilseeds have to be carefully weighed and registered when entering the factory and prior to storage. The installation of automatic weighing and registration machines are, therefore, essential that should be operated by a special raw material control unit (1). Samples have to be taken from each lot of raw materials that arrives in the factory and analysed at the factory's own quality control laboratory (14)

with regard to moisture content, oil content, impurities, percentage of shells/hulls and probably protein content. The figures in brackets refer to the model lay-out plan for a vegetable oil factory attached as Annex 1.

33. The raw material storage should specifically be designed for the type of seed to be stored (2). Bulk storage should be given preference over bag-storage. The store-houses have to be well ventilated in order to prevent self-ignition. The store house should be equiped with mechanical unloading, internal transport and feeding devices.

34. From the store house, the seed is transported to the preparation unit (3) where it is cleaned from impurities, dehulled if applicable (cottonseed, sunflower seed, etc.) and by passing certain cutting/milling equipment (breakers, fluted rolers, disc mills, etc.) the seed is broken into small pieces. The hulls and shells are transported to a special store house (9) and should in the absence of other means of utilization be used as boiler fuel. The steam boiler (10) should in this context be specifically designed for this purpose. Hulls are not normally sufficient to produce the required steam and provisions should be made for mineral oil fueling as well. A fuel oil tank needs to be installed next to the boiler (11).

35. Two possible ways of processing are now open depending on the type of seed, namely direct solvent extraction or pre-pressing and solvent extraction. Oil seeds with a low oil content such as soyabean (18 per cent) or probably cottonseed (30 per cent) can be solvent extracted without pre-pressing. Oilseeds with a higher oil content, as for example ground nuts, sunflower, etc. are normally pre-pressed in order to produce vegetable oil and oil cakes with a residual oil content of approximately 15 to 18 per cent. The pre-pressed oil cakes are then solvent extracted where again vegetable oil is obtained and the extracted protein meal with a residual oil content of less than one per cent. Low yielding oilseeds that require direct solvent extraction are normally passing flaking rolls that produce flakes of approximately 0,1 - 0,05 mm thickness.

36. After appropriate preparation, high yielding oilseeds enter the pre-pressing unit (4). The seed is heated and softened in special conditioning devices prior to entering the pre-presses. Modern pre-presses are large capacity machines (100 tons/24 hours and more) that work

continuously. The electricity consumption per ton of seed and the wear and tear aspects unfavourably effecting the final pressing technology are reduced to a minimum in modern pre-presses that operate with comparatively low pressure. Crude vegetable oil is produced and pre-pressed cakes with a residual oil content of approximately 15 to 18 per cent.

37. Either prepressed cakes or flaked low yielding oil seeds now enter the solvent extraction plant (5). A flow diagram of the solvent extraction process is outlined in Annex 2.

38. The solvent extraction technology, in principle, is based on the solvent hexane dissolving and extracting the oil contained in the seeds or pre-pressed cakes. The oil/hexane solution resulting therefrom is called "miscella", the concentration of which is normally between ten to thirty per cent oil in hexane. The miscella passes a series of vaccum distillation and condensation equipment where the hexane is being removed from the oil and recycled to the process. The hexane-wet meal leaving the extractor passes the desolventizer where it is made hexane-dry. The removed hexane is again recycled to the extraction presses. The extracted meal is dried and cooled and - if required pelleted - and stored in an especially designed meal storehouse (7) with relevant bagging and weighing equipment. The hexane-free oil is stored in tanks (8) and exported as such. Or - if required - the crude oil is sent to the vegetable oil refining plant (12) for the production of edible oil. Hexane as a solvent belongs to the inflammable products and is liable to special safety measures and instructions according to international law. Extremely careful handling of hexane is essential.

39. A modern vegetable oil factory has to be supplemented by its own laboratory (14) with round-the-clock operations, a suitably equipped mechanical and electrical work shop with spare-parts stores (15), a special security office (17) with a security engineer in charge of solvent operations and last but not least an office building (16) that houses the management and the buying, selling and accounting department.

40. As mentioned before, under para. 27, a vegetable oil factory designed for exports - for flexibility reasons should also operate a vegetable oil refining plant (12). Under the term "refining" four processes are

normally understood, namely a) degumming, b) neutralization, c) bleaching and d) deodorization. All of the four processes can be made continuous. However, it might normally be advisable to continuously carry out the neutralization and deodorization process while bleaching and degumming remain batch operations. Fully continuous refining plants should be based on only one type of raw material (crude oil) that is available in large quantities and uniform quality.

41. The refined vegetable oil is preferably filled in bottles or cans that after appropriate sealing are sorted and packed in a special storehouse (13).

