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BAGASSE NEWSPRINT 1/

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1. SCOPE OF THE PAPER.

The Paper defines the important reasons for establishing bagasse newsprint mills in cane growing countries and states the main criteria for judging the viability of such mills.

Five important commercial and economic aspects which may restrict the operation of bagasse mills or otherwise tend to impose limitations are discussed.

A brief account is given of a semi-mechanical bagasse pulping process that was used in a series of mill scale pulping, papermaking and printing trials in which acceptable newsprint was produced.

Reference is made to several different technical approaches to the subject of bagasse newsprint manufacture and these are briefly reviewed in the context of their economic as well as technical merit.

A summary of conclusions and recommendations is given in respect of all the different aspects discussed.

2. AIMS AND CRITERIA FOR ESTABLISHING BAGASSE NEWSPRINT MILLS.

The primary aim for establishing bagasse newsprint mills in the cane growing countries is to enable them to produce sufficient newsprint from their indigenous national resources to satisfy their internal market demands. To this may be added in some cases, the secondary possibility of exporting to neighbouring countries. To the countries where these mills may be built, these aims are in accord with a general policy of industrialisation and the provision of highly productive and stable employment in areas where the populations are heavily dependent on basic agricultural economies.

Investors in bagasse newsprint mill projects may have different objectives according to their particular interests and these are discussed in more detail in Section 3.5. It follows that the criteria by which investors will judge a project may also differ and particularly, Government and private investors may differ in the emphasis they place on various factors. Allowing therefore that any set of criteria is likely to represent a compromise, the important criteria for judging the viability of a bagasse newsprint mill are considered to be :

1. That the quality of the product must be satisfactory and acceptable to the market
2. That there must be a sufficient return on capital invested.

3. That there should be the maximum possible saving in foreign exchange for the country in which the mill is built.
4. That in due course the mill operation will provide Government revenue by taxation for social and public purposes.

There are no absolute standards to be met in considering each one of these criteria; rather it is necessary to review the combined merit of a project based on all these issues and other consequent effects.

3. LIMITING COMMERCIAL AND ECONOMIC FACTORS.

3.1 Prices and Markets.

The price which a bagasse newsprint mill can obtain for its product, and the extent of the markets open to it are decisive factors in determining mill revenue and profitability.

Ideally the selling price should be competitive with the price of imported groundwood newsprint and Project Studies show that this can be achieved in several countries where the production costs are low enough. However, the target is elusive because the cost of imported newsprint is ill-defined. The majority of the world's newsprint is consumed by the industrial countries who therefore constitute the important markets for the main producers. Sales of newsprint to the cane growing countries form only a very small part of the total world market in newsprint, and the evidence is that the prices of these sales are unstable and often at depressed levels. It has also been reported at a recent international conference that the sales are accompanied by irregular commercial practices which conflict with a free market. This situation creates a difficulty in determining the price a bagasse newsprint mill may expect to receive for its product.

This is an issue of first importance to the Government of a country in which a mill may be built, for the maintenance of a stable price - which can still be competitive - is a necessary foundation to a successful operation. It is suggested for consideration that a fair price basis for bagasse newsprint would be the recognised selling price of groundwood newsprint in

the country which is the present source, plus the cost of freight.

Governments will no doubt exercise their views as to what price a mill may actually receive for its product and presumably they will take into account all the potential benefits which can accrue to a nation from the establishment of a mill and which have been listed amongst the objectives. Further they will appreciate that their influence in determining the selling price of newsprint is one way by which they can attract private investors both foreign and national, to a project.

A Government clearly has the option to exert its influence to whatever degree it may consider appropriate in the interests of the country and depending on its overall economic policies it may, for instance, grant a project some encouragement by taxation advantages particularly during the initial years of operation when the debt servicing burden is heaviest. It may also go beyond the point of stabilising newsprint selling prices and ensuring the elimination of undesirable trading practices by establishing tariffs or quotas on imports. It is not uncommon for grades of paper other than newsprint to be subject to tariffs, usually to protect national manufacturers, and if this is considered a correct policy, there seems no good reason why newsprint should be treated differently. The size of the market open to a mill determines its capacity, and the larger the mill capacity, the lower the cost of production. It is clearly desirable to plan on the basis of present and projected markets available and to aim for the largest possible output compatible with machine sizes and roll widths.

Home markets for bagasse newsprint are the most reliable, and consumption of newsprint in a few cane growing countries is already sufficiently large to justify serious consideration being given to the construction of individual mills to satisfy these internal demands. As to whether exports are a commercial proposition depends in the first place on overcoming the same marketing problems which affect a home market, namely, to ensure a fair market price and price stability. Exported bagasse newsprint carrying an increment of freight cost would have to compete with imported groundwood newsprint and it would be unlikely that this could successfully be achieved if the imported newsprint from the world's major producers was being sold at artificially depressed prices. Moreover the bagasse newsprint prices could not be competitive if subjected to high commissions.

Compared with home sales, export markets inevitably entail a greater risk if only because the market conditions are outside the control of the producer and exporter. The circumstances surrounding the potential production of bagasse newsprint emphasise the case for the establishment of regional economic groups of countries, not necessarily to raise external tariffs but to share their markets under stable price conditions and enable them to develop their national industries and resources.

5.2 Viability of the Cane Sugar Industry.

An assured supply of bagasse at an economic price is a pre-requisite for the establishment of a bagasse newsprint mill. The viability of the operation of the sugar mills which are going to be relied upon to provide the bagasse is therefore a vital issue. In some cases it may be possible and desirable to view the operation of a cane sugar industry and a bagasse papermaking operation as a single commercial enterprise.

About 70% of the world's sugar is sold internally within the countries in which it is produced and of the remainder more than half is marketed for export under preferential agreements such as the U.S. Sugar Act, the Commonwealth Sugar Agreement and the pact between the Soviet Union and Cuba. Under these arrangements, the importing countries have long term contractual obligations to buy certain tonnages at agreed price levels which are considered fair to both producer and consumer. Outside these agreements, the majority of the remaining export market is subject to the International Sugar Agreement of 1969 which is due to be re-negotiated in 1974 and which operates mainly by a system of quotas. Political changes which are not connected in their origins with the world sugar market can affect the operation of the international preferential agreements so that quotas and market conditions may be altered when new agreements come into force. For example, the Commonwealth Sugar Agreement is likely to lapse if the U.K. joins the European Economic Community and whatever may be agreed in substitution, may affect the positions of the Commonwealth sugar producers.

Many countries subsidise their internal price of sugar in one way or another and the consequences and long term effects of such a policy warrant consideration. An excessive dependence on such support can lead to weaknesses which might make a sugar mill extremely vulnerable if political support were to be withdrawn.

Such issues, both international and internal, can affect the viability of the cane sugar industries of various countries, and this in turn may affect bagasse availability. However, from the point of view of a cane sugar mill, diversification into papermaking can diminish dependence on the sugar market and can mitigate the effects of losses of special sugar quotas or other protection.

The overall forecasts for world sugar consumption up to 1980 do not give cause for suspicion that there will be widespread cane mill closures in the present decade. On the contrary, the evidence is of an increase in consumption estimated from 51.8 up to 70.4 million tons between 1970 and 1980 with the biggest percentage increases coming in Latin America, the Far East and Africa. The new demand within these regions is likely to be met from cane grown internally and this alone constitutes a favourable circumstance for bagasse newsprint development. Nor is the position discouraging for those sugar producers who are dependent wholly or to some degree on exports, for even when taking into account possible changes in preferential Agreements, given the continued successful existence of the International Sugar Agreement, it seems likely that the free market world sugar price can be held at a level which is profitable to producers.

