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MAURITIUS

Technical report: Evaluation of a project for the manufacture of newsprint from bagasse

Prepared by the Government of Mauritius by the United Nations Industrial Development Organization executing agency for the United Nations Development Programme

Based on the work of Karl-Johan Biornstad, expert in the manufacture of newsprint from bagasse

United Nations Industrial Development Organization
Vienna

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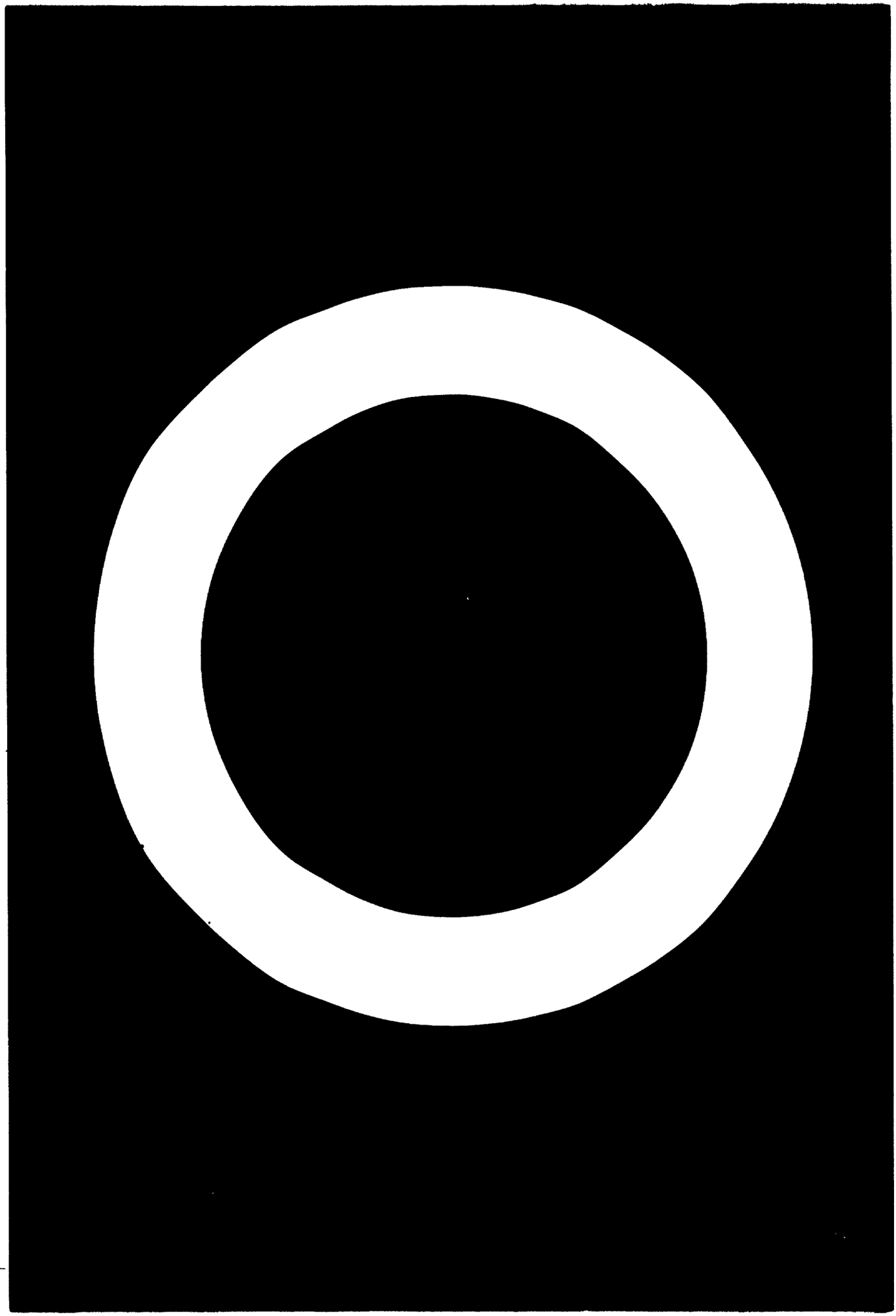

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Abstract

Until a process for making newsprint from bagasse has proven its viability in large scale operation it cannot be considered a risk free enterprise to invest in a newsprint mill based on bagasse.

There is enough bagasse in Mauritius for a newsprint mill.

As an average the newsprint market in 1980 will be able to absorb 93% of the capacity of existing newsprint mills.

It is doubtful if there is sufficient water in Mauritius for a newsprint mill.

Infrastructure will be needed at a cost of US$ 15 million.

The cost of bagasse is considerably higher than calculated by Sybetra.

The cost of bagasse is higher than the cost of wood.

The newsprint production costs are 70% higher than calculated by Sybetra.

The net annual revenue of total invested capital is 3% as against 16% calculated by Sybetra.

An increase of today's prices of newsprint with 45% is necessary in order to reach a revenue on total investments of 15%.

The Sybetra study cannot be used to base a decision on. It contains too many errors.

It can be expected that no foreign investors will grant any credits based on the Sybetra study.

A new feasibility study should be presented made by qualified and experienced experts.

It is not to be expected that the study will show sufficient profitability to attract foreign investors.

Introduction

In 1972 a company, Mauritius Paper Limited, was incorporated under Mauritius law. The intended activity was to produce newsprint using sugar cane bagasse as fibre raw material. The company obtained an Export Enterprise Certificate the same year.

In early 1976 a feasibility study was presented by the company covering the erection of a pulp mill with an alternative production of corrugating medium from bagasse.

Limited progress was made until Mauritius Paper Limited in May 1977 presented a new feasibility study now concerning the erection of a newsprint mill based on bagasse.

The investment costs of a paper mill as envisaged are very high and the impact from the company's activity on the whole of the Mauritius economy would be considerable.

Before taking any decision the Government of Mauritius wants to have the viability of the project evaluated. For this reason the Government requested UNIDO, United Nations Industrial Development Organization, to assist in the assessment of the project. The writer has been requested by Unido to make the critical review on their behalf.

The review has been based on the feasibility study prepared by SYBETRA, Belgium, in June 1977 in two volumes, later completed with another volume in August 1977 and two volumes more in October 1977.

The writer has drawn his conclusions only from documents which have been made available to him and from information obtained from discussions with local individuals. It has not been possible to take into consideration statements which have not been convincingly shown to be facts.

Newsprint from Bagasse

Since long ago it has been the dream of many paper-makers to make newsprint from bagasse. At this very moment it is still a dream. There is no newsprint mill in the world today built for using bagasse as the main fibre raw material. The reason is the lack of a process proven to be able to produce newsprint from bagasse with a satisfying result.

During the years since the last world war much time and large amounts of money have been spent on experiments in order to develop a suitable process for producing newsprint from bagasse. Fundamentally the problem is not to produce a paper that can be used for newspapers. Thousands of tons of paper which have been used as newsprint have been produced from bagasse. The real problem is to produce a bagasse based newsprint at a price competitive with the commonly used newsprint on the world market today. This newsprint is based on coniferous wood and the use of a mechanical pulp made therefrom, which pulp can be produced at a considerably lower price than the chemical pulp used for other kinds of writing and printing papers.

Making chemical pulp from bagasse and paper based on this bagasse pulp is a well known procedure. Between one and two million tons of bagasse based papers are produced yearly in the world today. Newsprint is a very special kind of paper in the way that it is produced with the intentional purpose of living just for a day and then to be thrown away. Obviously one wants to use a paper as

cheap as possible for such a purpose. It does not need to be specifically bright and it does not matter if it has the tendency of getting yellow when exposed to day light. It must be strong enough however to be able to pass the high speed modern printing presses without breaking and it must also have a minimum of opacity to avoid the printing shining through.

Mechanical pulp made from long fibred conifers in the way that the wood simply is ground against a grindstone has proven to be an excellent fibre furnish for newsprint. Giving a yield of almost 100% against only 50% for chemically produced pulp the paper can be produced at a low price compared to papers of higher quality because the fibre raw material constitutes an essential part of the production costs.

All the experimenting of making newsprint from bagasse has had the purpose to imitate the mechanical pulp from conifers as closely as possible. The experiments have in principle failed mainly due to the short fibres of the bagasse and the difference in the construction of bagasse as compared to wood which makes the application of a grinding process to bagasse difficult. The solutions tried have had to be modified in the direction of treating the bagasse to a limited degree chemically and then to defiberize it. The result of any chemical treatment of bagasse is that the yield goes down and parallelly the transparency of the resulting paper increases. For this reason substantial quantities of fillers have to be used in the paper to counteract the lacking opacity. The use of fillers

in newsprint made from mechanical wood pulp is unnecessary thanks to the high opacity of the groundwood.

Around 1960 quite an activity was going on around the world in the search for a bagasse newsprint process, primarily in U.S.A., Sweden and the Federal Republic of Germany. Several newspapers in these countries were experimentally printed on papers emanating from these trials and millions of U.S. dollars were spent. A suitable method for making newsprint from bagasse did not result, however, from all this experimenting. The interest for finding a suitable process has all the time since then been latent however and the discussions and laboratory activities went on. Specifically active were Cusi in Mexico and Peadco in Peru.

In 1970/71 Cuba started interesting itself for the subject. Cuba has no other fibre raw material for paper-making than bagasse and this they have in abundance being the largest sugar exporting country in the world. Recognizing the lack of a consequent initiative in the search for a suitable method for making newsprint from bagasse Cuba decided to start their own research on the subject. For this reason they approached the United Nations in order to achieve co-operation and to have funds allocated from the United Nations Development Program, UNDP. After some years of preliminary studies and negociations a UNDP project resulted with the participation of UNIDO, commonly known as the Cuba 9 project. The project

comprises a complete pilot plant for making newsprint from bagasse including a high speed paper machine. All possible modifications of the plant are foreseen in order to arrive at the method for making newsprint from bagasse considered the best. Most of the machinery will be delivered through UNDP at a cost of some U.S. dollars 4 millions. The rest of the total costs, calculated at some US$ 15 millions, will be paid by Cuba. The pilot plant will be ready for start up next year. As the experiments will take a couple of years' time the final results can be expected to be available in 1980 only. The spending of so much time and money on the subject makes evident the fact that the search is still going on for finding the right method for making newsprint from bagasse. One should keep in mind that Cuba had wanted to build a newsprint mill based on bagasse straightaway. Recognizing the lack of a proven method they decided to find the method first and then to build a mill. They considered it an unnecessary risk to go for a full scale mill from the beginning.