IV/4 The technology and the capacity

42. The determinant factor of the capacity of the entire vegetable oil factory is the solvent extraction plant. From the technical and technological view point and considering the up-ward economy of scale, the minimum capacity of a solvent extraction plant should be approximately 100 tons/24 hours. Normally, the higher the capacity, the better the production economy. In order to illustrate the relationship of the solvent extraction capacity with the total capacity of a vegetable oil factory, attention is drawn to the three cottonseed processing diagrams attached as Annex 3, 4 and 5.

43. A cottonseed processing factory with a total throughput capacity of 500 tons/24 hours of undelinted, undecorticated cottonseed with an oil content of twenty per cent will produce the following products and by-products in 24 hours. Following the pre-pressing and solvent extraction process.

a) 45 tons of linters
b) 125 tons of hulls
c) 99,5 tons of oil
d) 2305 tons of extracted meal (0,5 per cent of residual oil).

The factory will have to consist of the following processing capacities.

a) delinting unit, capacity 500 tons of cottonseed/24 hours.
b) dehulling unit, capacity 455 tons of delinted seed/24 hours.
c) pre-pressing unit, capacity 330 tons of dehulled seed/24 hours.
d) solvent extraction unit, capacity 274 tons of prepressed cakes.

44. The same factory - 500 tons/24 hours undelinted, undecorticated cottonseed (20 % oil) using the direct solvent extraction process will produce the following products in 24 hours:

a) 45 tons of linters;

b) 155 tons of hulls;

c) 96 tons of oil;

d) 204 tons of meal (2 per cent residual oil).

The factory will have to consist of the following processing capacities:

a) delinting unit, capacity 500 tons of cottonseed in 24 hours;

b) decortication unit, capacity 455 tons of delinted seed/24 hours;

c) solvent extraction plant, capacity 300 tons of decorticated seed/24 hours, equal to 600 tons of pre-pressed cake.

Remarks:

Because of the fact that the extraction time for decorticated cottonseed (33 per cent oil) is approximately double of the extraction time for pre-pressed cake (17 per cent oil), the solvent extraction unit has also to be doubled. In other words, a solvent extraction plant that processes 100 tons/24 hours of prepressed cakes can only process 50 tons of decorticated cottonseed.

45. The same factory - 500 tons/24 hours undelinted, undecorticated cottonseed twenty per cent oil - theoretically using the mechanical pressing process only will produce the following products in 24 hours.

a) 45 tons of linters;

b) 125 tons of hulls;

c) 82,5 tons of oil;

d) 247,5 tons of press cakes (6 per cent residual oil).

The factory will have to consist of the following processing capacities:

a) delinting unit, capacity: 500 tons of cottonseed/24 hours;

b) decortication unit, capacity: 455 tons of delinted seed/24 hours;

c) pressing plant, capacity: 330 tons of decorticated seed/24 hours.

Remarks:

A mechanical pressing plant for cottonseed processing with a capacity of 330 tons/24 hours is far too large for single pressing and would justify solvent extraction.

46. The above-mentioned technical details of the relationship between technology and capacity are self-explanatory. It shows the importance of the selection of the most suitable technology and equipment that has to be weighed against the investment and production costs. One should, however, be aware of the fact that the production cost figures are a permanent factor, while the investment costs are to be paid once and can be regulated later by appropriate amortization schemes.

V. The investment

47. An investor has normally to choose between two ways of establishing a factory, namely the turn-key approach and the individual approach.

48. The turn-key approach means that the investor is contracting the manufacture, supply, installation and trial operation of the complete factory with one and the same engineering company. The contractor takes over the full responsibility for the entire work to be carried out and is expected to hand over to the owner the complete factory ready for commercial operation. The turn-key approach is the more effective way of work, but is also the more expensive method. One will have to honour the responsibility and co-ordination work involved.

49. The individual approach involves a number of different suppliers, each of them only in charge of specific plant units or parts of them. One suitably qualified co-ordinator has to be appointed who is to be charged with the overall responsibility and who plays a vital role in the manifold activities involved in the establishment of an industrial plant. The costs involved are less but the risks taken are decidedly greater.

50. The actual investment costs can only be meaningfully estimated on the basis of a defined industrialization scheme. The type(s) of oilseed raw material has to be determined, the type(s) and quality of products to be produced, the detailed technology to be applied and the production capacity. It is nearly impossible to indicate costs of investment without prior definition of the one particular plant that is to be set up. As it was mentioned before, each factory is to be tailored to specific requirements. Keeping this fact in mind, one might consider the total investment for a vegetable oil factory as outlined in Annex 1 with an annual throughput capacity of 200,000 tons of oilseeds approximately between US$18 and 20 million.