Under all these circumstances in the next decade there is not likely to be any general depression in world sugar prices arising either from an inadequate demand or an excess of supply of sugar, and sugar mill closures connected with the sugar market are only likely to occur in exceptional isolated cases.

3.3 The cost and origin of fuel.

The release of bagasse for papermaking requires the provision of replacement fuel for burning in the sugar mill boilers as well as fuel for steam raising and other purposes in the paper mill.

Fuels available may be oil, coal or gas but in the majority of cases the fuel supply is oil and there are only a few instances in cane growing regions where coal and gas occur in sufficient quantities and at low enough cost to be considered.

Fuel requirements per tonne of paper produced vary widely for projected bagasse newsprint mills according to the extent and efficiency of power generation and the mill departments included. However, assuming the provision of efficient oil-fired boilers in the sugar mills and high pressure boilers with partial electric power generation in the paper mill, and provision of oil for lime burning, the total fuel oil requirement for bagasse replacement and all purposes in a newsprint mill using a 95% bagasse furnish will be approximately 1 tonne of oil per tonne of newsprint produced. This is a significant amount and consequently, the cost of fuel is normally the most important increment of the total manufacturing cost.

There are considerable variations in the unit cost of fuel oil when delivered to individual locations in the cane growing countries depending on its origin, the transport and storage systems involved and the level of excise duty charged. A high unit

cost of furnace oil delivered to a proposed mill location may constitute a limiting factor in achieving an adequate mill profitability. The effect of variations in the unit price of furnace oil on total manufacturing cost, assuming a typical boiler and power plant and lime burning arrangement is shown on the graph in Figure 1. Such calculations take account of the fact that the efficiency of bagasse fired boilers is usually very low and of the order of 54% compared with about 84% for an efficient oil fired boiler. Allowing for this difference in efficiencies, 1 tonne of furnace oil having a heat content of 18,000 BTU's per lb. is equal to about 6.75 tonnes of 50% moist bagasse, in the sense that these quantities of oil and bagasse when burned in different boilers will generate amounts of steam having the same useful heat content. In these terms, to burn bagasse as a boiler fuel is an extremely inefficient operation.

It may be economically advantageous to generate the whole of the electric power demand for a mill internally, and the optimum solution needs to be checked in every case having regard to the cost of purchasing power. However, in some countries national power authorities reserve the right to generate power beyond specified levels.

The most efficient fuel burning arrangement would occur if it is possible to combine the steam and power generation services of a large sugar mill with those of an adjacent bagasse newsprint mill. In such a case, the bagasse would be transferred directly or via an adjacent store from one mill to the other, and all the steam and power would be

GRAPH OF EFFECT ON TYPICAL MANUFACTURING COST OF THE PRICE OF FURNACE OIL.