The Peruvian approach to the problem has been quite different. Peru started producing pulp and paper from bagasse forty years ago. They have today two large paper mills producing together 150,000 tons per year of printing, writing and packaging papers from chemical bagasse pulp. Their knowledge and experience of bagasse as a raw material for paper making is extensive.

At the beginning of the nineteen hundred and seventies the Peruvian state took over the mentioned two paper mills from their American owners, W.R. GRACE. Since then the Peruvian pulp and paper industry has been declared an industry of national interest with the result that pulp and paper production in Peru now is an activity exclusively for state owned pulp and paper mills.

The newsprint consumption in Peru being not far from 100,000 tons per year costs a considerable amount of foreign currency. The Peruvian economy being a rather weak one it was only logic that Peru started thinking of making their own newsprint in order to avoid the import of it. Their newsprint would have to be based on bagasse as suitable conifers are not existing in the country. To promote such a production the Peruvian Government would protect the newsprint produced through adequate measures, i.e. by imposing import fees on newsprint possibly to be imported.

The Peruvians decided to take Mr. Cusi from Mexico as consultant in planning the mill. The Paadoo company belonging to W.R. Grace, U.S.A., had lost its base of existance as their paper mills in Peru were expropriated. A specific method for cooking the bagasse will be used which Mr. Cusi is using in Mexico for producing chemical pulp. With some modifications it will now be adopted to produce pulp for the newsprint furnish. The mill will have a capacity of 110,000 tons per year. Start-up is scheduled for the beginning of 1978.

In Mexico a mill is planned for the production of newsprint also based on bagasse. Quite logically Mr. Cusi is in the project as being the expert in Mexico who knows most of bagasse pulping technology. The exact status of the project as of today is not known to the writer. It was in 1975 announced to be a mill of 220,000 tons per year costing US$ 224 million. According to the latest information the capacity is now given as 150,000 tons per year. The import to Mexico of newsprint is at present more than 200,000 tons per year. The production from the envisaged mill will therefore without any difficulties be absorbed within the country.

When producing chemical pulp Mr. Cusi is using a specific method of his, i.e. a two stage cooking of bagasse with caustic soda. Apart from the pith bagasse can be said to consist of two parts, one which contains mainly shorter fibres and which is easier to cook, and one with coarser fibres which is more resistant to the cooking chemical. In a first cook now the bagasse is treated with chemicals sufficiently to bring the first mentioned part into a state where it can be readily defiberized, leaving the second part in a state still too coarse for easy defiberizing. After separating the two fractions, the second part is cooked once more and brought into a readily defiberizing state. The two parts are then subsequently mixed again. The idea is to not overcook the first part nor to undercook the second part as compared to cooking

only in one stage. Out of the more than one million tons of pulp produced from bagasse in the world today a relatively small part only is produced according to Cusi, whereas the procedure practised for the rest is a single, one stage cooking giving a reasonably good quality of pulp. Printing and writing papers made from such pulp can reach real high quality when practised properly.

In the search for a process suitable for newsprint the trend has been, as mentioned previously, to treat the bagasse less chemically and more mechanically. Different chemicals have been tried besides caustic soda, for instance neutral sodium sulphite, and different degrees of cooking intensity have been practised. Cusi has modified his method in the way that he makes the first stage a mild cooking and the second stage without chemicals at all, only heating with steam before defiberizing. The idea may seem logic. It remains to be seen if it will turn out to be of a correspondingly practical significance.

The writer cannot offer any firm opinion about which procedure to follow. As a matter of fact nobody can because the necessary experience does not exist due to the fact that there is no newsprint mill based on bagasse in production yet. Experience has to be gathered first, be it from the coming mill in Peru or from the Cuba 9 project. The ultimate answer is expected to be presented as the result of the research activity from the Cuba 9 project.

Considering now the situation in regard of production of newsprint from bagasse in the three countries discussed in the foregoing, Peru, Mexico and Mauritius, one should keep in mind the following. In Peru and Mexico there is a local market which will consume all the newsprint from the mills. No export will be necessary. Peru has a totally closed economy. That means that at any time the Government is in the position of giving the newsprint mill a protection if necessary to keep it viable. In Peru this grant is a fact already.

In both cases the local newsprint mills have the advantage as compared to possible producers in other countries of not to have to pay the transport costs from abroad which may amount to US$ 25-50 per ton.

A newsprint mill in Mauritius will have to rely exclusively on exports, as the consumption of newsprint in the country is negligible. It will have to compete on the world market with effectively working mills primarily in Canada, U.S.A. and even South Africa.

Considering the possibilities of the viability of newsprint mills based on bagasse in different countries, it is evident from the above that the mills in Peru and Mexico have the better chance of being viable compared to a newsprint mill in Mauritius. If need be the Governments in Peru and Mexico have the possibility by protection to make the mills viable through adequate measures due to the fact that the whole production of newsprint is consumed locally. This is not possible in Mauritius with its open economy and the impossibility of the Government to influence the world market prices of newsprint.

The Newsprint Market

Deciding for building a newsprint mill are the prospects of being able to sell the production and to achieve a price making the necessary investments profitable. If the demand is limited or the price unsatisfying the incentive for making the investment is not present.

For this reason a feasibility study normally presents a market analysis. That is not the case with the Sybetra study. Twenty pages of statistical figures concerning newsprint are presented which have their origin in Newsprint Data 1975 published by the Canadian Pulp and Paper Association. No attempt has been made, however, to analyse the figures and comment upon them for which exercise the figures form an excellent basis. No comments therefore are offered concerning the demand-supply relation in the past or of the demand-supply situation in the future. Thus the possibilities of the world market to absorb the 120,000 tons a year of newsprint production from the prospective mill stay unknown.

In Appendix 16, volume 2, of the Sybetra study an eighteen pages evolution of the pulp market in the U.S.A. and Scandinavia is presented. This study has obviously nothing to do with the newsprint project and should have been deleted. In addition it is totally outdated.

The study is however from a specific point of view very interesting, namely in illustrating the difficulty of forecasting developments in industry, in this case in the pulp industry which is an industry closely related to the paper industry in the way that pulp is the fibre raw material for paper making.

The study was published in 1975 and made by a reputable expert in marketing research. He stated that Western Europe by that time had been pushed into a pulp deficit from which it could not recover. The pulp deficit would continue at least for four more years to come, growing with one million tons per year until 1980 in which year a pulp deficit of eight million tons would result. He also explained the reasons for this development, the most important one being the fact that out of the past 30 years 28 had been the buyer's market. This was meant to indicate that investments in the pulp industry were not considered very lucrative. Contributing factors to this again were high costs for pollution control, up to 20% of the cost of a mill, investment costs increasing more quickly than inflation and, as the industry is very capital intensive, interest charges staying high because interest rates are not likely to decrease as long as high inflation exists.

The mentioned scepticism against investments in the pulp industry certainly are realities to be taken seriously as development has shown. Instead of a large deficit of pulp as predicted by the expert only less than three years ago the situation today is that there is an excess capacity in the world for the production

of pulp with the result that most pulp mills all over the world are producing considerably under their capacity and stocks of pulp are high. Whereas the forecasts predict an equilibrium to be reached only by 1982-83 in respect of long fibered pulp, the equilibrium for short fibered pulp will not be reached before 1990.

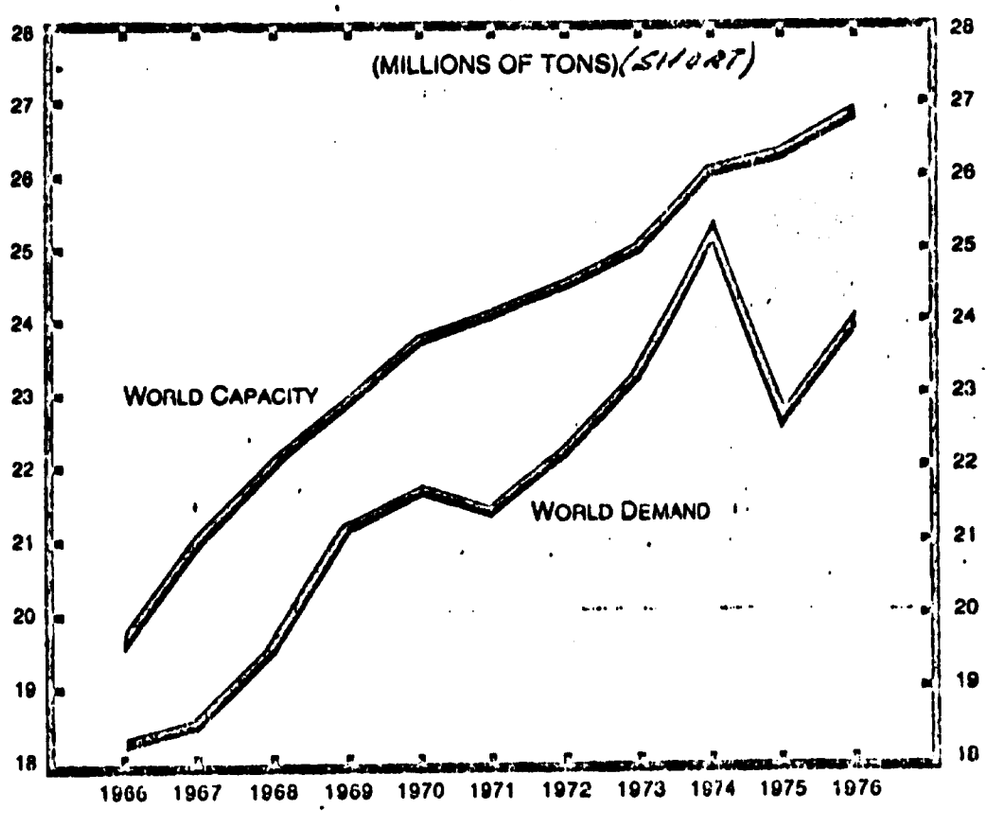
As in the case of pulp there are no absolute truths to base oneself upon when trying to foresee the future development of the newsprint market. The only we know, more or less for sure, is the past and the present. Speculations about the future therefore have to start with historical facts.

The diagram on the following page which emanates from Newsprint Data : 1976 published by the Canadian Pulp and Paper Association shows the relationship between the world demand and the world capacity of newsprint during the last decade. As is to be seen through all the years 1966 to 1976 capacity has been larger than demand. This means that the newsprint industry in none of those years has been able to run fully.