51. It should be noted in this context that even internationally acknowledged equipment produoers are reluctant to indicate prioes of complete factories without prior specification of all the technical details and the framework of the supplier's duties and responsibilities.

VI. Man-power requirements and training

52. A vegetable oil factory should not be considered for establishment for employment reasons. It is not the type of industry that gives a good employment opportunity because of its rather high degree of essential mechanization. Preference is to be attached to a limited number of skilled workers that are to be made in charge of the mostly continuous, mechanized production process. The training element, therefore, plays a rather important role and both in-plant training and theoretic training courses should be arranged for well in advance of the new factory's commercial production.

53. Apart from the actual labour requirements at the vegetable oil factory no doubts exist about the very favourable influence the vegetable oil industry has on a country's overall employment situation. The indirect employment created by it is considerable when one considers the raw material production sector, the transport sector, the product distribution and trade sector and last but not least the overall import and export sector with all the administrative and office work involved.

54. In order to illustrate the man-power requirements of a vegetable oil factory with an annual throughput capacity of 150,000 tons, processing high yielding oil seeds that require pre-pressing, a model manning table is attached - administration as Annex 6 and production as Annex 7. It can be seen that such a factory will require eighty-three administrative staff and from the total of ninety-four production workers fourty-nine skilled and forty-five unskilled workers will be required.

55. The number of employed staff and workers will remain rather constant with both increasing and decreasing throughput capacities. In other words, a factory with the same outline but only an annual throughput capacity of 100,000 tons will need about the same number of staff and workers and the same applies for a similar factory with 200,000 tons throughput per annum. From these figures one element of the upward economy of scale becomes visible.

VII. Publications

56. Being aware of the importance of the vegetable oil industry as a basic agro-industry to a great number of developing countries for the supply of vegetable oil and protein meal products for both domestic markets and exports, UNIDO has prepared a series of publications that are available in the form of United Nations Sales Publications to everybody interested. These publications are listed below:

a) UNIDO Guides to Information Sources No. 7. Information Sources on the Vegetable Oil Industry. ID/197. (UNIDO/LIB/SER.D/7 Rev.1) December 1977.

b) Guidelines for the Establishment and Operation of Vegetable Oil Factories. ID/196. Sales No.: E.77.II.B.1. November 1977.

c) Pre-Investment Considerations and Appropriate Industrial Planning in the Vegetable Oil Industry. ID/122. Sales No.: E.74.II.B.6. August 1974.

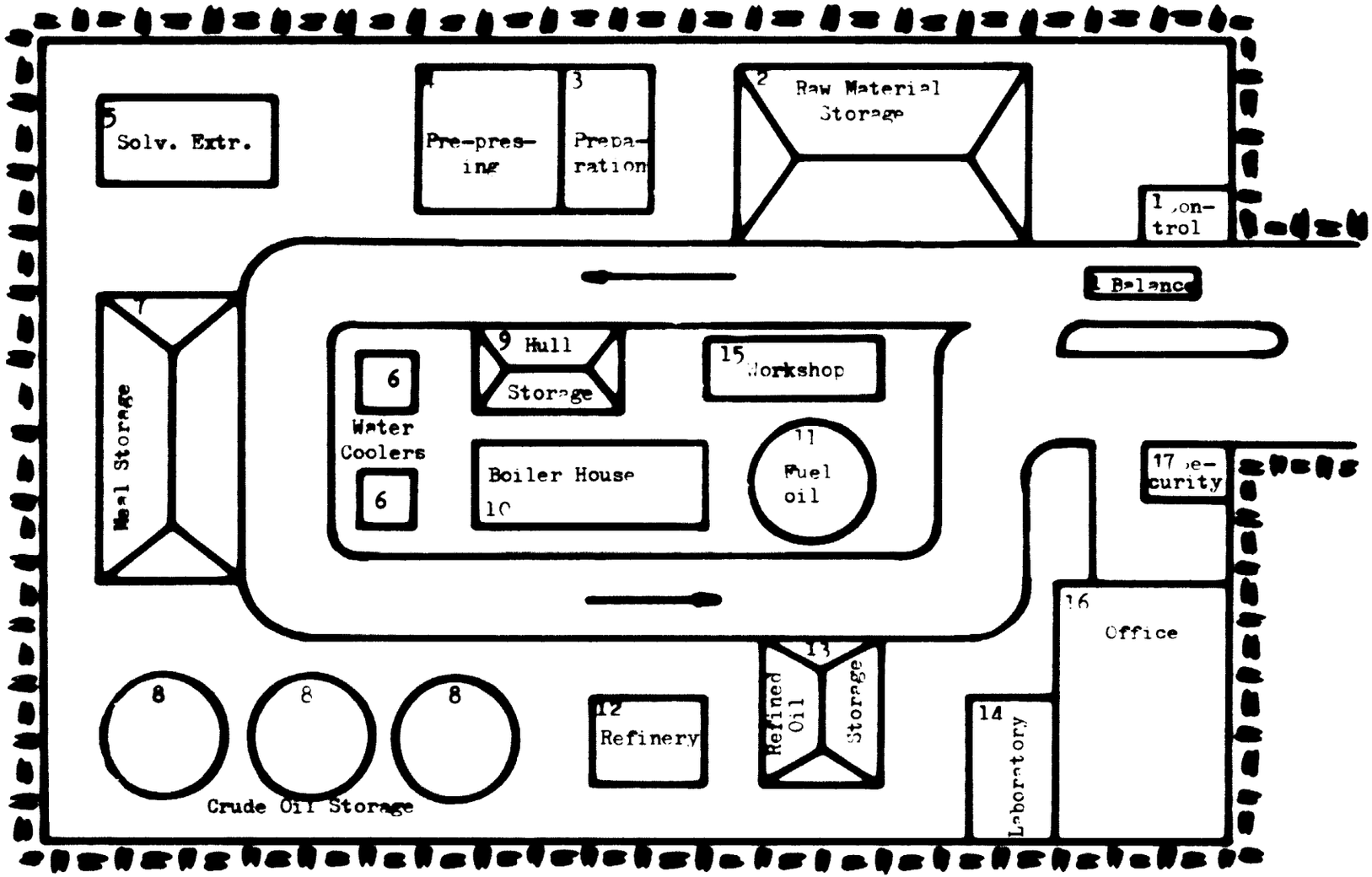
d) Technical and Economic Aspects of the Oil Palm Fruit Processing Industry. ID/123. Sales No.: E.74.II.B.10. 1974.