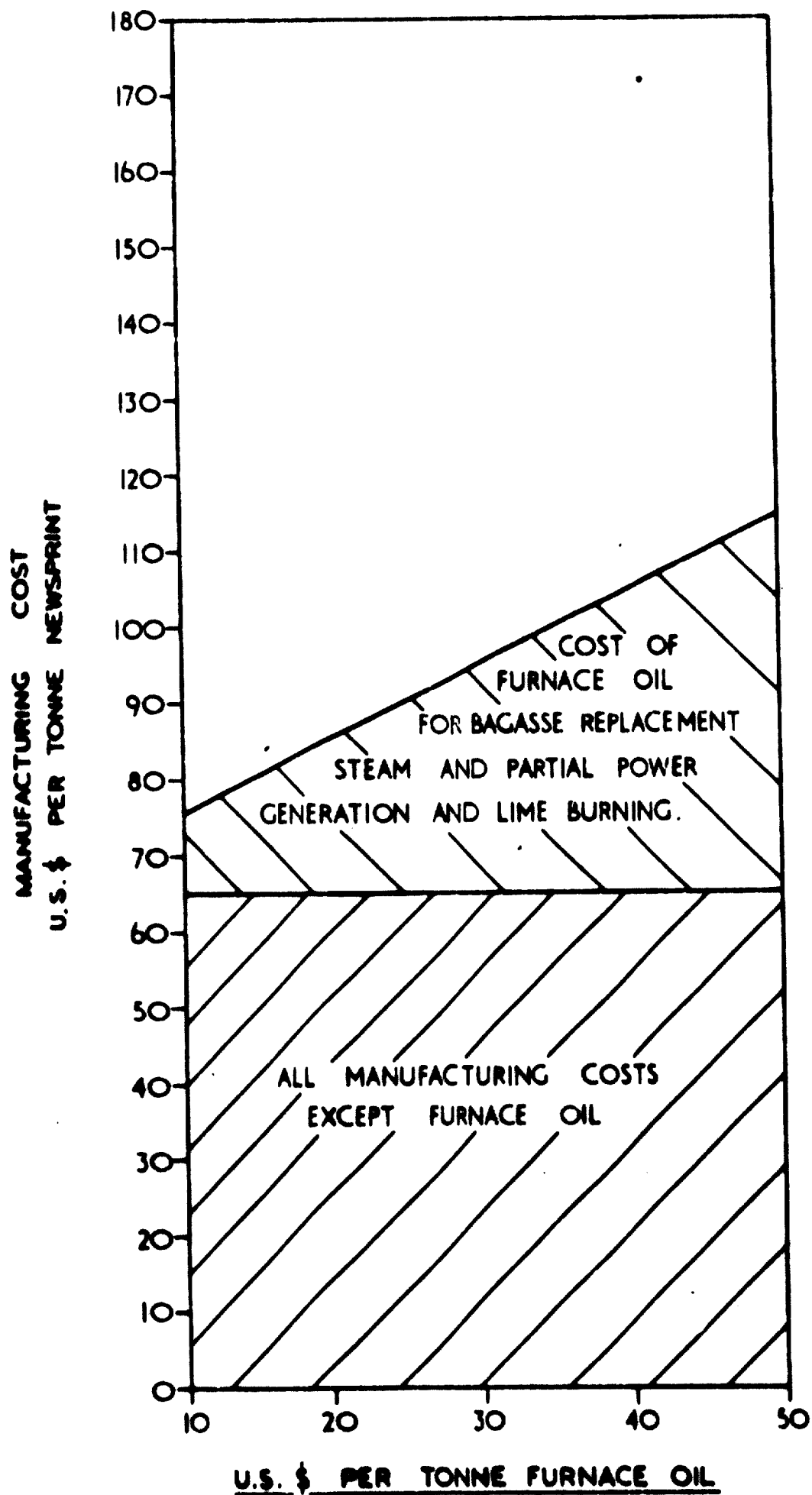


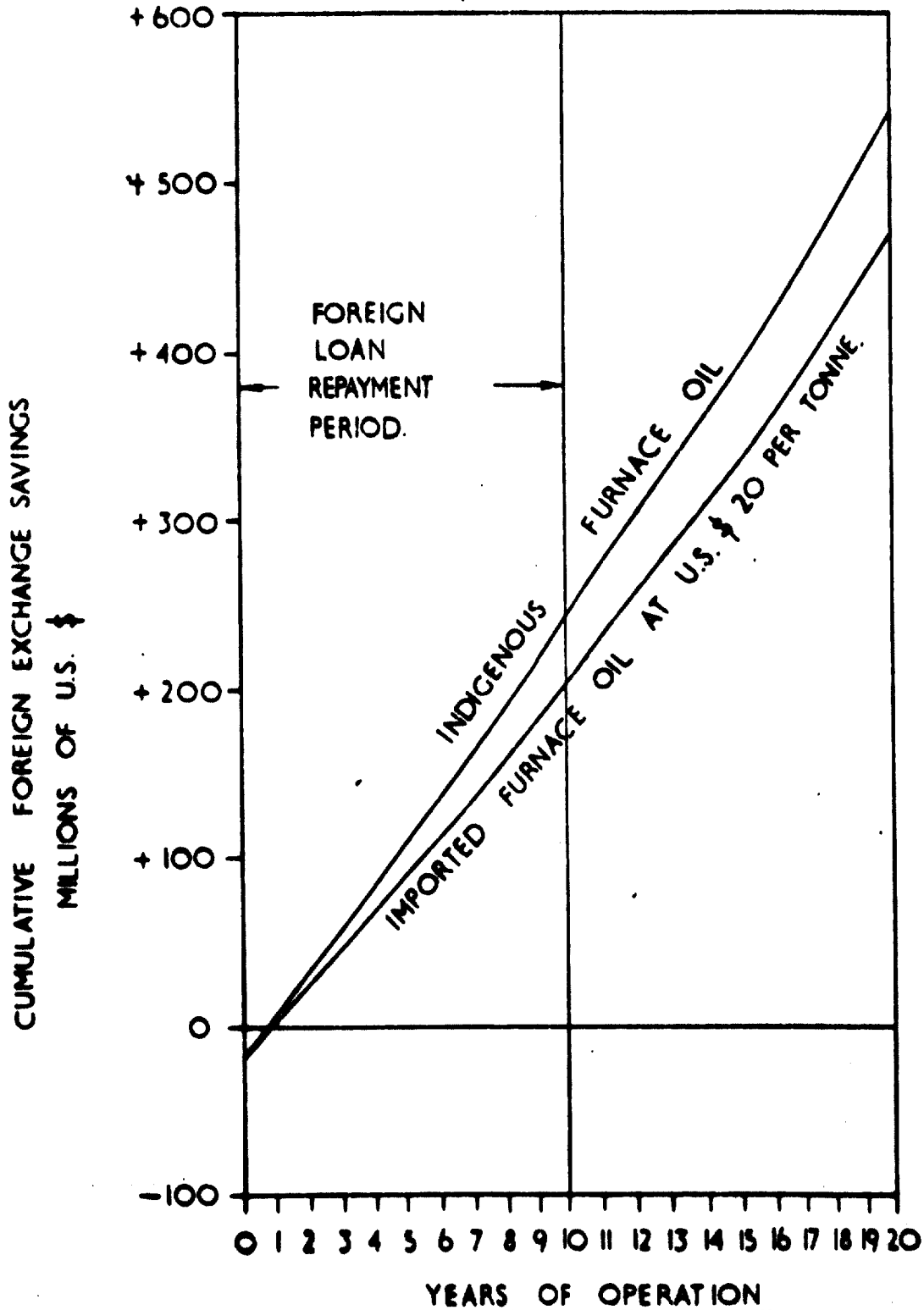
FIGURE 1.

generated for both units in common high pressure boilers. The economics of the power station would be still further improved if electric power could be fed to the national grid during periods when the sugar mill is not in operation.

In carrying out an economic analysis for any bagasse newsprint project, it is necessary to examine with cost models every possible alternative of steam and power arrangement, since substantial differences can occur between the alternatives in terms of the profitability and foreign exchange criteria.

Some countries have fuel resources which are already or are becoming fully committed and in these cases it is necessary to consider whether the importation of furnace oil has any significant effect on foreign exchange savings. This effect is shown by the graphs in Figure 2 assuming furnace oil at a price of U.S.\$ 20 per tonne delivered. The graphs show that the reduction in nett foreign exchange savings resulting from importing oil at this price, represents only a small proportion of the very large saving arising from eliminating or reducing imports of newsprint, and that judged by this criterion a bagasse newsprint mill is still justified even if oil is imported.

GRAPH OF EFFECT ON TYPICAL CUMULATIVE NETT FOREIGN EXCHANGE SAVINGS OF THE ORIGIN OF FURNACE OIL.



ASSUMPTIONS.

1. FIBROUS FURNISH - 95% BAGGASSE PULP, 5% PURCHASED INDIGENOUS LONG FIBRED PULP.
2. IMPORTED CONSUMABLES AND MAINTENANCE MATERIALS AT U.S. \$ 10 PER TONNE NESPRINT.
3. FOREIGN LOAN CAPITAL REPAYABLE BY 10 YEARS AFTER START-UP.
4. 600 TONNES PER DAY MILL.

FIGURE 2.

3.4 Comparison with wood based projects.

It is not within the scope of this Paper to make a comparative analysis of wood and bagasse based newsprint projects where both these possibilities exist in the same country. For such purposes, the circumstances cited in a recent Paper* prepared in respect of Latin America are equally applicable anywhere in the world.

The significant facts are that in the cane growing countries, sufficient areas of plantation forests of coniferous wood suitable for making newsprint do not exist. Some countries have the potential to grow such plantations but the trees would take about 15 years from planting to reach cutting age, and plantations on the scale required could only be grown by the implementation of a very long term programme. A few countries already have small coniferous plantations growing up, but the availability of wood from these areas is far deficient of what is required to meet newsprint demands. Some countries have large natural coniferous forests mostly comprising various species of pine but from the point of view of newsprint manufacture, this wood source has the technical disadvantage that the older trees produce a rather dark and resinous groundwood. This can be bleached, but the cost of doing so is considerable. Unfortunately the cost of cutting and recovering trees from these

* Jaakko Poyry & Co: An appraisal of the newsprint development opportunities in Latin America. ECLA/FAO/UNIDO. Paper V. Regional Consultation on the development of the forest and pulp and paper industries in Latin America, 1970.

natural forests, which are usually in high and inaccessible mountainous regions inadequately provided with roads and other infrastructure facilities, is prohibitive. Selective cutting of young trees is possible but renders the operation still more uneconomic because of the increased cutting areas involved.

Deciduous hardwoods are available in the cane growing countries in much larger quantities than conifers, but these trees mostly occur in mixed natural forests where selective cutting of trees by species and age for newsprint manufacture would not be an economic possibility. There are limited possibilities where trees of about the same age and species occur in sufficient concentrations and under these circumstances newsprint is being made from Eucalyptus in Australia and Gewa wood in East Pakistan; there are also proposals to use Poplar and Willow species in Argentina. Large plantation forests of hardwoods suitable for newsprint do not exist in the cane growing countries with the exception that Brazil has plantations of young Eucalyptus. However, it is reported* that technical procedures for producing satisfactory newsprint from Eucalyptus wood of this age are still in course of development.

To summarise, the cane growing countries with a few exceptions do not have sufficient uniform supplies of soft or hardwoods suitable to support a newsprint industry. By comparison, many of these countries do

* Jaakko Poyry & Co: P.17, 1b1d

have sufficient bagasse available to produce newsprint in mills of capacities of 100,000 tons per annum upwards. Moreover, compared with wood, bagasse has the merit of being available in bulk supply at the sugar mills without additional harvesting costs.

3.5 Ownership and mill management.

Who are the likely owners of a bagasse newsprint mill and what are their motivations for participation? They can be grouped in order of their likely involvement and are the Governments of the cane growing countries, private national investors in those countries, international financing institutions and foreign newsprint companies.