In the following list the figures expressing the world demand as per cent of the world capacity of newsprint are given for the years 1966 to 1976. The corresponding amount of reserve capacity in tons per year for the same years is presented parallelly:

# NEWSPRINT DATA: 1976

*Statistics of World Demand and Supply*




Data for 1974-1976 are based on 30 lb. basis weight and data for 1966-1973 have been converted to the same basis of measurement to provide comparability through the period 1966-1976.

JUNE 1977

| | World Demand/ World Capacity | Reserve Capacity |
|---|---|---|
| | % | 1,000 MTons |
| 1966 | 93 | 1,320 |
| 1967 | 88 | 2,420 |
| 1968 | 88 | 2,590 |
| 1969 | 93 | 1,640 |
| 1970 | 91 | 1,980 |
| 1971 | 89 | 2,660 |
| 1972 | 91 | 2,180 |
| 1973 | 93 | 1,650 |
| 1974 | 96 | 950 |
| 1975 | 86 | 3,370 |
| 1976 | 89 | 2,710 |

At the beginning of 1977 thus the excess capacity in the world for the production of newsprint was 2.7 million tons to meet future increasing demand of this kind of paper. These are the facts of today.

The question arises at what speed demand will grow in the future and which at the same time the increase of capacity will be. Based on the newsprint consumption in the past in the world an Industry Working Party organised by FAO undertook in 1977 to make an estimate of the newsprint demand in the world up to 1990. They arrived at the following being the most probable consumption figures. The historical statistical data back to 1960 are shown as well to complete the picture of the development:

| | 1,000 Metric Tons |
|---|---|
| 1960 | 14,064 |
| 1965 | 16,980 |
| 1970 | 21,417 |
| 1975 | 23,038 |
| 1980 | 25,848 |
| 1985 | 29,315 |
| 1990 | 32,927 |

The consumption of newsprint has grown steadily through all years up till today reflecting the increasing standard of living all over the world and the increasing literacy. The growth will logically continue in the future parallelly with increasing standard of living and literacy, primarily in the developing countries. In 1980, the earliest possible date to have a newsprint mill in Mauritius on stream, the world consumption is estimated to have reached 25.8 million tons.

The world capacity of newsprint production has developed in the following way:

| | 1,000 Metric Tons |
|---|---|
| 1960 | 15,300 |
| 1965 | 17,950 |
| 1970 | 22,820 |
| 1975 | 23,740 |
| 1976 | 24,320 |

Based on what is known from published announcements considered to be reliable the world's production capacity of newsprint in 1981 is expected to be 28.6 million tons. The corresponding figure for 1980 would be 27.9 million tons.

The consumption of newsprint in 1980 is estimated as mentioned earlier to be 25.8 million tons. With a capacity of 27.9 million tons this represents 93% of the newsprint quantity that could be produced with the mills running fully. The existence of an excess capacity of about 2 million tons will therefore be the case in 1980 and the newsprint mills of the world will in that year obviously not be able to produce at full capacity. Theoretically it would take three years before consumption would reach the production capacity of 1980 during which time one can foresee that new capacity in addition will have come into operation. There is no sense however in trying to speculate beyond 1980-81 because plans for capacity increase after that time are not known to anybody. What can be foreseen though with reasonable certainty is that a newsprint mill starting production in 1980 will have to face a resistance from the market in regard of introducing its production which, as normally is the case, will have to be met with price concessions. Pretty sure is also that the newsprint mills in common will not be able to sell all of the output which they would be able to produce and this situation will last at least for several years to come after 1980.

As to prices of newsprint the Sybetra study lists the newsprint price delivered at "Press room" New York City for the years 1924 to 1977. For this last mentioned year the price was US$ 305 per short ton. This price has been chosen as the price on which to base the profitability calculations of the newsprint project. From the price at "Press room" N.Y. US$ 25 per metric ton have been deducted as freight costs as well as 1.5% for commission. The resulting price ex mill is US$ 306 per metric ton. It is difficult to see however what this price which is based on "Press room" delivery New York has got to do with the ex mill price from a newsprint mill in Mauritius.

It is necessary to study the world export market prices in order to arrive at a price which could be used as an ex mill price from a mill in Mauritius. It is however difficult to obtain realistic and internationally comparable prices for paper depending upon a number of factors, some of them quite irrational, such as: differences in defining newsprint, country of origin, country of destination, distance from producer to buyer, part of the world of buyer as well as seller.

FAO published in June 1977 what they call the general development of paper prices from 1956 to 1975 out of which the following figures for newsprint are taken:

| | US$ Metric Ton |
|---|---|
| 1956 | 217 |
| 1961 | 196 |
| 1965 | 186 |
| 1970 | 183 |
| 1972 | 204 |
| 1973 | 215 |
| 1974 | 253 |
| 1975 | 290 |

The International Monetary Fund regularly publishes statistics on different commodities on the world market in their publication International Monetary Statistics, among others export prices of newsprint from the most important newsprint exporting countries, i.e. Canada, Finland and Sweden. Their quotations of newsprint f.o.b. are as follows. For comparison the wholesale price, i.e. the domestic price, of U.S.A. is given as well:

| | U.S. Dollars per Metric Ton | | | |
|---|---|---|---|---|
| | U.S.A. | Canada | Finland | Sweden |
| 1970 | 166 | 144 | 127 | 130 |
| 1971 | 173 | 152 | 132 | 136 |
| 1972 | 180 | 159 | 138 | 148 |
| 1973 | 188 | 169 | 162 | 180 |
| 1974 | 232 | 223 | 260 | 269 |
| 1975 | 283 | 270 | 348 | 361 |
| 1976 | 304 | 289 | 325 | 351 |
| 1977(May) | 329 | 307 | 350 | 387 |

It is evident that one cannot derive from the figures presented any meaningful world market price for newsprint.

It is interesting to note in the IMS series of figures that prices of newsprint are lower in USA/Canada than in Finland/Sweden. Interesting also is that even in two countries that are close to each other as Findland and Sweden price differences exist, for May 1977 as a matter of fact as much as more than 10%.

The reason for the difference in price levels in North America and Scandinavia are several, an explanation of which goes beyond the aim of the present study. The consequences of the difference is that the closer to Europe the higher the prices whereas in regions dominated by North America due to their nearness prices will be lower.

Up to and including 1973 prices were fairly stable. From 1974 onwards the prices increased considerably reflecting the impact of the increase in oil prices and the world crisis with heavy inflation resulting therefrom. By 1977 prices have levelled out. There will likely be no larger increase in prices of newsprint in forthcoming years. Corrections may be made reflecting the development of inflation.

The series of prices quoted from FAO earlier cannot be used as selling prices for basing a feasibility study upon. They are not meant for this purpose either. They are average figures only to be used for illustrating the overall development trend of newsprint prices over the years.

From the statistics available it is evident that no price can be derived upon which to base a profitability calculation of a newsprint mill in Mauritius. Instead one will have to base oneself on actual price quotations for the markets which are supposed to be the most likely ones for a newsprint mill in Mauritius.

The following quotations were offered on 22 November 1977 by a well known international trading house for newsprint 48.8 grams per square metre:

| | U.S. Dollars per Metric Ton CIF |
|---|---|
| East Africa | 400-430 |
| India | 360 |
| Far East | 360 |

Up to recently normal thickness of newsprint was 52 grams per square metre. Due to the high costs of the fibre raw material it has been desirable to lower the weight of the paper in order to get more square metres out of each ton. The large newsprint producing countries, thanks to the high quality of their fibre raw material, have been able to reduce the thickness to 48.8 grams per square metre still being able to deliver a strong enough sheet to satisfy modern printing presses.

In a large part of the world 52 grams paper is still the normal. In the case of newsprint from bagasse the writer is of the opinion that it will be necessary to keep this weight considering the lower strength properties of the bagasse fibre as compared to

the pine wood normally used in North America and Scandinavia, and perhaps even be happy if the paper does not have to be made still heavier to reach the strength necessary. Quite obviously 48.8 grams paper is more expensive per ton than 52 grams paper. For this reason it seems wise and logic in the case of newsprint from bagasse to base oneself on prices on the lower side of those quoted specifically when considering that the difference in square metre weight of 6% would indicate a lower price of the 52 grams paper of £ 20 per ton. Reasonable prices would be £ 400 per ton for East Africa and £ 350 per ton for India and Far East. Most likely one would be happy if those prices can be reached due to the still unknown characteristics specific for newsprint made from bagasse.

Knowing the prices c.i.f. one has to calculate the costs from the mill to the importers harbour to arrive at the net price ex newsprint mill.

The writer has had discussions with several representatives of shippers and brokers in Port Louis. The following are the charges to be paid in the harbour:

| | Rs/Ton |
|---|---|
| Landing charges | 55.- |
| Quay dues | 7.50 |
| Export fee | 4.40 |
| | 66.90 |

This corresponds to about $ 10 per ton. Further deductions to be made are insurance, 0.75%, sales commission and del credere, 2%, and freight. Total deductions from the c.i.f. prices will be:

| | U.S. Dollars per Ton | | |
|---|---|---|---|
| | East Africa | India | Far East |
| Harbour charges | 10.- | 10.- | 10.- |
| Freight | 60.- | 50.- | 60.- |
| Insurance | 3.- | 2.50 | 3.- |
| Sales commission | 8.- | 6.50 | 6.50 |
| | 81.- | 69.- | 79.50 |

Net prices ex factory will accordingly be as follows:

| | U.S. Dollars per Ton | | |
|---|---|---|---|
| | East Africa | India | Far East |
| Price C.i.f. | 400.- | 350.- | 350.- |
| Deductions | 81.- | 69.- | 79.50 |
| Net price | 319.- | 281.- | 270.50 |

The most interesting market would obviously be East Africa. The question is what quantities possibly could be sold there. The prospects do not seem promising. According to FAO Africa South of Sahara, i.e. Africa with the African countries around the Mediterranian excepted, was in 1975 self sufficient in regard of newsprint. In 1980 there will be an excess of newsprint beyond the domestic demand of 45%. This is primarily due to the start up

of a new machine in South Africa in 1976 producing 100,000 tons per year of newsprint. In addition a new mill for production of 100,000 tons per year of newsprint is planned in Nigeria for start up in 1981. It will seem therefore that exports from Mauritius will have to be directed towards India and the Far East. In this part of the world there would be room for imports of some 400,000 tons per year after 1980. Assuming though that it would be possible to export to the North African countries and the Middle East instead of to East Africa it seems a fair assumption to sell one third of the production from the mill to each of the three regions.