e) The Hydrogenation of Vegetable Oils and the Production Vegetable Ghee. ID/124. Sales No.: E.74.II.B.7. 1974.

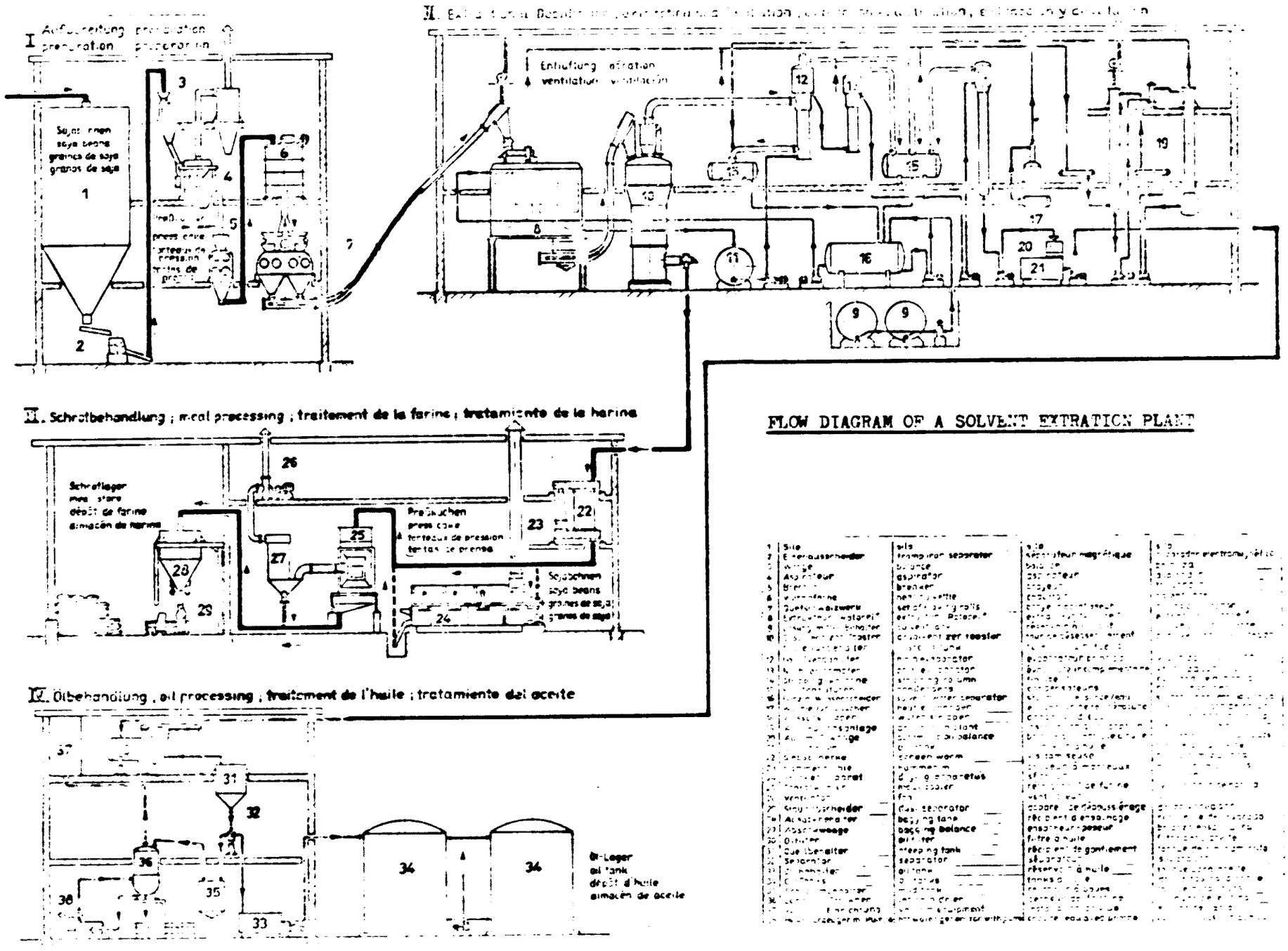
f) Castor Oil Production and Processing. ID/125, Sales No.: E.74.II.B.11. 1974.