Governments are invariably in a paramount position and their attitudes are decisive in determining whether a country will establish a bagasse newsprint mill. The powers of Governments transcend those of all other potentially interested parties in that they can control the importation of newsprint and strongly influence its price; they can and frequently do control many or all of the services which are essential to the operation of a newsprint mill such as transportation and supplies of fuel, power and water and directly or indirectly they usually control the cane sugar industry and therefore can control bagasse supplies. Invariably Governments decide the national fiscal policies which determine conditions of investment and levels of taxation and strongly influence profits.

The residence of absolute power with a Government to determine the existence and fortunes of a bagasse newsprint operation carries with it a correspondingly great responsibility for establishing a prudent policy with appropriate partners and ensuring that this is expeditiously executed. More than all other parties, Governments can derive the greatest benefits from a mill operation and they therefore have the greatest incentive to participate.

Governments have amongst their responsibilities the maintenance of a sound national economy, the promotion of profitable industry, the maintenance of a positive foreign exchange balance and the provision of stable employment for the population; their participation in a bagasse newsprint operation would be in accord with these responsibilities. In fact, it is very rare for a bagasse newsprint mill to be considered without the active participation of the Government concerned and as might be expected the majority of promotions in this field are led by Governments. It is usually the case that Governments in the cane growing countries not only require a majority of national equity capital investment in projects of national importance, but also prefer part of the investment to originate from private sources. Such investors may be private individuals, banks or other corporations and their motivation for investment is normally confined to obtaining a profitable return on capital invested. However, there may be a secondary motivation and for instance national papermakers or newsprint consumers may wish to secure an interest.

Considering the position of the world's newsprint companies, it must be remembered that their motivation is to make profits and specifically to do so by involvement in the newsprint industry. Secondly, more than any other parties they control the greatest resource of personnel experienced in newsprint production and marketing. However, despite the fact of a steadily rising demand for newsprint in all countries, it is inevitable that these companies see

the installation of bagasse newsprint mills as a potential threat to their existing markets and it is not surprising, therefore, that they tend not actively to promote such developments. Yet these companies are not disinterested, for if they can negotiate compromise arrangements with the Governments and any private investors involved whereby the newsprint company provides management services and is given the opportunity to make a profitable investment, this may improve their worldwide competitive position and be commercially attractive. These general circumstances of course apply to a large proportion of private foreign investment in new industries in developing countries.

In summary, Governments, private investors and the newsprint companies have widely varying motivations, however compelling, for participating in bagasse newsprint mills. Partially for this reason they tend to maintain isolated commercial positions added to which the newsprint companies are geographically remote from the cane growing regions; inevitably initial mutual contacts are largely by chance.

Given these circumstances, there is every justification for the newer international financial and industrial organisations to extend their activities more widely into a positive promotional role. This should be a catalytic function for the ultimate decisions and responsibilities must reside with the shareholders. Those international organisations which are empowered to participate financially in projects of this type have a vital and expanding role to play for they are in a unique position to facilitate greatly the formation of promoting organisations including

participation in pilot companies to develop projects, provide equity and loan capital and endow projects with a broader base and stability by their presence.

The difficulties involved in bringing together and reconciling the different views of potential investors who may be interested in participating in bagasse newsprint projects constitute the greatest impediment to progress in this field.

4. TECHNICAL CONSIDERATIONS.

4.1 Comparisons with existing newsprint manufacturing methods

The world's newsprint industry is located mainly in the temperate climatic regions of the northern hemisphere. These regions have extensive coniferous forests and water supplies and have developed thriving paper industries producing all grades of paper. The economic communities of the regions have substantial industrial resources in terms of technology, skilled manpower and capital.

Newsprint as it is generally known, is made under these circumstances and is produced as cheaply as possible compatible with its function as a printing paper. The properties of modern newsprint vary widely particularly in respect of basis weight and printing qualities, according to the type of printing presses on which it will be run and the quality of the ultimate publication. Within these limits, the properties are mainly determined by the availability and cost of wood and pulp, the needs to produce paper at low cost on fast wide paper machines and print on fast presses in order to mass produce copies in a limited time, and the need to produce an acceptable and clear printed impression having regard to the type of newsprint and the qualities and costs of inks.

The fact of making newsprint primarily from bagasse does not change the basic requirement to produce newsprint having acceptable printing qualities at the most economic cost but there is no good reason why the properties have to be identical, when using bagasse or any other fibrous source as the basic raw material, to those applicable when using coniferous wood. The most

significant potential difference between coniferous newsprint and bagasse newsprint is in the pulping methods and the furnish, and whereas in the former case the optimum economic solution is to use a minority proportion of chemical long fibre primarily to give strength and freeness and a majority proportion of mechanical groundwood to provide bulk, opacity and properties which collectively aid printability, it does not necessarily follow that bagasse newsprint should be made from a similar furnish nor even that full chemical or mechanical pulps should be used at all. For bagasse, the optimum furnish and pulping procedure should be decided only by the technical requirements for its use and the economic circumstances applicable in the developing country concerned and not by attempting to follow the methods which are used for making coniferous groundwood newsprint in countries which for the most part have entirely different climatic, economic and social circumstances.

4.2 Production Trials with a semi-mechanical Pulping Process.

A series of mill scale bagasse newsprint production trials have been carried out during the last 10 years using a semi-mechanical pulping process developed at the bagasse pulp and paper mill of Cia Industrial de San Cristobal S.A. in Mexico City. A large number of variations in this technology have been tested and although the pulp has always been made in that mill, the paper has sometimes been made on machines in other mills to permit the investigation of the effects of different paper machine designs when running with this type of pulp.