The ex factory price to base the profitability calculations upon will then be US$ 290.- per ton.

Bagasse Supply

The need of bagasse is in the Sybetra Study given to 450,000 metric tons of 50% dry bagasse per year. The amount seems reasonable.

In Mauritius the yearly amount of bagasse is about 1.5 million tons 50% dry. The Mauritius sugar industry is therefore able to supply the quantity of bagasse needed.

There is, however, some doubt if this can be arranged without difficulties. The existing law covering the relations between the sugar cane planters and the sugar estates can be read the way that the planters could claim their part of the fuel oil to be delivered to the sugar factories as substitution of the bagasse. Logically seen this would be absurd and make the newsprint project impossible. This is however an item beyond the limits of the present review. It is obvious, however, that no project can be decided upon without having this subject cleared out.

From a technical point of view some comments seem necessary about the bagasse supply. When basing a pulp or paper mill on bagasse as fibre raw material the rule has been to place the mill adjacent to a sugar mill, preferably the largest in the region which often covers 50% of the bagasse need or more. The reason is obvious, i.e. to save transport costs of the bagasse.

In the present case the paper mill will not be close to any sugar factory and all the bagasse will have to be transported. In addition the sugar factories in Mauritius are small. This complicates the problem still more as will be obvious from the following.

Before being used in the pulping process of the paper mill the bagasse must be depithed. That means that the small particles contained in the bagasse forming the substance called pith and which amounts to about 30% of the bagasse, must be removed as otherwise the resulting pulp will be no good. Depithing is normally made at the sugar mill in order to avoid transporting the pith and to burn the pith in the boilers of the sugar mill. For this purpose depithing equipment is installed at the sugar mills. In the case of large sugar factories supplying a pulp or paper mill the number of depithing plants are kept at a minimum whereas in Mauritius due to the small size of the sugar factories the number of depithing plants and hence the magnitude of the investment costs would be accordingly high.

In the Sybetra study no mention is made as to which alternative the study is based upon, i.e. depithing at the sugar mills or at the paper mill. Both have their disadvantages. In the former case the investment costs and the production costs for the depithing exercise will be disproportionally high, in the latter case the transport costs will be accordingly high instead. In both cases the small size of the sugar factories in Mauritius means a disadvantage.

Appendix 9, part 2, of the Sybetra study concerns the supply of bagasse. It deals with the supply of bagasse to a market pulp mill, however, and the calculations made are therefore not applicable to the present newsprint project.

Fuel oil

The availability of fuel oil and the cost of it is the most important single factor for the viability of the newsprint project because it is directly deciding for the cost of the bagasse to be used as the fibre raw material for the newsprint production.

Industrialized countries normally use heavy fuel oil for their energy supply. This oil has at agreeable room temperature, i.e. around 20°c, the consistency of shoe cream. In order to be able to handle it this kind of fuel oil must be heated otherwise it is not possible to pump it and have it transferred in pipes. The installation of heating equipment is therefore necessary, which is rather expensive. When having to install heating equipment for the oil in any case because of the relatively cold climate existing as a rule in the industrialized countries they use fuel oils as heavy as they can manage because the heavier the oil the lower the price of it.

The heaviness of fuel oil is measured as its viscosity which is expressed in seconds in the way that the heavier the oil the higher the value in seconds. The industrialized countries use fuel oil 3500 seconds and above.

In countries like Mauritius where temperatures normally do not fall below agreeable room temperature the heating installations can be saved if a fuel oil of lower viscosity is chosen, i.e. up to a maximum of 1500 seconds. This oil is somewhat more expensive than heavier oils. Taking into consideration the saving of the investment capital for the installation of the heating equipment and of the current production costs the

lighter oil will however be the better choice. The calculations for the newsprint mill project should therefore be based on the use of fuel oil max. 1500 secs. This oil contains maximum 3 per cent Sulphur which limits the discomfort caused by the flue gases.

Mauritius is at present importing some 100,000 tons of fuel oil a year, mainly of 1500 secs viscosity. Something more than half of it is used within the country, primarily by the Central Electricity Board, CEB. The rest is reexported as bunker oil for ships calling at Mauritius. Total storage capacity at Port Louis today is 23,000 tons. The oil is brought by ships loading 18-19,000 tons.

The Sybetra feasibility study bases itself on the existing equipment at Grand Port to be used as the terminal for all incoming fuel oil, for the sugar estates as well as for the paper mill proper. It is said to be in good shape.

The writer has inspected the oil terminal at Grand Port and also discussed it with local expertise. The terminal was built during the last war and has never been used. Now it is more than 30 years old. The oil tanks have been painted from time to time on the outside. This has however, not been able to prevent corrosion of the equipment. 30 years is after all a long time, specifically when the terminal not being used and taking into consideration the nearness to the sea resulting in a corrosive atmosphere. The terminal as it stands can not be used for unloading oil tankers and for the storage of oil without being renovated. The equipment will have to be totally dismantled

except for the tanks and refurbished whereby obsolete and corroded equipment must be replaced. Parts which already now obviously are not to be used any more are the dolphin, the submarine line from the dolphin to the shore and the pump. How much more still that has to be replaced will depend on the result of a thorough inspection.

The cost of refurbishing the oil terminal is estimated at half a million U.S. dollars. Until the result of a detailed calculation of the costs is available it will be wise to consider the amount mentioned as a minimum.

The price of fuel oil 1500 secs is at present 2,70 - 2,75 Rs per gallon free storage tanks Port Louis without tax. This is the price paid by the CEB today. It corresponds very closely to 100 U.S. dollars per ton. The transport costs to the sugar estates in tank trucks is offered to be about 40 Rs per ton. Free delivered at mill therefore the fuel oil will cost 105 U.S. dollars per ton.

Water

Most of the year there is plenty of water in Mauritius. During the dry season, i.e. October to December, water gets scarce, however. A paper mill needs a constant supply of water all the year round. It will therefore be the water situation in the dry season which will be the deciding factor for the viability of the newsprint mill.

The site of the newsprint mill is supposed to be near the Ferney power station, one of the reasons being that water from the power station would be used as process water for the newsprint production. The writer has visited the Ferney power station and has also had discussions with representatives of the Central Water Authority, CWA, the Central Electricity Board, CEB, and other persons supposed to be able to contribute with facts and points of view related to the water situation.

The Ferney power station is during the dry period of the year used as a peak load station. This means that the water available is saved during certain periods for being used when the need of electricity is at the highest, i.e. primarily daily between 6 and 8 o'clock in the evening. This results in a very uneven flow of water through the power station. Most of the day in the dry season no water at all is passing through the turbines. This may as a matter of fact be the case even for periods of days in a row. During such periods there would be no water available for the newsprint mill. Obviously a paper mill can not be viable under such conditions.

The question therefore arises if possibilities exist which would make a constant flow of water possible to satisfy the mill even in the

dry season. Diverting water from other rivers into the Ferney power station system has been considered. Water from Ruisseau Tranquille is as a matter of fact being diverted into the Ferney system since recently. It has however had only limited effect on the discharge from the power station if any at all in the dry season.

A diversion of the river La Chaux has also been discussed. It is not of actual interest however as CEB has no plan for a realization of the project.

Still another project could be of interest in the connection discussed. Plans have for some time been going on for building a power station in the Grand River South East. Two alternatives are discussed. The original idea was to build the power station in the Grand River South East proper. Recently the idea has come up to place the power station in the way that the water would be taken from Grand River South East and emptied into the Champagne River whereby the water would be introduced into the Ferney water system. This is a project in the magnitude of thirty million U.S. dollars. At present nothing is decided about if and when the project would be realized and which of the two alternatives would be chosen. In any case it will take many years to implement.

It will therefore seem that one can not count on additional water to be introduced into the Ferney water system but that the newsprint mill will have to rely upon the water resulting from the system as it is today.

Lake Eau Bleue constitutes the water reservoir in the Forney water system. It has a volume of 220 million cubic feet corresponding to six million cubic meters. The question arises to which extent Eau Bleue is able to bridge the dry season and make a necessary minimum flow of water to the newsprint mill available. The quantity needed by the mill is given to 27 cubic feet per second. With some security added it is wise to make it 1 cubic meter per second which corresponds to 35 cu ft per second.

Lake Eau Bleue has since several years back never been full of water at the beginning of the dry season. With adequate measures taken it must be considered possible however to have it filled on the 1 October. With a volume of six million cubic meter and tapping 1 cubic meter per second the lake theoretically lasts for six million seconds which corresponds to 70 days. As a matter of fact however there will be no six million cubic meter available from the lake. Due to the bottom of the lake consisting of porous volcanic soil water is constantly leaking out and this at a speed of 15 cu ft per second. This will reduce the number of days during which it would be possible to draw 1 cubic meter per second to the mill to about fifty days. As the dry season lasts around one hundred days, in extreme dry years even more, this makes only half the time to be bridged. As a matter of fact the considerations upon which to base the water supply should be the driest out of a sequence of at least ten years in order to make the risk taking reasonable.

There is still the question of possible contributaries to the Creole River below the Eau Blouo lake. As a matter of fact a quantity of about 25 cu ft per second are estimated to flow into the river on its way down the valley towards Ferney. This water never reaches the power station however. The reason is that the Riche en Eau Sugar Estate has the right to use up to 30 cu ft per second for irrigation. There is an agreement however that the sugar estate does not draw the full quantity possible when the water flow is less than 30 cu ft per second in order that the river does not totally get dried out. At present, i.e. in the second half of November 1977, the situation is that out of an inflow of about 25 cu ft a second into the Creole River the Riche en Eau Sugar Estate draws about 21 cu ft a second. This leaves about 4 cu ft a second to flow further down the river. This quantity is far too small to keep a turbine at the Ferney power station running. The water is instead gathered in the small dam situated above the power station. The water gathered during twenty four hours makes it possible to run one generator during half an hour with a load of about 2000 KW which is only a fifth of the capacity of the station. This fact shows clearly the difficult position in what concerns the water supply at the Ferney power station.

In order to help bridge the water deficit period the building of a dam for the creation of a reservoir of some five million cubic meter of water in connection with the erection of the paper mill could be taken into consideration. The project would be costly and would make the sacrifice of sugar cane plantations necessary. It has not been

possible to penetrate the prospects concerning if and how much a project could be realized. In any case such a solution would in the history of pulp and paper production for a project of this magnitude represent quite an unusual case.

