

SECTION 3

MANUFACTURE OF PAPER IN DEVELOPING COUNTRIES

INTRODUCTION

The following review is intended to give guidelines on raw materials which could be used for pulp and paper manufacture in developing countries, particularly in tropical climates.

The general sections on tropical woods and non-wood fibres (including agricultural wastes) suggest possible sources of information which may be useful in follow-up studies. The literature available in this field is so vast that it would not be possible to prepare a complete literature review.

Details of commercial enterprises, listed by continent and country, have been compiled from published information which is available. This list is not completely comprehensive but should give an indication of raw materials currently being used on a commercial scale.

The last section, on small-scale waste paper recycling, again suggests contacts and sources for further information.

TROPICAL WOODS

The FAO has published a number of reports dealing with forest resources in developing countries and their potential for papermaking. A report on forest resources in Asia and the Far East (1) covers the current use and future supply potential of woods growing in Australia, Bangladesh, Burma, Fiji, India, New Guinea, the Philippines, Sri Lanka and Thailand.

The ECLA/FAO/UNIDO Forest Industries Advisory Group for Latin America published a report in 1976 (2) on the prospects for pulping mixed tropical hardwoods in Latin America. The report covers plans for using mixed tropical hardwoods in that area, types of pulp and paper which can be produced and wood harvesting problems.

An FAO study (3) published in 1975 summarizes data on the wood characteristics and pulp and papermaking properties of a number of fast-growing wood species. The information was collected from data published in different sources between 1950 and 1972.

A further report by Navarro (18) published by the FAO deals with the evaluation of mixed tropical woods for papermaking from their wood and fibre properties, and includes evaluations of 79 species from a forest area in Surinam. The conclusion with regard to the usefulness of wood and fibre properties for evaluating papermaking potential of individual species was on the whole negative. It was however concluded that, with certain restrictions, wood density could be used as a preliminary indication of some pulping and papermaking characteristics of a wood mixture.

The FAO has also prepared reports for governments of developing countries on the possibility of establishing pulp and paper industries (e.g. reports to the Government of Ghana in 1966 (4) and to the Government of Nigeria in 1968 (5)).

Considerable research has been done on the properties of tropical woods grown in different countries. It is not possible to refer to all the work, but the following examples give some indication of published information which is available.

Jackson and Parkinson (6) have reported on kraft pulping studies of tropical hardwoods grown in Panama. Results indicated that there would be no problems in converting them into acceptable paper products.

Petroff (7) (8) has described work done at the Centre Technique Forestier Tropical in France on the development of pulp and paper industries in French-speaking tropical Africa. Five industrial projects have been carried out in Gabon, the Ivory Coast, Madagascar, the Congo Republic and the Cameroons. The Sogacel project in the Gabon involves the building of a bleached kraft hardwood pulp mill. It has recently been reported that the costs for building this mill have risen sharply, and are likely to be over U.S. \$ 565 million. The mill will initially have a capacity of 200,000 tonnes/yr (in 1981) which will rise to 242,000 tonnes/yr by 1984. The company, Sogacel, consists of a number of groups representing the Gabonese government, French, Japanese and Swedish paper companies, and French and African banks.

Eucalypts, of which there are over 600 different species, have been used for some time in the manufacture of paper, particularly in Australia, but also in Brazil, Portugal and Spain. The literature on the use of eucalypts in papermaking is fairly extensive and there have been over 100 major articles published in the last ten years. A general assessment of eucalypt pulps in the Australian papermaking economy has been made by Higgins (9).

Oudshoorn (10) described in 1974 the establishment of plantations of pine, eucalyptus and other species such as *Gmelina arborea* in South America, and discussed wood yields and costs. More recently Clephane (11) has given quotations for wood costs (pine and eucalyptus) in Brazil, and has analysed the economics of a new eucalyptus based pulp mill built there.

Both Flinta (12) and Haas (13) have reported on the development of pulp-wood plantations in Argentina. These include plantations of poplars, willows, eucalypts and US southern pines.

Gmelina arborea, a very fast growing tropical tree originating from South East Asia, which has been used in plantations in South America, has been evaluated by the Tropical Products Institute in London (14). The laboratory pulping trials were based on *Gmelina arborea* grown in seven countries.