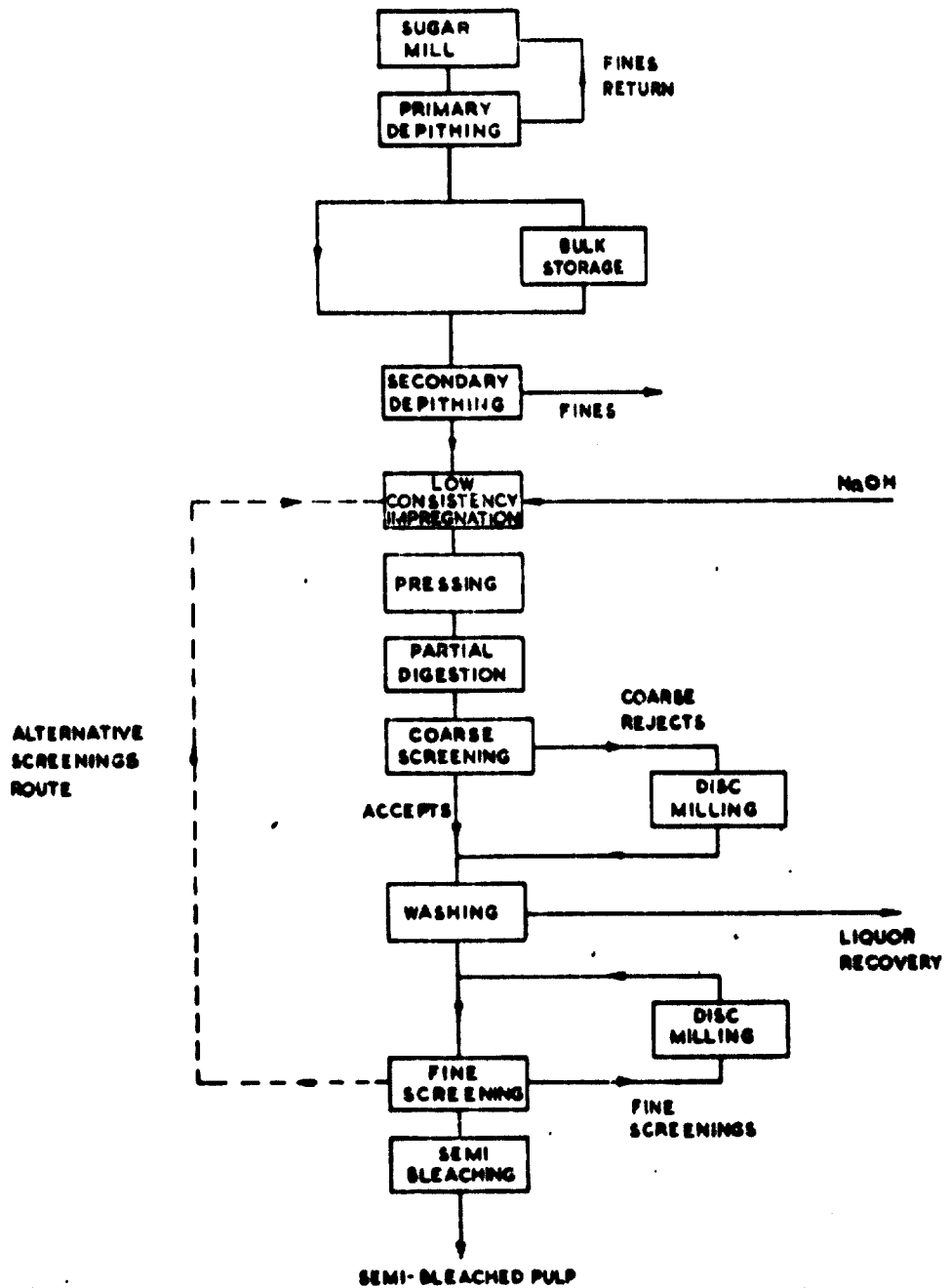
The process commences with a good depithing system having an average overall yield on raw bagasse of about 70%. It is considered that it is uneconomic to use a higher degree of depithing on account of the higher cost of depithing plant and higher operating costs in terms of power consumption; moreover in view of the greater bagasse requirement, bagasse availability and transportation becomes a limitation in some cases. Primary depithing is applied at the sugar mills in order to upgrade the fibre before purchase and secondary wet depithing at low consistency in water is applied at the pulp mill to remove more pith and clean the fibre. This is followed by dewatering prior to low consistency impregnation in caustic soda and rapid digestion in normal short cycle continuous horizontal digester units. The amount of caustic soda absorbed during impregnation is kept within the range of 7 to 8% NaOH which gives a digestion yield of about 70% on depithed fibre. After this mild digestion

the fibre is subjected to coarse screening* where there is a reject rate of more than 50%. The rejected material defibres readily in a disc mill without having its fibrous nature destroyed. Power consumption is reduced and strength properties improved when disc milling is carried out under pressure. Disc mill maintenance is normal. The coarse screen accept fraction by-passes the disc mills and thereby avoids any possibility of its mechanical degradation; it is subsequently re-combined with the disc milled fraction to give a single pulp stream for washing, cleaning and bleaching. Adequate brightness is achieved in two stages of hypochlorite bleaching with a yield of about 93%. The average overall yield of pulp bleached to 62° in one of the major trials was about 46% calculated on raw unpeepithed bagasse intake. A block flow diagram of the process used is shown in figure 3.

Considerable practical experimental work has been done at this mill in order to determine the optimum proportions of chemical and mechanical treatment necessary to produce a pulp which not only has adequate strength and other important properties but also contains sufficient fines to make paper having good printing qualities. Figure 4. shows the beating curves in respect of the strength properties for one typical batch of pulp produced in a recent trial.

Bagasse is a short fibred material and the conclusions of the research team at San Cristobal concur with those of other research workers that excessive mechanical

* D.S.Cusi: Commercial experience in the depithing and fibre fractionation of bagasse. ECA/BTAO/FAO. CONF/PAPER II. b.3. Pulp and Paper Development in Africa and Near East, 1965.



FLOW DIAGRAM FOR THE PRODUCTION OF NEWSPRINT GRADE SEMI-MECHANICAL BAGASSE PULP.

FIGURE 3

STRENGTH PROPERTIES OF NEWSPRINT
GRADE SEMI-MECHANICAL BAGASSE PULP.

———— SEMI-BLEACHED NEWSPRINT PULP.
 BRIGHTNESS = 82-10° GE

- - - - - UNBLEACHED NEWSPRINT PULP
 KMNO₄ = 24-25.

CIA INDUSTRIAL DE SAN CRISTOBAL SA (MFI 70-601/OT 5200)