From the aforesaid one has to draw the conclusion that it must be considered doubtful if there is water enough from the Ferney power station to base a newsprint mill upon. It will be necessary to take other sites for the mill in consideration if other sites with sufficient water do exist.

Grand River South East is by several persons said to be the only possible water source for a paper mill thinkable in Mauritius. The Grand River South East being unregulated even here the dry season will create difficulties and it is the consideration of experts that the necessary minimum flow needod can not be guaranteed all the year round. A power station with a dam in the river would change the situation. It is unthinkable however to base the erection of a paper mill of the size and cost envisaged on a possibility which at the best may be realized some time in the future.

It is the writer's view that the water supply in Mauritius represent a serious obstacle to the creation of a large paper industry in the country. The writer's view should be further investigated by experts who have the necessary time available for a detailed study of the problem.

Pollution

Fundamentally one has to consider two possibilities of pollution from a paper mill, air pollution and water pollution.

Air pollution from a newsprint mill as foreseen will be small and in any case limited to the closest neighbourhood.

As to water pollution normal elsewhere in the world is that there is a recipient, normally a river, of a magnitude of a multiple of the effluent from the paper mill where the water from the mill sufficiently treated is diluted to a degree at which it can be accepted by the authorities.

In the case of a paper mill at Ferney the situation is that there, at least during the dry season, will be no recipient. The water taken into the mill as process water will be the only quantity flowing down the river to the sea when coming out of the mill again. This is not to be accepted because it would be a nuisance to the surroundings.

In a wider sense the lagoon outside Ferney is the recipient of the water coming from the power station and would logically be so also for the mill effluent. It would not be satisfying however to have the mill effluent flowing out into the shallow lagoon. Even if thoroughly cleaned the water leaving the mill contains chemicals and fibers which would influence the lagoon negatively in regard of domestic activities, fishing etc., as well as from a touristic point of view. The solution must be to have the effluent from the mill

pass the lagoon in a tube in order to be emptied outside the reefs where it hopefully would be absorbed by the Indian Ocean without further nuisance. Solutions like this have been practiced in several cases in industrialized countries.

The Sybotra study does not mention anything about how the pollution problem is going to be solved.

Site of Mill

Normally a number of single factors is deciding for the choice of site of a paper mill : water, electricity, effluent recipient, roads, railway, harbour, ground, workers, climate.

In the case of Mauritius water will be the deciding factor for placing the mill because water is scarce. In fact there seems to be only one possibility of obtaining water and that is from the Ferney power station. As shown elsewhere in this report under Water Supply the writer is doubtful if at all Ferney will be able to supply the paper mill with sufficient water. Apart from the water problem Ferney seems to present reasonable conditions concerning communications, ground, effluent recipient, workers and climate.

Infrastructure

For an industry of some size the existence of an adequate infrastructure is a necessity for its proper functioning. Transport facilities which make possible an effective organization at a reasonable cost of the supply to the mill of raw materials and other commodities as well as for the deporting products to leave the mill in a simple and effective way must be well developed. Other kinds of modern communications which make the connections with the surrounding world possible must be readily available and properly functioning. The import and export of goods and products must be possible to arrange in an effective way in order not to add unnecessary costs to the price of the products.

One of the reasons for choosing Forney as the site of the newsprint mill is said to be the nearness to the Grand Port harbour and the existence thereof an oil terminal and a jetty. The writer has visited Grand Port and has had discussions with representatives of the Mauritius Port Authorities, the contractor responsible for the work now being carried out in Port Louis harbour and others on the subject of Grand Port.

As to the oil terminal the parts of it which belongs to the harbour, i.e. the dolphin and the submarine pipe, are obsolete and of no value and the jetty can not be used for the export or import of goods with ships of any size. The Grand Port harbour therefore lacks every kind of infrastructure.

It will seem that the entrances to the lagoon surrounding Grand Port, there is a Northern one and a Southern one, do allow ships of

100,000 tons to enter. It is considered that ships of up to 40,000 tons may enter the harbour of Grand Port without dredging or blasting being necessary and this without assistance of tug boats. For larger ships dredging and tug boats would be necessary. The harbour at Grand Port therefore would fundamentally be feasible as harbour for the newsprint mill when equipped with the facilities necessary to receive ships of the magnitude in question and the corresponding arrangements for loading and unloading.

As the existing pier can be used only by shallow draft vessels a new pier will have to be built extending 400 m into the lagoon. The pier itself would be 200 m long to accommodate tankers as well as carriers of paper and other goods of 40,000 tons magnitude. The pier proper would be connected with the shore by a causeway of 200 m length which must be able to take loads of 25 - 40 tons from warehouses on the shore storing paper and raw materials of different kinds for the paper production.

An alternative to this arrangement would be to dredge the lagoon in order to come closer with the ships to the shore thus saving the necessity of extending the pier 400 m out into the lagoon in order to reach the necessary depth without dredging. This would necessitate dredging of a channel 75 m wide and a turning space for the ships of 400 m diameter. This would include the dredging of 1,5-2 million cubic meter at the cost of around 25 Rs per cubic meter and additional costs for the mobilization of the dredging equipment. Advantages with this alternative would be the reclamation of some 40 Hectares of land which could be used for the warehouses to be based upon. As the shore is rather narrow between the sea and the steep hills of the countryside the placing of the warehouses

creates some diffioulties. Other advantages would be closer access to the ships to be loaded and unloaded thus saving the transport via a causeway onto the main pier allowing at the same time increased man handling and less costly machinery to be used.

Today 600 m of quai is being built in the harbour of Port Louis at a cost of 59 million Rupees. Two warehouses of about 12,000 Sq m are being erected costing 16 million Rupees. Basing oneself on these real cost figures and taking into considoration increased prices since the work in the Port Louis harbour was contracted the installations at Grand Port can be estimated to cost as follows.

| | |
|---|---|
| 200 m quai | 40 million Rs |
| Warehouses | 12 " " |
| Back facilities, cranes, mechanical handling in bulk | 13 " " |
| Unspecified | 10 " " |
| | 75 million Rs |

This corresponds to 12 million U.S. dollars.

The port will have to handle about 400,000 tons of goods all kinds a year. During the years of erection all machinery and building materials will be imported via the Grand Port harbour. A road system that makes possible the undisturbed transport of all incoming and outgoing goods must be an integral part of the port.

As in the case of the Grand Port harbour a well developed road system must be made available to the newsprint mill. The quantity of bagasse to be transported to the mill is 450,000 tons a year. The transport between

the sugar mills and the paper mill will be in trucks loading sixteen tons. For reasons of avoiding serious deterioration of the bagasse the transport must be carried out during the milling period of the sugar mills i.e. during six months. Divided equally over 24 hours a day and every day of the week this means that a sixteen tons truck will be arriving at the mill for unloading bagasse every nine minutes. In addition there will be trucks bringing other raw materials among which are 85,000 tons of fuel oil a year to the mill and above all the transport of outgoing goods, primarily the 120,000 tons a year newsprint from the mill. All taken together this makes some three quarters of a million tons to be mastered by the road system around the mill per year.

There will be an intensified traffic to and from the sugar mills of fuel oil and bagasse. The existing roads are not able to carry this heavy traffic. Bridges will have to be fortified, roads straightened and pavings improved. It is not easy to estimate the costs for the improvement of the road system. It is the writer's view, however, that it will be wise to calculate with a cost for the additional infrastructure needed by the newsprint mill, including harbour facilities, roads and other communications systems, to not less than fifteen million U.S. dollars. Increased maintenance costs of the roads will be made necessary by the intensified and heavy traffic. The complex of infrastructure must however be thoroughly studied by experts on the spot to arrive at a more exact figure for the investment costs of the infrastructure.

Cost of Bagasse

The Sybetra study gives the cost of the bagasse to BF 1,487 per metric ton bone dry free at paper mill according to the following calculations. For comparison the writer's corresponding figures are listed in a separate column:

| | SYBETRA | | Present review |
|---|---|---|---|
| | BF/MTBD | US$/MTBD | US$/MTBD |
| Replacement fuel oil | 1,144.- | 32.- | 35.- |
| Premium to sugar mills | 197.- | 5.50 | 5.50 |
| Transport on roads | 61.- | 1.50 | 11.50 |
| Baling wires and services | 35.- | | |
| Diesel oil for stackers, etc. | 15.- | 3.- | 3.- |
| Maintenance materials | 19.- | | |
| Insurance | 1.5 | | |
| Contingency | 14.5 | | |
| | 1,487.- | 42.- | 55.- |

The checking of the Sybetra calculations is made difficult by the fact that Sybetra is working with escalated prices, i.e. prices which are believed to be prevailing at the moment of start-up of the mill. Nothing is said however in what manner the escalation has been made.

A check on the calculations concerning the replacement fuel oil shows the quantity to be incorrect. It is said that one ton of fuel oil is equivalent to 3.75 metric tons bone dry of bagasse. This is obviously wrong. Right is that 1 MT of oil is equivalent to 6 MT 50% bagasse which corresponds to 3 MTBD bagasse. The error could have

been avoided if the one who made the calculation had taken into account a letter of 7 December 1973 written by Mauritius Paper Ltd. themselves where the correct figure is given. The result of the error is a 25% higher quantity of fuel oil needed than calculated by Sybetra which means 75,000 tons per year instead of 60,000 tons per year representing an additional cost for substitution fuel oil of 1.5-2 million US dollars per year.

In the separate column which the writer has prepared for the cost of bagasse the figures which he considers to be correct have been introduced whereby it is to be observed that these figures are based on actual prices of today whereas Sybetra's figures, as mentioned, are based on escalated prices presumably some three years from now. The writer's calculated price of fuel oil is 105 U.S. dollars per ton as shown elsewhere under "Fuel Oil" whereas Sybetra's escalated price is 120 U.S. dollars per ton. The writer's cost for replacement fuel oil will be 0.333 x 105 = US$ 35 per ton bagasse bone dry.

The premium to the sugar mills is by Sybetra given to a bit less than 6 dollars per ton bone dry corresponding to almost US$ 3 per ton moist bagasse. This seems to be a fair figure.

As to the costs for baling, diesel oil, maintenance, insurance and contingency the writer has had no time available for a check. The figures are therefore accepted as presented.