Jeyasingham (15) has reported that attempts to produce paper from rubber-wood, a possible tropical wood with papermaking potential, have not been successful due to difficulties in removing the latex from the pulp.

Boyhan (16) has reported on tropical woods growing in Latin America and the Pacific Basin areas, with reference to plantation development costs and potential species. Laboratory evaluations of the properties of mixed tropical and other hardwood pulps are discussed and effects of density variations and pulp yields are mentioned.

Atchison (17) has summarized information on the location of tropical forests and draws general conclusions on the use of mixed tropical hardwoods.

These are:

- (a) most mixed tropical hardwoods can be satisfactorily pulped by the kraft process for production of high quality bleached or unbleached pulp;
- (b) the quality of the pulps produced from mixed tropical hardwoods appears to be unaffected by plantation location;
- (c) the hardwood mixtures can usually be satisfactorily pulped by the NSSC process for the manufacture of corrugating medium;
- (d) although yields of individual species vary considerably, the yields from mixtures of the woods are similar to or only slightly lower than those of temperate zone hardwoods.

Since the quantity and quality of tropical woods appears favourable, the most significant factor in their use is likely to be the economics of harvesting and transport.

A conference on improved utilization of tropical forests was held in Madison, Wisconsin, USA from 21 - 26 May 1978. The conference was organized by the US Forest Products Laboratory which has done work on the use of mixed tropical hardwoods in papermaking. Results of research have shown that segregation of different species is not necessary for manufacturing a wide range of materials from tissue to linerboard.

NON-WOOD FIBRES (INCLUDING AGRICULTURAL WASTES)

A general review of the present status and future possibilities for non-wood plant fibres was made by Atchison in 1974 (19). The non-wood fibres covered in this review include sugar cane bagasse, straw, bamboo, reeds, esparto grass, sabai grass, sisal, abaca, henequen, bast fibres such as hemp and kenaf, cotton linters, flax tow and papyrus. Statistics are quoted, on a worldwide basis, for the availability of the various fibres and the estimated amount of pulp produced from each fibre at that time. A list of existing bagasse pulp and paper mills is given along with the effective production capacity and estimated actual production of each mill in 1972. Some of these mills are included in the list of commercial enterprises given later in this report.

Grant (20) has also reviewed non-wood fibres with papermaking potential, and Judt (21) has covered developments in this field since the Atchison review in 1974, with particular reference to the use of bagasse.

The literature on the use of non-wood fibres is quite extensive but the following may be useful sources for further reading.

PIRA has published a bibliography (22) on the use of bagasse for pulp and paper manufactured covering literature published between 1963 and April 1976. The Institute of Paper Chemistry, Appleton, Wisconsin, USA, also has bibliographies available on cereal straws (23), bast fibres (24), and bagasse and other fibres (25).

Boyhan et al (26) have reviewed processes available for the production of newsprint from bagasse and have proposed a new process using a combined furnish made up of: 60% high-yield semichemical sulphite pulp for strength and brightness; 30% refiner groundwood bagasse pulp for high-yield, opacity, smoothness and printability; and a small proportion (5 - 10%) of imported semi-

bleached kraft for overall strength, especially tear.

Zegarra and Zarate (27) have discussed the characteristics of bagasse papers, particularly bond papers and newsprint, and have reviewed the latest technical developments and commercial plans, covering improvements at the Paramonga mill in Peru, new newsprint mills in Peru and Mexico based on bagasse, and papermaking trials in Europe.

Atchison and Collins (29) have reviewed studies done on the use of kenaf as a papermaking raw material. Although considerable research work and mill trials have been carried out in the USA, Australia, Japan, Europe, Latin America and the Far East, as yet it does not appear that any company is using kenaf for papermaking on a commercial scale.

The current world production of bamboo pulp was estimated in 1972 as 1,240,000 tonnes, and in India it currently provides about 70% of the total pulp production. The main disadvantage in using bamboo is its tendency to flower unexpectedly, when an entire stand can die and take several years to be re-established. Flowering problems are now understood to a greater extent than in the past and are thought to be overcome by selection of the correct species and/or control of copper in the soil.