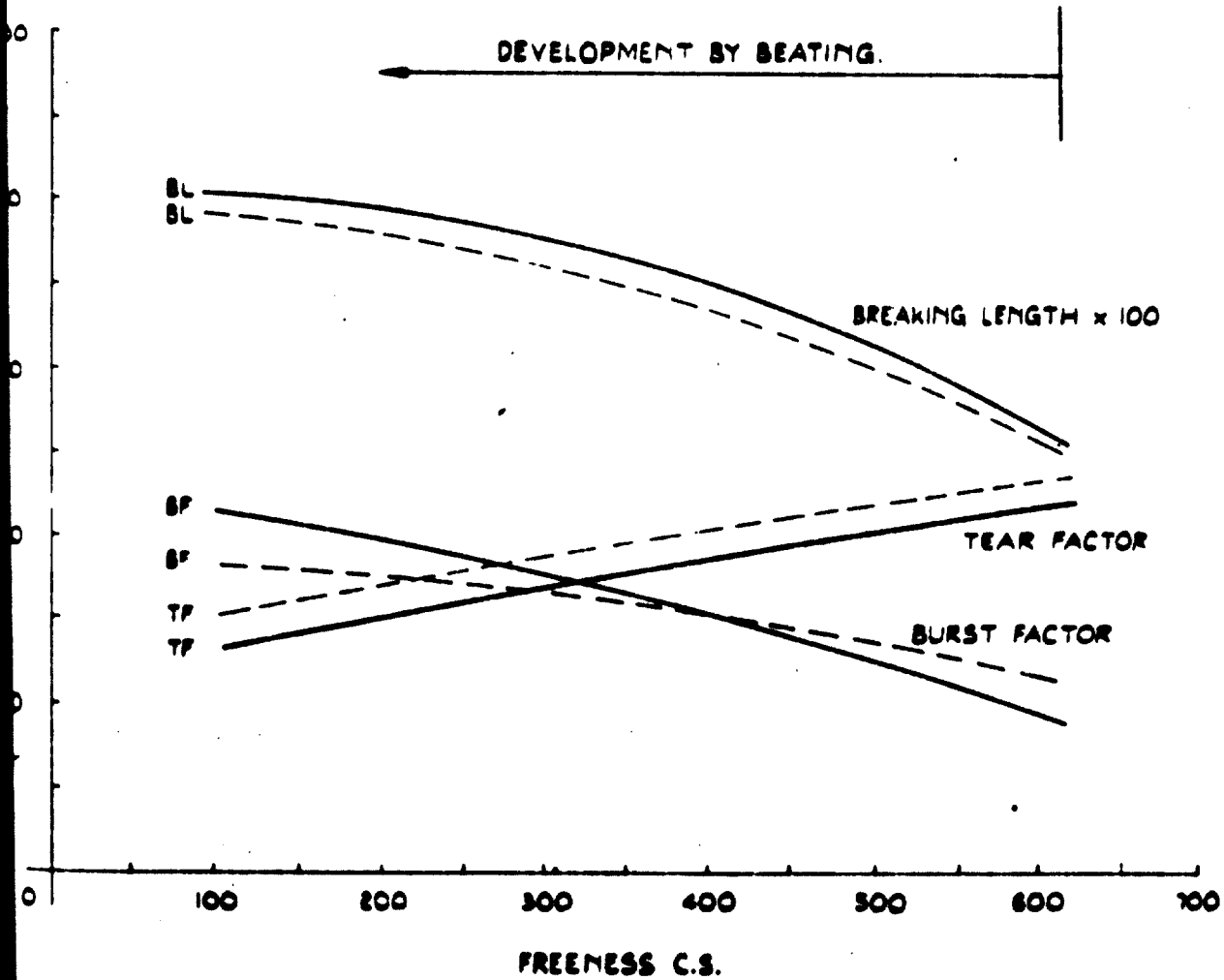


FIGURE 4

pulping destroys the fibres to such an extent that it becomes necessary to add high proportions of expensive soft wood long fibre in order to obtain adequate strength properties. The additional cost of long fibre more than offsets the reduction of costs consequent to decreasing soda usage. It is also apparent from this research work that some degree of softening of the intercellular bonding is necessary if bagasse is to be defibred in disc mills without degradation of the fibres themselves; the mild soda digestion used in this process achieves this objective.

A further reason that a certain degree of chemical treatment has been maintained in this process is to permit the preparation of pulp having sufficient brightness. Present day world newsprint standards demand a sheet brightness level in the range 58 to 60° G.E. and even more in some cases and it is therefore essential that bagasse pulp for this purpose has to be bleached if it is to meet these conditions. Freshly crushed bagasse at the sugar mills often has a light colour - not as bright as high quality softwoods which are used in the groundwood industry - but sufficient to produce a pulp of about 50° G.E. brightness without bleaching. Usually, however, bagasse does not have even this colour and soon darkens when placed in storage. Some chemical treatment and bleaching is therefore inevitable. As is well known amongst research workers on bagasse pulping, early experimental productions of semi-chemical pulp revealed a deficiency in opacity level. This has been sufficiently overcome by adjusting the digestion, disc milling and bleaching conditions and in a recent bagasse newsprint production run made in Canada from Mexican pulp, adequate opacity was achieved with a clay retention of 6%. Other

newsprint productions with adequate opacity have been made without clay but using smaller quantities of titanium dioxide and other paper making additives. The addition of clay in these proportions is not considered to be disadvantageous and on Fourdrinier machines the two sidedness of the paper produced did not constitute a shortcoming in either papermaking or printing. It is considered that whilst the printing properties of the paper produced have been acceptable when using small proportions of clay filler or other additives, still further improvements can be effected if more cellulosic fines are contained in the furnish. One means of doing this which is being investigated is to pass the fine screenings and centricleaner rejects through a separate high horsepower secondary refiner to produce fines which can be returned to the main pulp stream for bleaching.

Many of the trials which have been carried out have incorporated varying proportions of groundwood in the furnish but the results obtained are not considered to justify the inclusion of such an increment.

The technology used in these trials has produced a sufficiently strong and free draining pulp that has given good runability characteristics on appropriately designed paper machines.

As shown by the properties listed in the following table a furnish comprising 95% bagasse pulp and 5% semi-bleached kraft with up to 6 - 7% retained clay has given acceptable results.

PROPERTIES OF BAGASSE NEWSPRINT PRODUCED BY SEMI-MECHANICAL PROCESS.

Property	Lufkin 1965	Canadian 1970	Canadian 1970
Furnish, Bagasse, groundwood, long fibre %	75-15-10	80-15-5	95-0-5
Filler (as ash) %	T1 O ₂	6.0	7.0
Basis weight, gsm	54.0	53.0	53.0
Caliper mm	0.075	0.078	0.077
Burst factor	--	16.8	19.9
Tear factor, MD	46.7	52.2	58.1
Tear factor, CD	56.5	59.5	62.2
Breaking length, MD.m	3946	4127	4381
Breaking length, CD.m	2257	2349	2863
Brightness °GE	62.0	58.0	59.5
Opacity %	90.5	89.5	87.8
Printings	1. Lufkin News 2. Springfield News 3. San Antonio News (Texas, U.S.A.)	1. Montreal Star 2. La Voix (Montreal, Canada)	1. Novedades (Mexico City)

Trials have been carried out on a pilot twin wire paper machine operating in excess of 2700 feet per minute and using a stock having a fibre furnish comprising 80% of this type of bagasse pulp, 15% of groundwood and 5% of long fibre with sufficient clay to leave about 6% retained in the paper. The trial took place without any running problems and the top speed was limited by the machine facilities and not

by the behaviour of the stock. The formation of the sheet on the twin wire machine was more even and superior to that obtained on normal Fourdrinier machines and there was less tendency towards flocculation of the fibres.

As part of the most recent large scale trial when some 75 tons of newsprint were produced, the rolls were distributed to several of the leading national daily presses in Montreal, Canada and in Mexico City. Supervised printing trials were carried out on Letterpress and Web Offset installations with various inks under controlled conditions. The copies produced were sold to the public together with copies from standard groundwood newsprint rolls. In some cases editions comprised some wood and some bagasse sheets and in other cases editions were sold made up entirely from bagasse sheets. The differences were not readily discernible.

4.3 Technical approaches to bagasse newsprint manufacture.

Considerable work has been done by many research teams over the last 20 years in an effort to establish satisfactory technical criteria for producing what has been described as bagasse newsprint. Some proposals have been put forward which, had they been implemented, no doubt would have produced acceptable paper but would have been of little or no economic benefit to the countries concerned. In fact, the economic merits of the various proposals have varied widely.

It is useful to re-state the essential technical and related economic criteria.

Technically the paper produced must have sufficient strength, not only of the final product to permit its printing without breakage in high speed presses, but also wet strength to permit its transfer between wire and press sections on the paper machine, even with a suction pick up. Secondly, the paper must have the necessary printing characteristics sufficient to give a clear impression. These qualities are variously expressed by laboratory tests on brightness, opacity, smoothness, oil penetration and others including laboratory printing tests.

Economically the newsprint must be made at the lowest possible cost using a minimum possible amount of imported materials in order to maximise foreign exchange savings. Further, the capital investment must be minimised but not to the extent that pulping of indigenous materials is wholly or partially excluded since this would not be in accord with the economic objective to maximise foreign exchange savings. Considering these criteria, the following is a summary of the merits of various types of bagasse and wood

pulps from the point of view of their inclusion in a bagasse newsprint furnish.

Concerning the alternatives of chemical or mechanical pulping, chemical pulps are generally more expensive than mechanical pulps on account of the higher capital cost of plant required to produce them, the lower yields obtained and the higher cost of raw materials and services required in their manufacture.

Chemical wood pulps are capable of imparting maximum strength but they are also the most expensive pulps; usually they have to be imported into cane growing countries and in such cases their use diminishes the foreign exchange saving.

Chemical bagasse pulps may be as expensive as chemical wood pulps particularly if they are not made in large plants which benefit from the economies of scale.