g) Review and Comparative Analysis of Oilseed Raw Materials and Processes Suitable for the Production of Protein Products for Human Consumption. ID/126. Sales No.: E.74.II.B.8. 1974.

Annex 1 - Lay-out Plan of a Vegetable Oil Factory

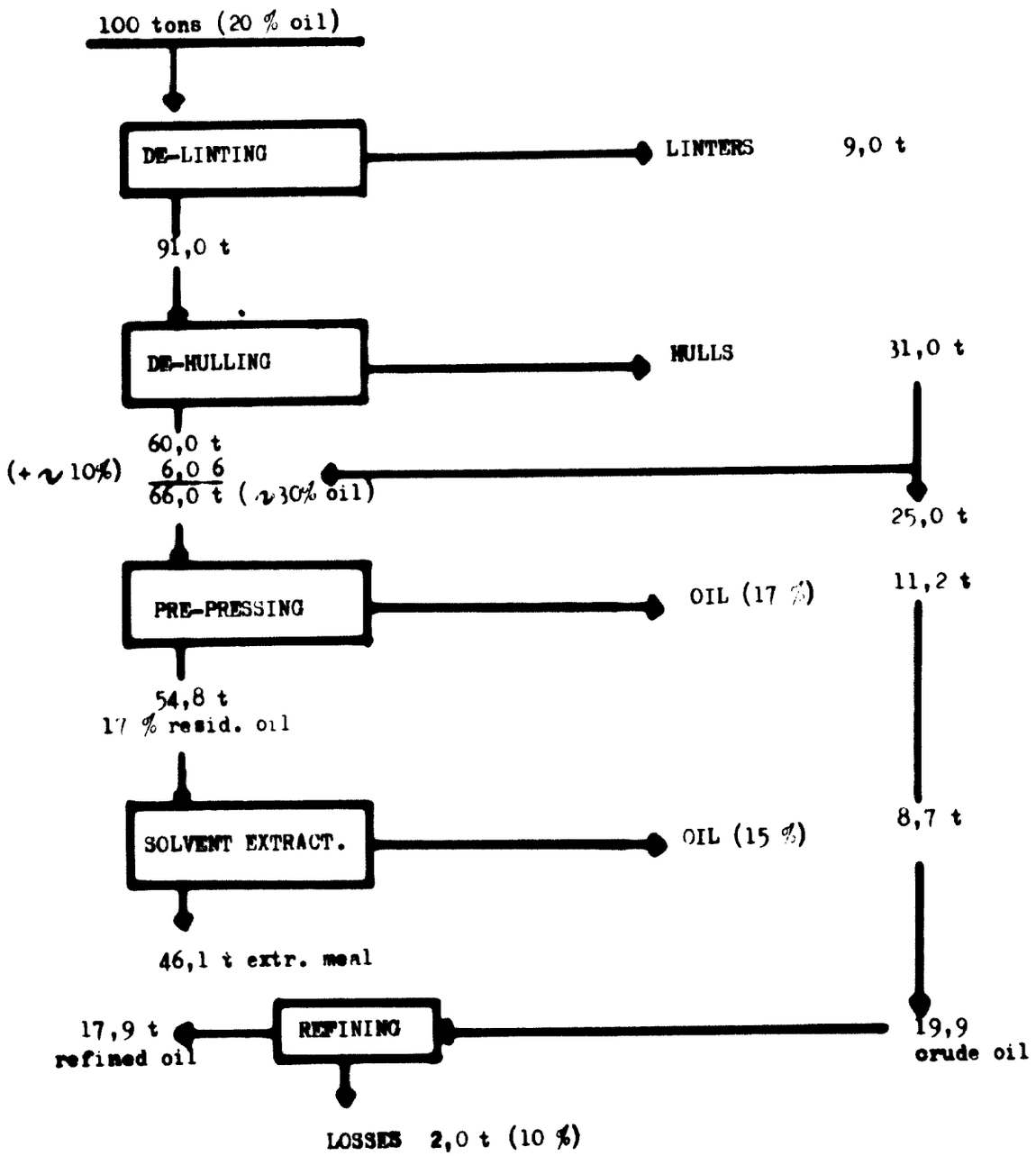