Bollon (29) has summarized information on the types of bamboo used in papermaking, their characteristics, harvesting and pulping. Haun et al (30) have described studies carried out by the US Department of Agriculture on the preparation and evaluation of bamboo pulps. The bamboo species studied included a number of temperate species from Savannah, Georgia and tropical species from Mayaguez, Puerto Rico.

The possibility of using home-grown bamboo in the UK as a papermaking raw material was studied for some time by Wilson (31). Following on from this work, PIRA collected a considerable amount of information on the use of bamboo, and considered setting up a feasibility study, together with other interested parties, on its growth in the UK. Plantations of bamboo had already been established by the Northern Ireland Department of Agriculture and the Agricultural Institute in Dublin, An Foras Taluntas. Prior to the feasibility study, an overall survey of indigenous sources of UK papermaking fibres was made by Dean and Calver (32). It was finally decided however to drop the feasibility study on bamboo, and studies were continued only on the use of straw and coppice willow.

The use of cereal straw for papermaking was covered in a PIRA Special Report (33) in 1974. This stimulated several British companies and the Department of Industry to fund a project that would, hopefully, lead to the successful exploitation of straw for papermaking. The straw consortium report, published in four volumes by PIRA in 1978 (34), covers information on straw prices and availability, as well as work done on other fibres such as coppice willow and *Nothofagus* (southern beech). The main part of the work describes studies on possible pollution-free pulping processes for straw, and commercial aspects of setting up a straw pulp mill.

COMMERCIAL ENTERPRISES

Africa

Algeria

1. SONIC (Société Nationale des Industries de la Cellulose)
15 rue Hamani, Algiers
SONIC has five mills, two of which have pulping facilities. The mill at Medjdoub has facilities for producing 25,000 tonnes/yr straw pulp; the Mostaganem mill can manufacture up to 66,000 tonnes/yr of esparto pulp, 20,000 tonnes of which is used in the mill itself for manufacturing printing and writing papers. A description of the activities of SONIC, and the Mostaganem, El Harrach and Souk Ahras mills has been given by Haas (35).

Egypt

1. RAKTA (Société Generale de l'Industrie du Papier)
Tabia, Alexandria
The RAKTA mill has capacity for producing 28,000 tonnes/yr of rice straw pulp which is used in the production of printing and writing papers and duplex and triplex boards. Ibrahim (36) has described the mill's experience in stock preparation and fine paper manufacture from rice straw. A further paper by Ibrahim (37) covers experiences and problems encountered in the bleaching of rice straw pulp.

Kenya

1. Panafrican Pulp and Paper Mills Ltd.,
Broderick Falls, Webuye
This integrated kraft pulp and paper mill for the production of 150 tonnes/day bleached and unbleached papers has been in operation since 1975. The mill currently uses pine and cypress wood from government plantations as raw materials, but new plantations are being established at Turbo to supply timber to the mill on a 15-year rotation. Singhi (38) outlined the background to the operations prior to start-up in 1974.

Morocco

1. Cellulose du Maroc,
Zankat Tissa, Rabat, Morocco
The Cellulose du Maroc mill at Sidi Yhia du Gharb which started production in 1957, processes Eucalyptus rostrata and Eucalyptus gomphocephala. The present capacity of the mill is 50,000 tonnes/yr of bleached kraft eucalyptus pulp, of which 90% is for export. The activities of the mill have been mentioned by Rahmani (9) in his review of the Moroccan pulp, paper and board industry, and also by Mezzour (40).

Nigeria

1. Nigerian Newsprint Manufacturing Co.
Oku Iboka
This newsprint mill is scheduled to start up in 1980 to produce 100,000 tonnes/yr newsprint using locally grown *Gmelina arborea*, pulped by a chemimechanical process.

Tunisia

1. Société National Tunisienne de Cellulose
Kasserine
The mill, which started up in 1970, has a capacity for 30,000 tonnes/yr esparto pulp, which is used in the manufacture of printings, writings and packaging papers.

Asia

Bangladesh

1. North Bengal Paper Mill
P.O. Paksey, Dist. Pabna
The mill has a capacity of 15,000 tonnes/yr bagasse pulp for use in the manufacture of printings, writings and packaging papers.