Their strength properties are less than those of long fibre chemical wood pulp but they have the advantage that the basic fibre is indigenous although the chemicals used may have to be imported. There are many variations to the methods of production of chemical bagasse pulp and qualities vary considerably; these variations are concerned with depithing, fibre classification during chemical treatment and the conditions of pulping particularly temperature, pressure, time and chemical concentration. Poorer quality bagasse chemical pulps tend to have low freeness and opacity.

Semi-chemical bagasse pulps cover a wide range of properties and production methods mainly dependent on the relative amounts of chemical and mechanical treatment which may be anywhere in the range between nearly full chemical and full mechanical. Like full chemical bagasse pulps, poorer quality semi-chemical pulps which

have not been subjected to adequate depithing and appropriate fibre selection and have been made predominantly by chemical treatment tend to be low in freeness and opacity. In general, the greater the proportion of mechanical treatment applied in the production of semi-chemical bagasse pulps, the higher the opacity, the lower the bleachability and beyond a certain point, the lower the strength.

Groundwood in many cane growing countries has to be imported although in a few cases indigenous resources of suitable wood are available. It is capable of imparting good printability to newsprint but may lack brightness and have other technical shortcomings if made from natural forest wood which is not of top quality.

Ground bagasse has been made but its production has never been demonstrated - even on a large scale pilot plant. Its production requires high power consumption and it has very low strength.

The following table gives a comparison of some typical figures of strength properties for various wood and bagasse pulps. All the results given are in respect of unbeaten pulps. Wide variations of the properties of each type occur.

Property	Stone Ground Spruce	Groundwood Canadian 67% Spruce 33% Balsam	Bleached Sulphite Softwood	Semi- Bleached Sulphite Mexican Pine	Bleached semi- chemical bagasse	Bleached full chemical bagasse
Freeness, Canadian ml	117	100	740	718	457	399
Burst Factor	14	14.5	21	19.1	30.2	25.8
Breaking Length, m.	3,300	3,160	3,500	3,191	5,530	5,662
Tear Factor	52.0	58.0	118	217.3	50.0	41.5

Several groups of research workers have published Papers* describing their results and the following six cases summarise the more important different technical approaches. Observations are stated on each when considered against the economic as well as the technical criteria.

Most of the proposals have involved the use of a proportion of wood pulp - either chemical or mechanical or both. The proportions of wood pulp recommended have varied between 5% and 60% with the qualification in some cases that after start-up of a mill and the acquisition of experience by the mill operators, it will be possible to reduce the wood pulp content or eliminate it entirely.

Case 1.

Furnish: 30% wood long fibre - Semi-bleached kraft.
70% ground bagasse.

- Comments:**
1. High cost of production due to long fibre cost and high power cost for grinding bagasse.
 2. Foreign exchange saving diminished due to imported long fibre.
 3. Low Brightness, adequate opacity.
 4. Ground bagasse techniques not developed.

* W.G.Meyer and J.T.Henderson: The Production of Bagasse Newsprint, ECA/BTAO/FAO CONF/PAPER II. b.6. Pulp and Paper Development in Africa and Near East, 1965. Chemical Week, 4 February 1961. Sweet News for Bagasse.

B.Wahlstrom, H.Bergstrom, C.Steen: Paper Making Aspects on newsprint from bagasse. ECA/BTAO/FAO CONF/PAPER IV.10. Pulp and Paper Development in Africa and Near East, 1965.

The Aschaffenburg Process of manufacturing newsprint from bagasse - Pulp and Paper prospects in Latin America, p. 390, UN 1955.

A. Sundelin: Newsprint manufacture from bagasse - A Case Study. ECA/BTAO/FAO CONF/PAPER IV. 3. Pulp and Paper Development in Africa and Near East, 1965.

Case 2.

Furnish: 50% chemical bagasse pulp by soda digestion
50% groundwood.

- Comments:**
1. High cost of production in respect of full chemical bagasse pulp.
 2. Foreign exchange saving diminished due to imported groundwood.
 3. Adequate opacity.

Case 3.

Furnish: 40% chemical bagasse pulp by soda digestion.
10% Semi-bleached kraft.
50% ground bagasse.

- Comments:**
1. High cost of production in respect of chemical bagasse pulp, long fibre and high power cost for grinding bagasse.
 2. Small imported material increment increases foreign exchange saving.
 3. Low Brightness, adequate opacity.
 4. Ground bagasse techniques not developed.

Case 4.

Furnish: 95% semi-mechanical bagasse pulp with hot pre-impregnation, partial soda digestion and hot stock refining of selected fraction.
5% Semi-bleached kraft.
6% Mineral filler or lesser amount of other additives.

- Comments:**
1. Small imported material requirement increases foreign exchange saving.
 2. High yield pulping method has produced pulp at 62° Brightness suitable for all newsprint grades including offset.
 3. Mechanical pulping and mineral filler results in adequate opacity.

4. Chemical recovery system using a conventional high pressure recovery boiler reduces operating costs and eliminates black liquor effluent problem.
5. Mill scale papermaking and printing trials completed under international inspection produced acceptable paper.

Case 5.**Furnish:**

- 80 to 100% semi-chemical bagasse pulp with hot pre-hydrolysis, partial digestion with sodium bisulphite and sodium silicate and hot stock refining.
- 20 to 0% wood pulps (Long fibre or groundwood)
- 5% Mineral filler in some cases.

Comments:

1. Bagasse requires very strong depithing in order to obtain a suitable fibre for pulping.
2. Insufficient data available to comment on foreign exchange savings.
3. High yield pulping method producing pulp at 55° Brightness unsuitable for offset grades and not comparable on Brightness with imported newsprint.
4. Insufficient information available to comment on inclusion of mineral filler.
5. No provision for chemical recovery. Potential chemical effluent pollution problem.

Case 6.**Furnish:**

- 100% semi-chemical bagasse pulp with hot pre-hydrolysis and neutral sulphite digestion.
- 15% Mineral filler.

Comments:

1. Technical and economic problem of chemical recovery and effluent disposal.

2. Low Brightness
3. Mechanical grinding and mineral filler result in adequate opacity but mineral filler is high to the point of producing potential supply, papermaking and printing difficulties.

Considering the yields obtainable in Cases 4 and 5, the evidence suggests that the methods are both capable of giving an overall yield of about 50% of bagasse pulp as a percentage of raw undepithed bagasse. However, the Brightness in Case 5 is only 55° and the yield would be lower if the Brightness was brought up to an adequate level. Moreover, information is not available on the effects of having to use old stored bagasse during the non-crushing season when the bagasse may have darkened in colour. These circumstances may result in still lower Brightness.

Considering all six cases, it is significant that the only method which satisfies the technical and economic criteria and for which mill scale newsprint production and printing trials have been carried out, with all the yields and other technical data verified by international inspection, and has produced acceptable newsprint under all these conditions, is Case 4 - the modified semi-mechanical method using a partial soda digestion.

5. CONCLUSIONS AND RECOMMENDATIONS.

5.1. Prices and Markets.

5.1.1. Conclusions:

5.1.1.1. A bagasse newsprint project needs an adequate and stable market with an assured selling price at a remunerative level.

5.1.2. Recommendations:

5.1.2.1. That individual Governments take action to prevent unfair competition on home markets from imports of newsprint at depressed prices.

5.1.2.2. That Governments negotiate towards the formation of regional economic communities to enable the cane growing countries to develop bagasse newsprint industries to meet their combined needs.