FLOW DIAGRAM OF A SOLVENT EXTRATION PLANT



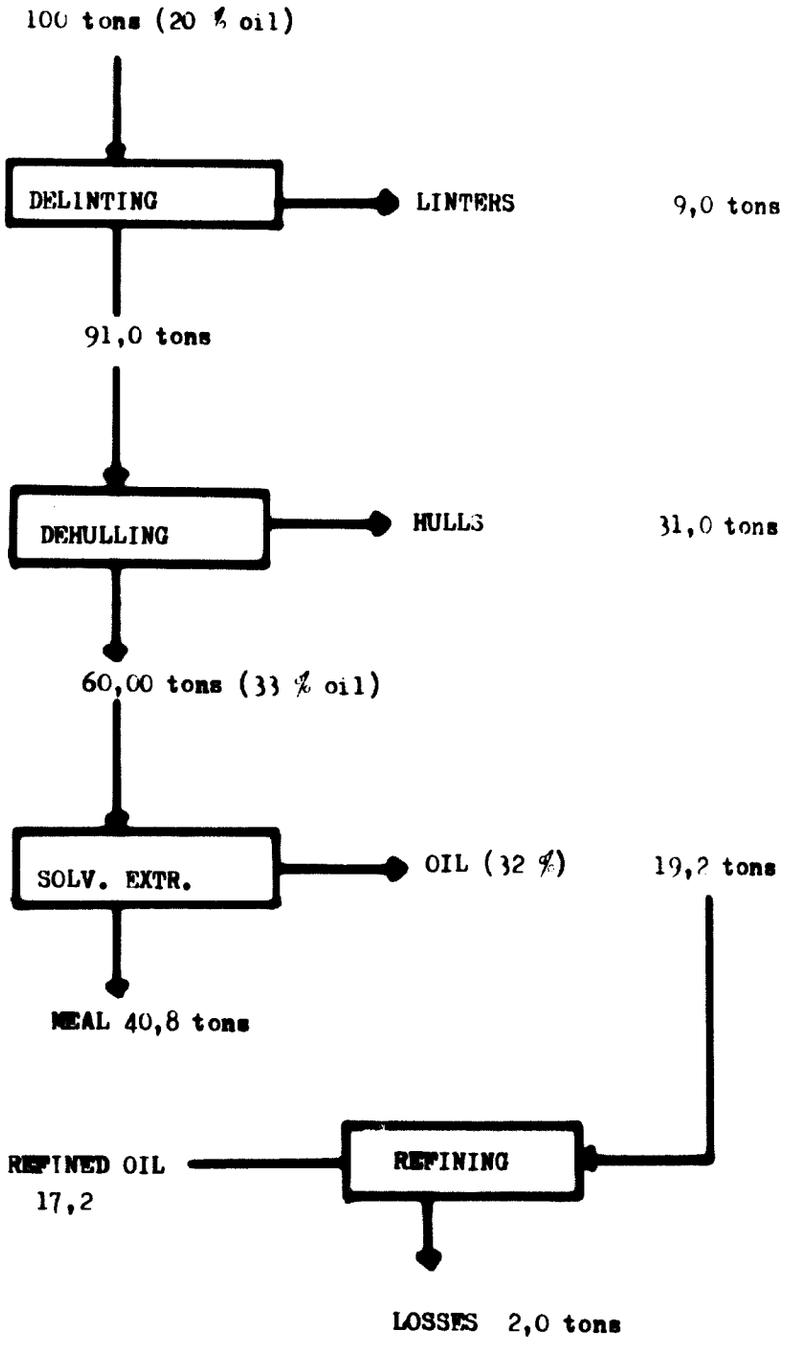
Annex 3

Calculation basis for pre-pressing and solvent extraction of cottonseed



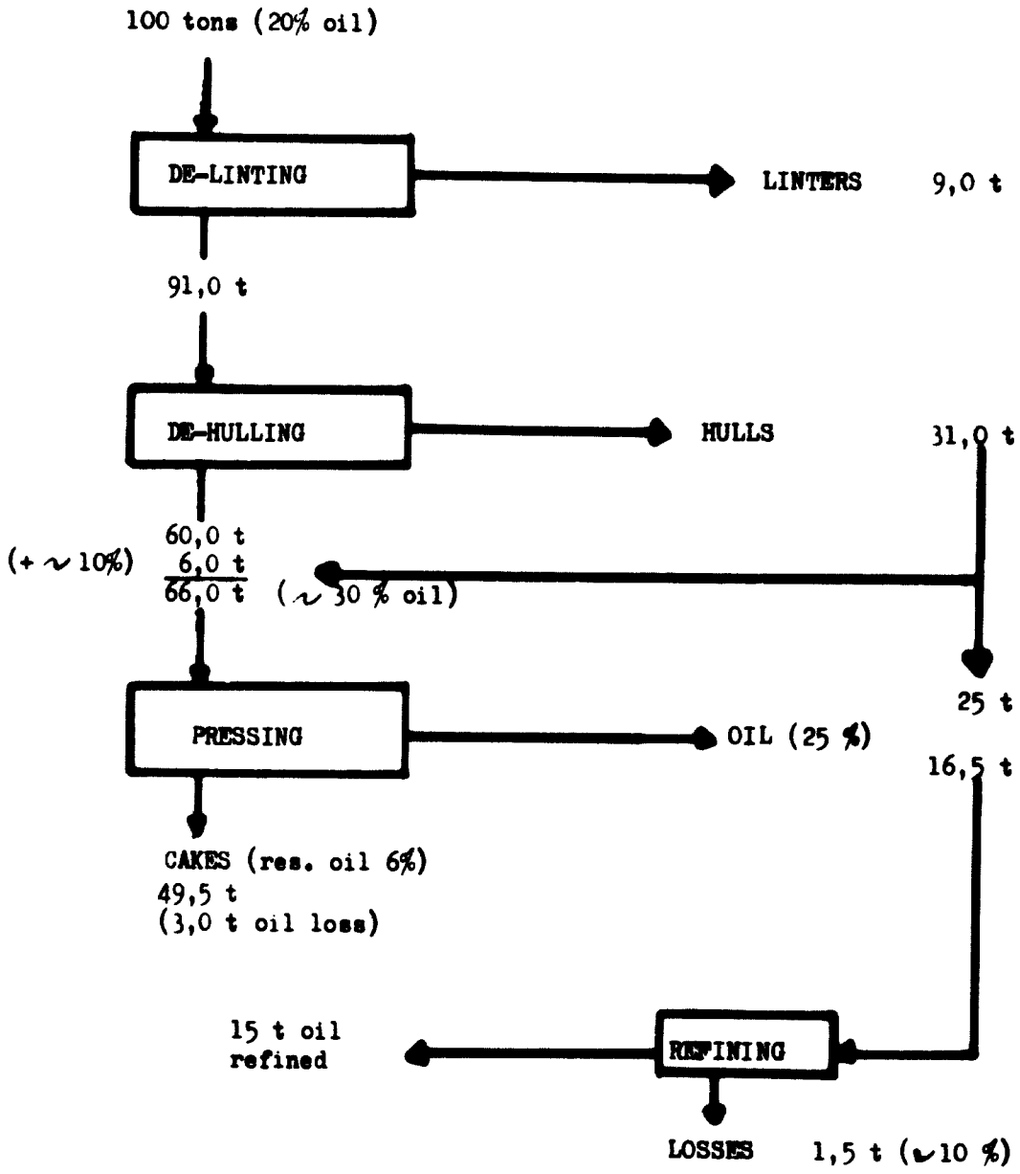
Annex 4

Calculation basis for the direct extraction of cottonseed



Annex 5

Calculation basis for mechanical pressing of cottonseed



Annex 6

Man power requirements (Administration) for a vegetable oil factory processing high yielding oilseeds with a throughput capacity of 150,000 tons per annum.