India

1. Orient Paper Mills Ltd.,
Birla Building (13th Floor), 9/1 R.N. Mukherjee Road,
Calcutta 1
The Amlai mill (41) in Madhya Pradesh State produces 85,000 tonnes/yr cover papers, unbleached kraft, and printings and writings from bamboo pulp.
2. Central Pulp Mills
Songad, Gujarat
The mill has a capacity for producing 30,000 tonnes/yr of bamboo market pulp. Sadawarte et al (42) have described the characteristics of bamboo (*Dendrocalamus strictus*) pulps produced at Central Pulp Mills. In particular, the beating and refining characteristics of bleached bamboo kraft pulps are discussed, as well as the effects of flash drying or slush drying the pulps.
3. Andhra Pradesh Paper and Pulp Mills Ltd.,
Shreeniwas House, Bombay 400001
The mill in Rajahmundry has a capacity of 75,000 tonnes/yr of printings, writings, wrapping and kraft papers. The main raw material is bamboo, but the mill also has an 8 tonnes/day rag plant for the manufacture of high quality bonds and ledger papers. A short description of the mill was given by Aggarwala (43), when the mill expanded in 1968.
4. Ballarpur Paper and Straw Board Mills Ltd.,
Thapar House, 124 Janpath, New Delhi
The company has two mills, one at Shree Gopal in Northwest India, the other at Balharshah in Central South India. Vaid (44) has

described the activities of the Balharshah mill, which makes 35 tonnes/day bamboo pulp by the fractional two-stage process for use in printing and writing papers. A 15 tonnes/day rice straw mill was also commissioned in 1969.

5. National Newsprint and Paper Mills Ltd.,
Nepanagar, E. Nimar District
The mill, the only newsprint mill in India, currently has a capacity of 75,000 tonnes/yr newsprint. It is based on bamboo (*Dendrocalamus strictus*) and salai (*Boswellia serrata* Roxb.). The mill had an actual production of 53,800 tonnes in 1975. Sawhney (45) has included a description of the mill in his report on the newsprint industry in India. Groundwood pulp is prepared from the salai wood and a two-stage fractional kraft pulping process is used for bamboo. In 1976, the furnish used for newsprint was 55 - 56% groundwood and 44 - 45% chemical pulp. It was proposed at that time to incorporate a cold soda pulping plant for the salai wood so that the furnish would be 34% groundwood, 33% chemical pulp and 33% cold soda. The incorporation of the cold soda pulp would give increased strength and reduce the costs/tonne of pulp produced.
6. Mandya National Paper Mills Ltd.,
Belagula R.S., P.O. K. R. Sagar, Mysore State
The mill has capacity for producing 10,000 tonnes/yr bagasse pulp. Estimated actual production in 1972 was 3,000 tonnes.
7. Bengal Paper Mill Co.
P.O. Ranigani 713347, District Burdwan, West Bengal
The mill in 1972 was producing 3,000 tonnes/yr bagasse pulp for use in fine papers.

Iran

1. Pars Paper Co. Ltd.,
124 Elizabeth II Boulevard, Tehran
The mill at Haft Tappeh currently has a total capacity of 200 tonnes/day of bleached bagasse pulp, which is used in the production of printings and writings. The mill, the first in the Middle East based on bagasse, was opened in December 1970. The plant (60 tonnes/day) was designed and constructed by Reed Engineering Services (Overseas)Ltd., a member of the Reed Group. The machinery was supplied by Krauss-Maffei. A description of the mill at its start-up (46) covers bagasse storage (using the Ritter process) and depithing, and the pulp and paper mill. Benzinger (47) has described the second bagasse pulping line (140 tonnes/day) which was added in 1975.

Iraq

1. State Company for Pulp and Paper Industries
P.O. Box 248, Basrah
The mill has a bagasse pulping line of estimated capacity 20,000 tonnes/year.

Pakistan

1. Pakistan Paper Corp. Ltd.,
Charsadda, Peshawar District
The mill has a 27,000 tonnes/year bagasse pulping line. In 1972 actual production of bagasse pulp was 15,000 tonnes, which was used in the production of printing, writing and wrapping papers.