5.2. Viability of the Cane Sugar Industry.

5.2.1. Conclusions:

5.2.1.1. A bagasse newsprint industry is dependent on an assured supply of bagasse at an economic price.

5.2.1.2. Forecasts for the world sugar market up to 1980 indicate a steady increase in demand, and it is likely that a satisfactory free market price can be maintained.

5.2.1.3. Changes in international preferential agreements and internal national policies can affect the viability of individual sugar mills, but mill closures are only likely in exceptional isolated cases.

5.2.2. Recommendations:

5.2.2.1. That the possibilities be examined of the commercial and technical integration of cane sugar and bagasse papermaking operations.

5.3. Cost and Origin of Fuel.

5.3.1. Conclusions:

5.3.1.1. Fuel cost represents the largest single increment of the manufacturing cost of a bagasse newsprint operation and can be a limiting factor.

5.3.1.2. The most efficient steam and power arrangement is to combine the power plants of sugar and paper mills.

5.3.1.3. The cost of importing oil is a relatively small proportion of the total foreign exchange savings which can accrue from the operation of a bagasse newsprint mill using about 95% of bagasse in the furnish.

5.3.2. Recommendations:

5.3.2.1. That in appropriate cases consideration be given to the integration of power systems between sugar and paper mills.

5.3.2.2. That in appropriate cases Governments consider the rebate of excise duty on fuel oil used for bagasse mills.

5.4. Comparison with wood based projects.

5.4.1. Conclusions:

5.4.1.1. Suitable plantations of soft or hard woods do not exist in the cane growing countries in sufficient quantities to support newsprint industries, and long term forestry programmes would need to come into production before sufficient supplies could become available for this purpose.

5.4.1.2. Natural forest timber is usually too costly to collect and is deficient in properties for newsprint purposes. There are some limited exceptions, where hardwoods can be used.

5.4.2. Recommendations:

5.4.2.1. That in appropriate cases Governments embark on planned afforestation and meanwhile promote the use of bagasse for the manufacture of newsprint.

5.5. Ownership and mill management.

5.5.1. Conclusions:

5.5.1.1. Governments have overriding powers and responsibilities over most matters affecting the operation of bagasse newsprint mills.

5.5.1.2. Private investors, international financing organisations and foreign paper companies are potential interested parties, but, to some extent, have different motives for participating. The reconciliation of the different views of

investors in a project constitutes the greatest obstacle to progress in this field.

5.5.2. Recommendations:

- 5.5.2.1. That Governments consider the most appropriate forms of financial and other measures to assist the development of bagasse newsprint projects.
- 5.5.2.2. That international organisations and especially international financing organisations should adopt a positive promotional role.


5.6. Technical considerations.

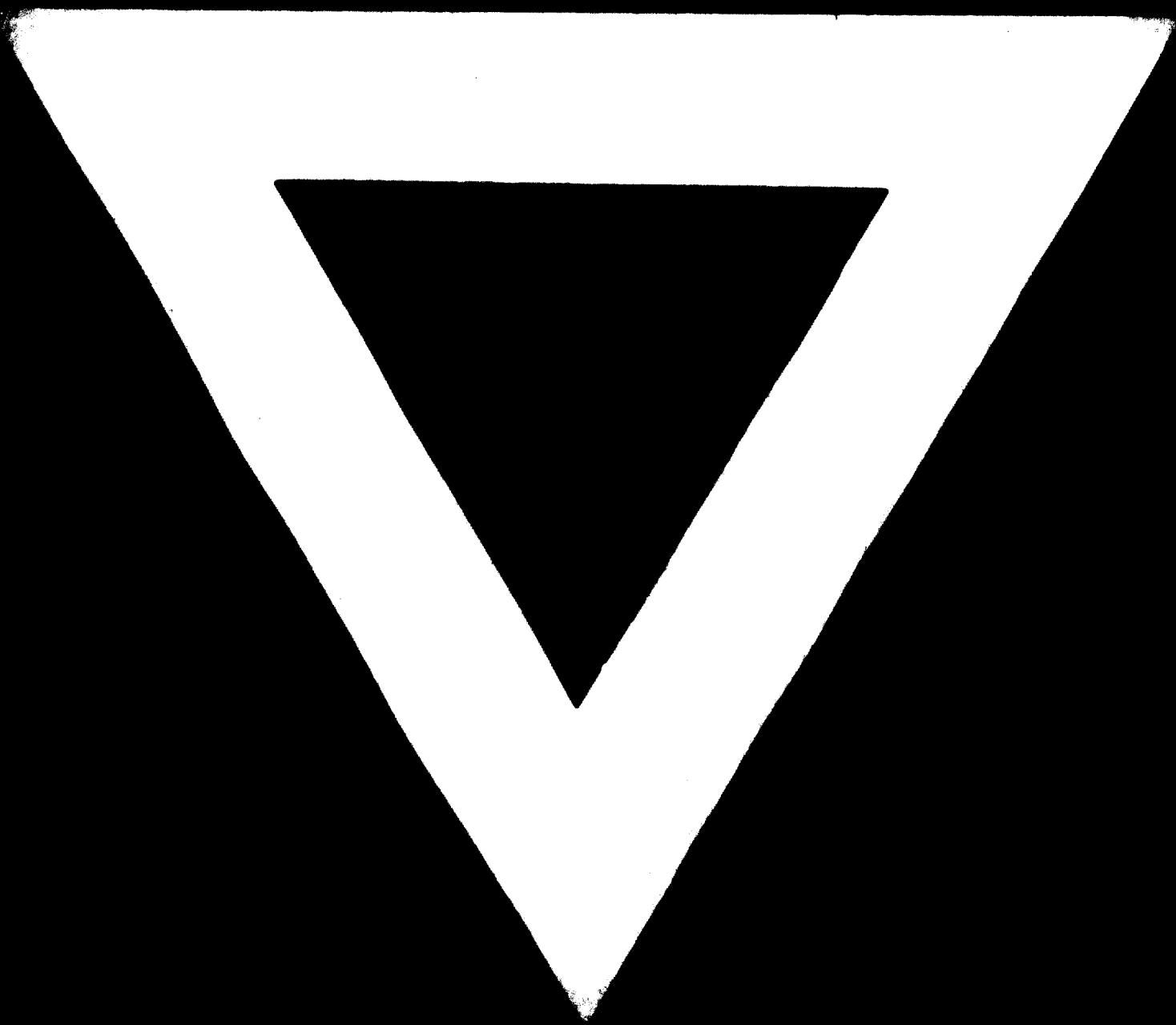
5.6.1. Conclusions:

- 5.6.1.1. A large number of newsprint trials have been carried out by various research groups using different technical approaches.
- 5.6.1.2. For any project, inter-related economic and technical criteria need to be satisfied, particularly production cost, foreign exchange savings, paper strength, printability, opacity and brightness.
- 5.6.1.3. High quality offset grades with a Brightness in the range 58° to 62° represent a large part of the market in some cane growing countries.
- 5.6.1.4. A semi-mechanical pulping method with hot pre-impregnation and caustic soda digestion and appropriate fibre

classification has been used to produce acceptable newsprint in large scale trials. Printing of the paper has been tested on a wide range of designs of presses in Canada and Mexico and the paper has been accepted by the public without any difference being noticed.

5.6.2. Recommendations:

- 5.6.2.1. That the semi-mechanical pulping method can safely be adopted for the production of bagasse newsprint.**
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