The cost for transport on roads of the bagasse given by Sybetra is US$ 1.70 per ton bone dry bagasse. This is obviously too low. Sybetra themselves give in their General Report of August 1977, last Appendix, quite different rates for transport costs which are specified for each of the five sugar mills meant to deliver bagasse to the newsprint mill. A weighed average of these rates gives a transport cost of Rs 38 per ton. This corresponds to about US$ 6 per ton which can be considered as an acceptable figure. Per ton bone dry the cost will be the double or a bit less than US$ 12 per ton.

With the corrections made for fuel oil and transport the writer arrives at a cost per ton bone dry bagasse free at paper mill of US$ 55.- to be compared with Sybetra's US$ 42.- per ton bone dry. It has still to be remembered that the writer's cost is based on today's prices whereas Sybetra's cost is based on escalated prices three years from now.

Production Costs

A systematic review has been made of the different components comprised in the production costs as presented by Sybetra. Sybetra presents all costs in Belgian Francs. This may be feasible when working within Belgium. Working on an international level as in the present case normal is to work with one of the internationally well known currencies, primarily the U.S. dollars. All costs therefore have been converted into this currency for easier reference when comparing with other calculations of similar kind. (US$ 1 = BF 36).

On the following page the writer has listed the figures at which he has arrived for the production costs parallelly with the corresponding Sybetra figures. The following comments are offered to the different items. It should be remembered that Sybetra operates with escalated prices whereas the writer uses prices of today. (See pages 76 and 77 Feasibility Study, Vol.I).

Limestone (Coral)

The calcium carbonate needed in the recovery process normally is covered by limestone. Sybetra plans the use of coral instead. Coral is by Sybetra said to be freely available in Mauritius. This does not seem to be the case however.

Limestone is at present taken from a quarry close to Mahebourg for use in a lime kiln. The quantity available does not seem to be sufficient for the supply to a paper mill on a sustained basis however. Coral sand could be used, needs however a very special

## SUMMARY OF MANUFACTURING COSTS AT 100% CAPACITY

Production Costs in $ per MT

MILL OUTPUT : 120,000 TONS/YEAR

| Item | Sybotra | Present review |
|---|---|---|
| Limestone (coral) | 2.50 | 2.- |
| Salt | 6.50 | 7.50 |
| Alum | 6.50 | 6.- |
| Resin | - | 4.50 |
| Barium carbonate | 0.50 | 0.50 |
| Mercury | - | - |
| Graphite | 0.50 | 0.50 |
| China clay | - | 9.- |
| Sulphuric acid | 0.50 | 0.50 |
| Polyelectrolyte | 1.50 | 1.50 |
| Tri-sodium phosphate | - | - |
| Hydrazine | - | - |
| Dyes | 0.50 | 0.50 |
| Suveall flocculant | - | - |
| Slimicide | - | - |
| Fuel oil | 65.50 | 74.- |
| Water | - | - |
| Bagasse | 77.50 | 103.- |
| Aloe fiber (bast.) | 6.50 | 17.50 |
| Process Royalty | 1.50 | 1.50 |
| Consumables | 14.50 | 11.- |
| Sales of sodium hydroxide excess | ( 10.50) | ( 6.- ) |
| SUB-TOTAL : VARIABLE COSTS | 174.50 | 233.50 |
| Adm. & technical staff costs | 15.- | 11.50 |
| Labour costs | 4.50 | 3.50 |
| Miscellaneous expenses | 1.- | 1.- |
| Plant insurance | 1.50 | 4.50 |
| SUB-TOTAL : FIXED COSTS | 22.50 | 20.50 |
| TOTAL COSTS | 197.- | 254.- |

process for being burnt and the influence of removing large quantities of sand from the lagoon has to be taken into consideration. The quantities of coral rock now being taken out of the sea are very limited It is therefore quite undecided at present from where the calcium carbonate needed for the paper mill could be taken. The writer has not had the time to further penetrate this subject. It seems necessary to make a check as the quantity needed is large, not far from 20,000 tons per year.

Considering that Cusi is advocating the use of calcium hypochlorite for bleaching and not sodium hypochlorite the amount of coral seems acceptable. The writer can however not offer any opinion on the feasibility of using coral in the process as no chemical analysis of coral is available.

As to the price, BF 600 per ton corresponding to US$ 17 per ton escalated price, it seems to be acceptable for the calculation of the production costs.

Salt

The consumption indicated by Sybetra seems reasonable.

The price, BF 2,000 per ton corresponding to $ 56 per ton seems somewhat low taken into consideration being an escalated price. Today's price in Mauritius is Rs 400 per ton corresponding to $ 62 per ton. $ 60 per ton seems a reasonable price.

Alum

Alum is used for sizing the paper and for water treatment. The quantity listed by Sybetra will be sufficient.

The price, BF 6,500 per ton corresponds to $ 180 per ton escalated price which seems reasonable. The writer will use a price of $ 165 per ton as a price of today.

Resin

No expenses for resin are listed in Sybetra's production costs. For some reason this item has been forgotten. The quantity needed will be 0.75% of the paper furnish, i.e. 900 tons per year. With a price of $ 600 per ton, the costs for resin will be $ 4.50 per ton of newsprint.

Barium carbonate, Mercury, Graphite total in the Sybetra study BF 41 corresponding to $ 1 per ton. This figure is accepted for being used in the calculation. The writer wants to point out however that the use of the meroury method for the electrolysis of salt should be avoided because of the toxicity of mercury. The diaphragma process should be used instead.

China Clay

The quantity of China clay as calculated by Sybetra seems reasonable. The price as given to BF 10,000 per ton corresponding to $ 278 per ton. There must be some misunderstanding here. This price is much too high. A reasonable price is by the writer considered to be $ 80 per ton.

A further mistake is made by Sybetra in calculating the cost of China clay. When multiplying 13,583 tons with the price, BF 10,000 per ton the result is given as BF 135,830. It should read 1,000 times more, i.e. BF 135 million.

Sulphuric acid, Polyelectrolyte, Tri-sodium phosphate, Hydrazine, Dyes, Savcall flocculant, Slimicide are together BF 92.81 per ton newsprint corresponding to $ 2.50 per ton. The amount is without any further checking adopted by the writer.

Fuel Oil

The fuel oil in this connexion means the oil consumed within the paper mill for the paper production proper not comprising the bagasse substitution oil. It is calculated by Sybetra to amount to 66,149 tons per year according to the following. The writer's calculated quantities are listed parallelly.

| | Sybetra | Present review |
|---|---|---|
| | Tons per year | |
| Process | 49,516 | 49,516 |
| Lime burning | 6,805 | 6,805 |
| Balance power | 9,828 | 28,600 |
| | 66,149 | 84,921 |

The writer has had no time for going into the detailed calculations of the two first mentioned items. One remark has to be made however concerning the calorific value of pith used in the calculations. 6,750 Kcal/kg. as given certainly is wrong. It corresponds to the heat value of coal which obviously is not possible. A rough check of the two items show them in spite of this to be of a magnitude which can be accepted.

Oil needed for the balance power concerns the additional power to be produced in excess of the power that can be generated as backpressure power by expanding the process steam in a turbo-generator before being used in the paper making process. This balance power must be produced through firing fuel oil for generating additional steam specifically meant for use in a condensation turbine.

The quantity of oil calculated by Sybetra for this purpose represents the generation of a certain quantity of steam the heat content of which would be sufficient for generating the electrical power if generated as backpressure power. This additional power has to be generated as condensation power however which means that the energy needed in the shape of oil is three times higher. This error could have been avoided if Sybetra had properly studied their own report. In Appendix 20 of the study some considerations of Mr. Cusi about the production of newsprint from bagasse are presented. Amongst others it is shown, how to calculate the relationship between fuel oil and electric energy, i.e. according to the following

$$\frac{10.000 \text{ Kcal}}{\text{Kg.}} \times 0.3 \times \frac{1 \text{ Kwh}}{860 \text{ Kcal}} = 3.48 \text{ KWH/Kg. fuel oil.}$$

Using the same formula as Mr. Cusi, which is a commonly known one, the quantity of fuel oil needed for the Balance power is 28,600 tons per year instead of 9,828 as calculated by Sybetra. This means an extra cost for fuel oil of $ 2 million a year.

The need of fuel oil in the newspaper production process will therefore be 85,000 ton/year instead of 66,000 ton/year as calculated by Sybetra.

The price of the fuel oil is in the chapter Fuel oil calculated to be $ 105 per ton.

Water

It will be up to the water authorities to decide the price to be paid for the water to the mill. The writer has no opinion to offer as to what can be considered appropriate. The cost is set at zero.

Bagasse

Under the separate chapter Cost of bagasse the price of bagasse was calculated by the writer to be $ 55 per ton as against $ 42 per ton according to Sybetra.

The quantity of bagasse per ton of paper is considered to be adequate.

Aloe Fibre

In order to achieve a sufficient strength of the newsprint a certain amount of long fibre pulp in the furnish is needed. In the conservative kind of newsprint based on groundwood a normal furnish is 85% groundwood and 15% semibleached long-fibred pulp. Through the introduction of a new kind of groundwood recently it has been possible to produce newsprint from 100% groundwood.

In the present case the fibre furnish is based upon 95% bagasse pulp and 5% long-fibred pulp. In addition 8% of fillers calculated on the finished newsprint will be added. Typical for the uncertainties in respect of producing newsprint from bagasse is that the furnish on which the newsprint production in Peru is based is 8% long-fibred pulp, 4% groundwood and 10% fillers. In both cases Mr. Cusi is engaged as consultant.

In the present case Sybetra intends to produce the long-fibre pulp needed from aloe available in Mauritius. The intention is to pulp the aloe fibres in the same equipment as the bagasse.

The quantity of long-fibred pulp needed is some 5,000 tons per year. As the aloe plant contains 2.5% fibres only this would mean the handling of 200,000 tons of aloe per year. The whole idea of using aloe seems to the writer more theoretical than realistic. With all the handling necessary and the production costs included it would certainly result in a very high price of the pulp if at all sufficient aloe would be available to satisfy the need on a continuous basis.

The writer is furthermore of the opinion that the aloe fiber is not an ideal fibre as the long fibre furnish in newsprint if it is at all feasible to use it.

The idea of using aloe fibre should be reconsidered. This would certainly result in the idea being dropped. The simplest is to import semibleached kraft pulp. The cost will be some $ 425 per ton.

Process Royalty

This is an item which will have to be discussed both concerning the magnitude and the length of time it should be paid. The amount suggested is BF 60 per ton corresponding to 1.50 $ per ton.

Consumables

The cost of consumables and maintenance materials are given to BF 530 per ton corresponding to $ 15 per ton which figure seems reasonable as an escalated figure.