Philippines

1. Isarog Pulp and Paper Co. Inc.,
Kilikao, Daraga, Albay
A 20 tonne/day abaca (manila hemp) pulp mill was started up by Isarog in 1976. Abaca is found growing in the Philippines, Central America and South America, but the Philippines produce over 70% of the world supply. Silvario (48) has discussed the background to the mill and the properties of the pulp produced. The abaca fibre is extra long and slender, which thus makes it suitable for production of speciality papers such as tea bag tissues, nonwovens, carbon base papers, filters and various papers for electrical insulation.
2. Central Azucarera de Bais
Bais Central, Negros Oriental
The mill produces 10,000 tonnes/yr bagasse pulp.
3. United Pulp and Paper Co. Inc.,
Calumpit, Bulacan
The mill produces 18,000 tonnes/yr bagasse pulp.

Sri Lanka

1. Eastern Paper Mills Corp. (now National Paper Corp.)
356 Union Place, Colombo 2, Sri Lanka
The mill at Valaichchenai manufactures 23,000 tonnes/yr of different paper and paperboard grades. The mill uses various fibre sources: bleached and unbleached straw pulp, deinked waste paper, mixed waste, bleached and unbleached wood pulp. Pulp is produced from rice straw by the monosulphite process. Jeyasingam (49) outlined the activities of the mill when the new combined board machine started up in 1972. Problems connected with bleaching rice straw pulp have also been discussed (50). Special equipment is needed for washing and bleaching rice straw pulp because of the high percentage of fines in the pulp. It might be possible to increase the brightness level of the pulp by increasing the number of stages and by using bleaching agents such as chlorine dioxide and peroxide along with chlorine and hypochlorite, but costs and other factors need to be taken into account.

Taiwan

1. Taiwan Pulp and Paper Corp.
53 Nanking East Road Sec. 2, Taipei, Taiwan
The mill has capacity for production of 45,000 tonnes/yr bleached bagasse pulp, 25,000 tonnes being available as market pulp. The mill has a chlorine dioxide closed system for bleaching the bagasse

pulp. Sodium acid sulphate is separated as a by-product and converted to salt cake for make-up in the sulphate recovery cycle.

2. Taiwan Sugar Corp.,
25 Pao Ching Road, Taipei, Taiwan 100
Wang (51) has recently described the development of the Pingtung pulp mill with a daily capacity of 300 tonnes of bleached bagasse pulp (100,000 tonnes/yr). An acid wet bulk storage system (improved Ritter process) is used for the bagasse which is then pulped by the kraft process.

Thailand

1. Siam Kraft Paper Co. Ltd.,
518/4 Ploenchit Road, P.O. Box 5-174, Bangkok
A description of the integrated bagasse pulp and paper mill near Bangkok was given (52) in 1970, soon after its start up. The mill has capacity for production of 24,000 tonnes/yr bagasse pulp, most of which is used in the production of kraft wrappings and linerboard.

Vietnam

1. Bai Bang paper mill
The Swedish International Development Authority has embarked on a large programme of assistance to the now united Socialist Republic of Vietnam. Brauns (53) has outlined the largest project, which is setting up a pulp and paper mill at Bai Bang, northwest of Hanoi. The mill is expected to come into operation successively in the late seventies, beginning with one paper machine. The annual production will be 48,000 tonnes of kraft pulp, used in 50,000 tonnes of writing and printing papers and 5,000 tonnes of wrapping paper. The fibrous raw materials for the mill will be Vietnamese mixed hardwoods and bamboo.

South and Central America

Argentina

1. Ledesma SA
Sarmiento 440, Buenos Aires
Ledesma, an integrated bagasse pulp and paper mill, has capacity for production of 35,000 tonnes/yr bagasse pulp. Wilson (54) has described the mill, which features a Ritter bagasse bulk storage system and a black liquor recovery system. The bagasse pulp is used in the production of high quality printing and writing papers.
2. Papel Misionero S.A.I.F.C.
Santa Fe 220, Posadas, Misiones
Papel Misionero is an integrated kraft mill, started up in 1976, with a capacity of 36,000 tonnes/yr of kraft sack papers and linerboard. The mill aims to use fast-growing pines (*Pinus taeda* and *Pinus elliottii*) from local plantations (55).