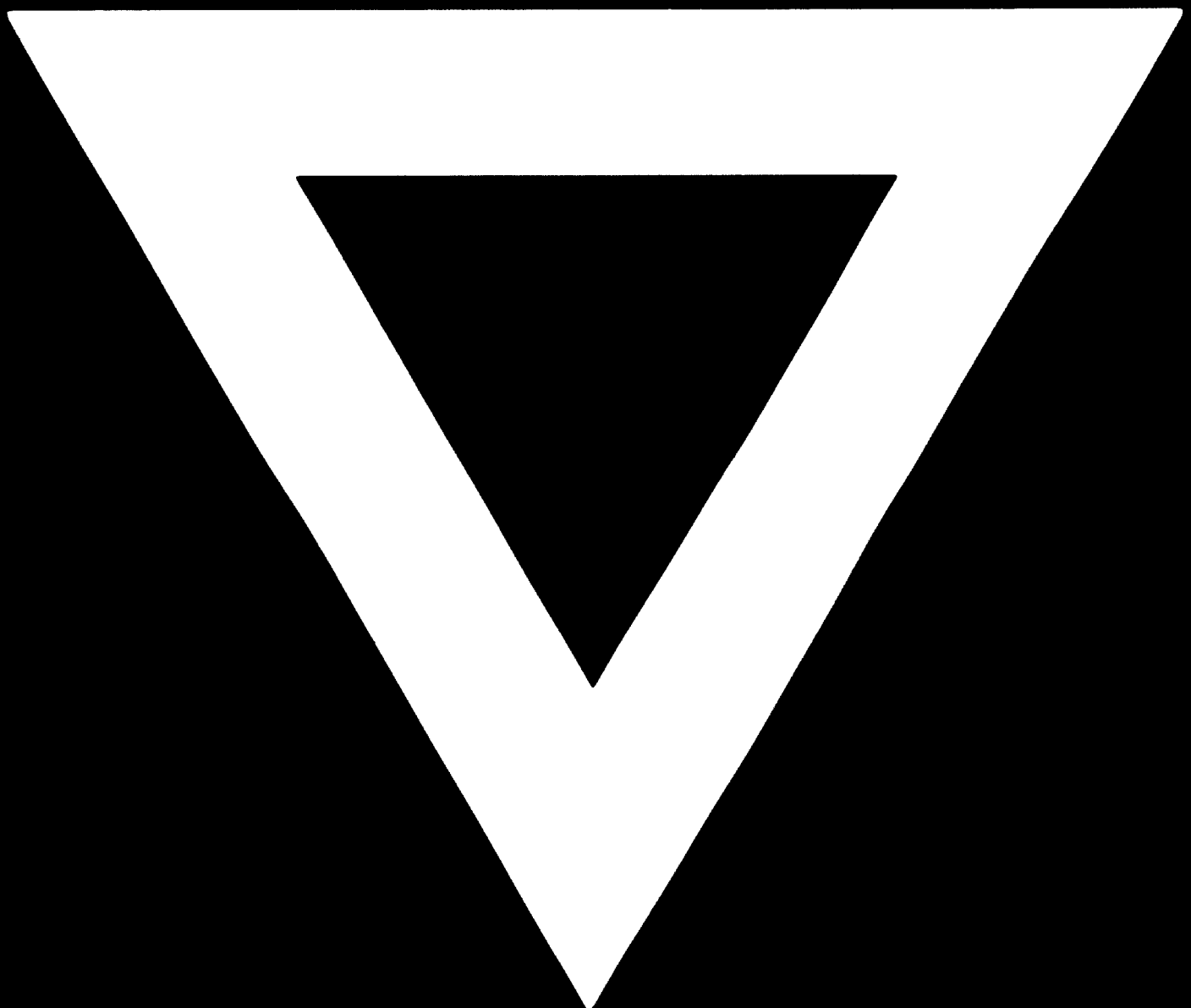
Director General	1
Director Administration	1
Director Technical	1
Director Finance	1
Director Purchasing	1
Director Sales	1
Chief Engineer	1
Production Manager	1
Chief Accountant	1
Accountants	5
Chemist	1
Laboratory staff	8
Electricians	5
Safety Engineer	1
Master Mechanic	1
Mechanics	10
Drivers	15
Guards	8
Clerks	10
Secretaries	10
Total:	83

Annex 7

Man power requirements (Produotion) for a vegetable oil factory processing high yielding oilseeds with a throughput capacity of 150,000 tons per annum.

	one shift	four shifts	day time	total
Shift Master	1	4	-	4
Weighing/Registration				
Skilled	-	-	1	1
Unskilled	-	-	1	1
Raw material storage				
Skilled	-	-	2	2
Unskilled	2	8	2	10
Preparation				
Skilled	1	4	-	4
Unskilled	1	4	-	4
Pre-pressing				
Skilled	1	4	-	4
Unskilled	1	4	-	4
Solvent extraction				
Skilled	4	16	-	16
Unskilled	1	4	-	4
Meal storage				
Skilled	-	-	1	1
Unskilled	1	4	5	9
Crude oil storage				
Skilled	-	-	1	1
Unskilled	-	-	1	1
Boiler house				
Skilled	1	4	-	4
Unskilled	1	4	-	4
Refinery				
Skilled	3	12	-	12
Unskilled	2	8	-	8
Total				
Skilled	11	44	5	49
Unskilled	14	36	9	45

C-675



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