Sales of Sodium Hydroxide

In order to obtain the necessary quantity of chlorine needed for the bleaching of the bagasse pulp a certain amount of salt must be electrolized. The result is that a quantity of sodium hydroxide or caustic soda is produced corresponding to the chemical formula of salt. The quantity of caustic soda will in the present case be larger than needed and an excess of about 5,000 tons per year results. Sybetra calculates this quantity to be sold at a price of BF 8,775 per ton corresponding to $ 245 per ton.

Mauritius has at present a consumption of caustic soda of about 1,000 tons per year. This quantity would logically be sold within the country. The rest would have to be exported. In order to export caustic soda it has to be evaporated into dry state and then melted into drums for transport. It is not likely that a plant for evapo0 rating 4,000 tons per year would be economically feasible. The excess of caustic soda would instead have to be used within the paper mill in which case it can be a substitute for the lime intended for calcium hypochlorite. The value of the excess quantity of 4,000 tons per year may possibly be half the export price, i.e. with the 1,000 tons per year at full price an income corresponding to 3,000 tons per year at $ 245 per ton will result.

Administration and Technical Staff

The total amount calculated for this item by Sybetra is BF 65,438,000 per year corresponding to 1.8 million dollars per year.

The number of employees foreseen by Sybetra seem sufficient and the salaries have been checked by local expertise. They seem reasonable. Taking into consideration that Sybetra works with escalated figures, without indicating though in which way, the writer has reduced the amounts in Sybetra's calculation by 25% in order to arrive at the costs of today.

Labour Costs

Total amount is BF 19,252,186 per year corresponding to $ 533,000 per year. The same considerations is valid for this item as for the preceding concerning Administration and technical staff. The amount has been reduced with 25% accordingly.

Miscellaneous Expenses

The amount is BF 5,235,000 per year corresponding to $ 145,000 per year. This is said to be an allowance for miscellaneous expenditures calculated at 8% of the staff cost. The writer has no comment to offer and the amount is accepted.

Plant Insurance

The amount calculated by Sybetra is BF 7 million per year. This corresponds to about 1.5 per milleof the plant value. The premium seems low. According to local insurance companies insuring sugar mills and an existing fertilizer plant a minimum rate is 0.5% including loss of profit. The writer has used a figure of 0.4%.

Total production costs are in Sybetra's calculation $ 197 per ton and according to the writer $ 254 per ton whereby must be observed that Sybetra's prices are escalated prices and the writer's not, which makes the difference still larger.

Comparing the main elements of the two calculations the writer's figures exceed Sybotra's figures with the following amounts:-

Rosin, $ 4.50 per ton of newsprint. This item was omitted.

China clay, $ 9 per ton of newsprint. This item was miscalculated.

Fuel oil, $ 8.50 per ton of newsprint. The quantity of oil needed was miscalculated by 30%.

Bagasse, $ 25.50 per ton of newsprint. The transport costs were miscalculated by $ 10 per ton of bagasse. The quantity of replacement fuel oil was underestimated by $ 3 per ton bagasse.

Aloe Fibre, $ 11.50 per ton newsprint. The aloe fibre will have to be replaced by imported long fibred pulp.

Sales of caustic soda, $ 4.50 per ton newsprint. Only part of the caustic soda can be absorbed by the local market and the rest cannot readily be exported.

According to the foregoing the writer arrives at a cost of production 254 - 197 = 57 $ per ton higher than Sybetra, still keeping in mind that the writer's figure is today's price whereas Sybetra's figure is an escalated price.

It should be observed that in arriving at this difference in cost the writer has strictly followed the Sybetra pattern of calculations.

Investment Costs

The investment costs of the newsprint mill is by Sybetra calculated to BF 5,727,644,160 corresponding to $ 160 million* escalated price. No description is given of the processes to be used in the different divisions of the mill or of the machinery and equipment to be installed. No information is given as to what is included or to what is not included. The writer can therefore not comment upon details of the investment costs or upon the technical feasibility of the processes and equipment suggested.

The paper as well as the pulp industry is a very capital intensive industry. The capital costs per ton of produced paper and pulp are therefore high. Prices of machinery and equipment have increased heavily during recent years. With a price index of 100 in 1965 it was 140 in 1970 and 260 in 1975. In 1977 the investment costs will have almost tripled compared to 1965. Compared to mills built in previous years a new mill of today will have considerably higher expenses for capital costs. This makes the prospects of profitability of such a mill less favourable.

There do not exist any standard prices for pulp and paper mills. The investment costs may vary as much as 25% up or down from an average figure, depending on type of mill, what process to be used, country, site, effluent disposal, quality of machinery and

*(US$ 1 = BF 36)

equipment, local construction costs, degree of instrumentation, local costs and availability of skilled erection workers, technical assistance from outside, training of personnel abroad, infrastructure, volume of machinery comprised in the deliveries and several other factors.

The Sybetra figure of 160 million dollars represents an escalated cost figure. Nowhere is said how the escalation has been made. Most likely it would indicate a price of today of some £ 140 million. Taking into consideration extra costs specific for the present project, e.g. the large number of installations at the sugar mills of steam boilers, oil storages, baling equipment, depithing plants, further water dam at the mill, need of numerous skilled erection personnel all categories from abroad, lack of workshops and other auxiliary industry in the country, the investment costs of £ 140 million may be questioned. The writer is prepared, however, to accept it as the basis of the profitability analysis. It is understood that the amount does not include costs for infrastructure such as oil terminal, harbour, roads or investments needed for trucks, salt manufacture and other things not directly belonging to the paper mill as such.

Profitability

The profitability of a project is determined by the sales revenues, the production costs and the investment costs.

As mentioned earlier Sybetra has based their calculations upon escalated cost and price figures. This is not the normal way of making a feasibility study. Nobody knows what the future will bring. The only thing we can be sure of is that escalated prices will turn out to be wrong when time comes. Working with escalated prices therefore brings an uncontrolable factor of uncertainty into the calculations. Normal is to use present prices and costs as the basis of profitability studies. The result arrived at can then be used for sensitivity analyses regarding single factors of deciding influence on the economical outcome such as price of final product, rate of production and others.

Normal figures for the production from a paper mill in the first years of operation are 70% of the capacity for the first year, 90% for the second and 100% for the third year. Sybetra in their study mentions nothing about the first two years, says however that the full capacity will be reached at the end of the second year, which must mean that full capacity will be reached during the third year of operation.

In their listing of the tonnage of production for the first 10 years they have however reached 90% already during the first year and 100% during the second. These two statements are evidently contradictory. They are however to be found on the very same page of the Sybetra report.

In the same listing of the tonnage of production Sybotra reach a production volume of 105% during the third year, 110% the fourth and 115% all the years thereafter. This is a most unusual way of calculating and the writer never saw anything like it in another feasibility study. Even in an industrialized country highly experienced in pulp and paper making one would be happy to reach 100% during the third year and nobody would dare to count on reaching 115% during the fifth year. In a feasibility study one should not go beyond 100% of the capacity. If one succeeds in reaching a higher production it will be something to be happy and grateful about. In a developing country where the conditions are less favourable than in industrialized countries one certainly will be happy to reach 100 the third year and to maintain this output thereafter. There are too many examples of pulp and paper mills in developing countries never reaching 100%.

In this connection one should keep in mind as was discussed in the chapter Market Survey that most likely the newsprint mills for lack of orders will not be able to sell the full production quantity possible. The assumption that a quantity corresponding to 100% of the capacity will be sold is therefore already optimistic.

Sybotra's figures to base the profitability calculation upon are the following:

| | Rs |
|---|---|
| Total capital invested | 1,046,145,150 |
| Sales | 322,177,200 |
| Production costs | 155,824,990 |

This results in a net annual revenue of 16% of total invested capital.

For the ease of reviewing the complex of factors involved in the profitability analysis the writer prefers to operate with the figures representing the selling prices and production costs per ton of newsprint and not the total yearly amounts. As reported earlier Sybetra's figures translated into U.S. dollars were the following:-

| | |
|---|---|
| Investment costs | $ 160 million |
| Sales price (306 x 1.33) | $ 407 per ton |
| Production costs | $ 197 per ton. |

Based on these figures a profitability of 16% results which shows the transferring from Rupees into Dollars to be correct.

The writer's corresponding figures were:

| | |
|---|---|
| Investment costs | $ 140 million |
| Sales price | $ 290 per ton |
| Production costs | $ 253 per ton. |

This gives a net annual revenue of 3% of invested capital as compared to the 16% mentioned above based on Sybetra's figures. 3% will obviously not provide sufficient funds to cover the payment of interests on credits and loans, amortization and profit.

In order to further analyse the results arrived at the two sets of cost figures are listed parallelly in the following:

| | Sybetra $ | Present review $ |
|---|---|---|
| Investment costs (million) | 160 | 140 |
| Sales price (per ton) | 407 | 290 |
| Production costs (per ton) | 197 | 253 |

The large difference in sales price is apparent only as Sybetra's price is an escalated price. The corresponding present price is $ 306 per ton.

The fundamental difference between the two series lies in the production costs. In spite of the Sybetra cost being escalated the cost resulting from the present review as being prices of today is more than 25% higher than Sybetra's figure. Escalating the writer's cost of production of today with, as seems logic, the same percentage as the sales price, i.e. 33%, gives an escalated production cost of $ 336 per ton. Based on this production cost with the sales price and investment cost unchanged Sybetra's return on investments is 5%. The rest of the difference between the figures, from 5 to 3, is explained by a small difference in sales price.

Fundamentally there is no difference between the two calculations in regard of sales price and investment cost. The large difference is to be found in the production cost. Item by item the differences in production costs have been discussed in the separate chapter on Production Costs and the causes for the differences explained in detail. The correctness of the writer's figures can therefore easily be checked.

The return on investment can be influenced by each of the three components, sales price, production cost and investment cost. The production cost has been reviewed and discussed in detail in this report and further discussions cannot bring about any substantial changes. In respect of investment costs there does not seem to be too much disagreement. The last component that could be argued is the sales price. Even in this case there is no serious difference in opinion, only 5%, which is of marginal influence only.

A study of the influence of varying sales prices on the profitability will be of interest. Assuming a 10% higher sales price than the one used by the writer will bring up the prices from £ 400 and £ 350 per ton cif to £ 440 and £ 385 per ton cif or from £ 290 per ton to £ 326 per ton ex factory. The return on investment will increase from 3% to 6%. A 20% increase in sales price, meaning c.i.f. prices £480 and £ 420 per ton respectively will increase the return on investment to 9%. In order to achieve 15% return on investment the cif prices would have to be increased by 45%.

15% return on total capital invested is normally considered necessary for attracting the interest of possible investors. To achieve this, prices for East Africa would have to be increased to £ 580 per ton cif and the prices for India and the Far East to £ 510 per ton cif. The prices of today being £ 400 and £ 350 per ton cif respectively, this is far beyond the limit of possibilities.

When selling on the world market one has to compete with other producers of the same kind of goods as produced by oneself. The fibre raw material being the dominating factor in the production costs of paper it is important to know how the own costs of fibre raw material compare with the costs of fibre raw material consumed by presumptive competitors.

In the present case of newsprint from bagasse the fibre furnish consists of bagasse pulp and long fibred pulp to which comes China clay. The cost of these three components together is $ 129.50 per ton at today's prices, say $ 130 per ton.

As mentioned earlier the newsprint on the world market with which the bagasse newsprint would have to compete consists of groundwood and chemical pulp both from coniferous wood. The quantity of wood needed is 2.5 $m^3$ per ton newsprint. This is the total furnish as no filler is used.

The price of wood differs considerably in different parts of the world. In Chile plantation wood is reported to cost less than $ 10/$m^3$. In Honduras the cost is $ 15 per $m^3$ and in Guatemala $ 16 per $m^3$. In the Southern states of U.S.A. the price is around $ 18 per $m^3$ whereas in the Northern States and Canada the price is higher, around $ 25 per $m^3$, all prices free delivered pulp or paper factory. In Sweden finally which has the highest wood prices in the world the price will be $ 28-32 per $m^3$ depending on species and part of the country.

Keeping in mind that 2.5 $m^3$ are consumed per ton of newsprint the cost of the fibre furnish will be from $ 25 per ton of newsprint in Chile, to $ 40 per ton in Central America, $ 45 per ton in the Southern States of USA, $ 63 per ton in Canada and in Sweden finally $ 75 per ton newsprint.

Comparing now the cost of the fibre furnish in Mauritius $ 130 per ton with the corresponding cost in USA and Canada from where the main competition can be expected, amounting to $ 45-63 per ton, it is obvious that bagasse is no cheap fibre raw material. Until the oil crisis three years ago bagasse was a cheap fibre raw material. With the booming oil prices that is not the case any more. Even Scandinavia with their high costs of wood have a lower cost for fibre raw material than would have Mauritius.

Having to face the fact that the fibre furnish for the newsprint is higher in Mauritius than in countries where news-print is produced for export, the question arises if Mauritius has advantages of other kinds which could counteract this fact. As far as the writer's study in Mauritius has shown this is not the case. Fundamentally therefore Mauritius does not seem to grant conditions specifically favourable for a successful competition on the world market in respect of newsprint production.

Financing

As mentioned earlier the investment costs in the pulp and paper industry are very high. There are no major units being built today which are not based on credits and loans. Credits will come from producers of machinery and equipment, loans from financing institutions of different kinds, in the case of developing countries including different regional development banks and the World Bank.

Even in the case of the newsprint mill in Mauritius large credits and loans would be needed and the promoters of the project have approached possible manufacturers of machinery and financing institutions in this regard.

Normally there will be good aspects for receiving credits from machinery manufacturers and banking institutions for new industrial enterprises. The only condition that will have to be filled is the necessity of showing that the profitability of the project will be of a reasonable magnitude.

This will be a necessity even in the case of the newsprint mill in Mauritius. The machinery producers and the credit institutions approached by the promoters of the project have one thing in common : they declare their willingness of giving credits and loans under the explicit reservation that a feasibility study be presented showing a, in their view, satisfying profitability.

The Sybetra feasibility study of June 1977 is far from being of World Bank standard. The study contains numerous errors and miscalculations, some of them serious. This has been made evident by the writer in the foregoing as a result of his review of the study. The quality of the study as a whole does not inspire confidence. Quite sure no machinery producer or financing institution would grant any credit or loan based on the feasibility study of June 1977 presented by Sybetra.

In order to attract possible investors' interest it would be necessary to present a feasibility study made by qualified persons having the necessary knowledge of pulp and paper production and experience in making feasibility studies.

It is the writer's view that it is doubtful if such a study would be able to show the project to have a profitability high enough to attract the interest of foreign investors and hence make the realization of the project possible.

Conclusions and Recommendations

As has been demonstrated in the foregoing the technology suggested by Sybetra to be used for producing newsprint from bagasse has not been practised in any large scale newsprint mill yet. Until any process of this kind has proven its viability in large scale operation it cannot be considered a risk free enterprise to invest in a newsprint mill based on bagasse.

The quantity of bagasse available in Mauritius would be sufficient to supply a newsprint mill as envisaged.

The market study presented in this review makes the existence of a certain over-supply to the world market of newsprint in the period following the start up of a newsprint mill in 1980 to be expected. Most likely a newsprint mill during this period would only with difficulty be able to sell the whole of its possible production.

The writer comes to the conclusion that it is doubtful if there is sufficient water available in Mauritius to cover the needs of a newsprint mill. The writer's view should be followed up by a detailed study.

Apart from the water situation the site of the mill seems suitable.

As the effluent from a paper mill always is contaminated by chemicals and fibres it will be necessary to have it cross the lagoon in a tube to be emptied into the ocean.

There will be a need of a harbour near the mill and of improved road communications. The costs of the infrastructure made necessary by the paper mill is estimated at US$ 15 million which supposedly would have to be invested by the Mauritius State.

The review shows that the cost of bagasse is considerably higher than calculated by Sybetra. A comparison of the cost of bagasse with the cost of wood used for paper production in newsprint exporting countries shows bagasse to be a more expensive fibre raw material than wood.

The critical review of the production costs of the newsprint makes evident errors and miscalculations in the Sybetra study of a magnitude that makes their figure 70% too low.

This brings about a total change in the profitability of the project. Whereas Sybetra arrives at a revenue of 16% on the total investment costs the writer's corresponding figure is 3%.

A 10% higher price of the newsprint increases the return on investments from 3 to 6% and a 20% increase of price heightens the return to 9%. In order to reach 15% return on investments the newsprint price would have to be increased by 45%. This is beyond realities.

The present review will have made evident that the Sybetra Study of June 1977 cannot be used as a document on which to base a decision concerning the erection of the newsprint mill. No

deciding steps should be taken before a new feasibility study has been presented made by qualified and experienced experts.

From the conclusions arrived at as the result of the present critical review of the project it is not to be expected that the study will show the project to have the profitability necessary to attract the interest of foreign investors.

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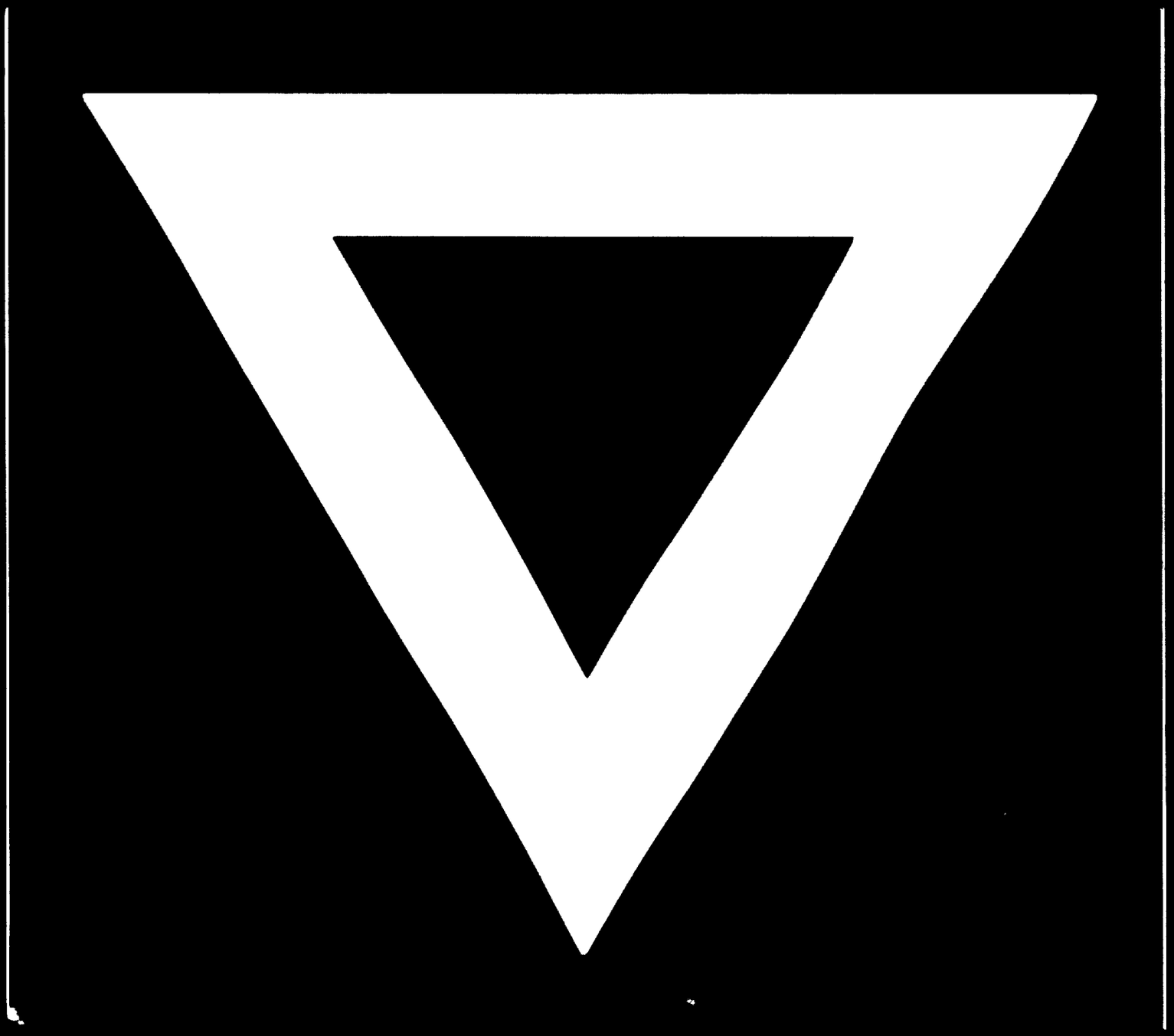

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