3. Celulosa Argentina SA
Av. Mate de Luna 1934, San Miguel de Tucuman, Prov. of Tucuman.
The mill has capacity for production of 5,000 tonnes/yr bagasse pulp.
4. Azucarera del Norte SA (Cia)
Ingenio Leales, Province of Tucuman
The mill has capacity for production of 3,000 tonnes/yr bagasse pulp.

Brazil

1. Companhia de Celulose de Bahia
Rua Marquez do Monte Santo 50, CP 472, Salvador, Bahia
A market pulp mill based on sisal is being built in Bahia State, in the north-eastern region of Brazil (56). The mill is being designed for output of 64,000 tonnes/yr. A new crushing process for the sisal leaves has been developed, and the juice collected from crushing will be used in the manufacture of chemical by-products. The pulp will be cooked by a normal alkaline soda process. Sisal pulp is reported to have high tear strength and porosity and it is hoped that when blended with other pulps will substitute for softwood pulp.
2. Industrias de Papel Simao SA
Caixa Postal 172, Rua do Manifesto 931, Sao Paulo
Leonardos (57) has described how problems inherent in using all-eucalyptus furnish in the manufacture of fine papers at Industrias de Papel Simoa were solved. This involved studies on refining and modifications to the paper machine. An earlier paper by Leon and Borges (67) described the production of bleached kraft eucalyptus pulp for printings and writings.
3. Cenibra (Celulose Nipo-Brasileira S/A)
Minas Gerais
A short description has been given of the Cenibra market pulp mill scheduled to have started in 1977. The mill will have an initial capacity of 750 tonnes/day bleached eucalyptus pulp. About 50% of the output will be shipped to the Japanese owners on a 15-year contract, the rest will be available for other markets.
4. Rio Grande Companhia de Cellulose do Sul (Riocell)
P.O. Box 2896, 90,000 Porto Alegre
It is perhaps worth mentioning that the Riocell market pulp mill based on eucalyptus which started out as part of the Borregaard Group, is now in severe financial difficulties and has had to be rescued by the Brazil National Development Bank.
5. Jari Florestal
Munguba
A market pulp mill, based on Gmelina arborea, is due to be completed in 1980 with an annual capacity of 260,000 tonnes kraft pulp (59). Jari Florestal é Agropecuária, part of the US based National Bulk Carriers Organisation, is expected to yield some 12,000 tonnes of commercial timber a day. Technical management for the pulp mill will be provided by Kaukas-Kymmene of Finland. The complete pulp mill and power plant has been constructed on floating units in Japan for towing to the site. This overcame problems of attracting and accommodating skilled technicians on the isolated Jari site during construction.

6. Celulose e Papel Refinadora Paulista SA
Bairro Monte Alegre, Caixa Postal 65, Piracicaba, Sao Paulo
Integrated pulp and paper mill with capacity for producing
9,000 tonnes/yr bagasse pulp for use in manufacture of fine papers.
7. Companhia Industrias Brasileiras
Cáis da Alfândega 130, Recife, Pernambuco
Integrated pulp and paper mill with capacity for producing
12,000 tonnes/yr bagasse pulp for use in kraft sack papers.
Bamboo and hardwood kraft pulps are also manufactured.

Colombia

1. Carton de Colombia SA
Apartado Aereo 219, Cali
Gomez and Mondragón (60) have described trials in which in-
creasing amounts of Colombian hardwoods were included in
kraft linerboard furnish at Carton de Colombia. It was found
that it was feasible to increase the proportion of mixed tropical
hardwoods in the furnish from 40% to 80%.
2. Productora de Papeles SA (Propal)
Apartado Aereo 4412, Cali
Klass and Evans (61) have described the bagasse handling and
pulp system in operation at the Propal mill, when a new paper
machine for lightweight papers was installed in 1968. The mill
currently has a capacity for production of 70,000 tonnes/yr
bagasse pulp and 90,000 tonnes/yr fine papers and tissue
wrappings. The bagasse is pulped by a soda process in Defibrator
digesters, and a three-stage bleaching sequence is used:
chlorination, alkaline extraction, sodium hypochlorite.

Ecuador

1. Papelera Nacional SA
P.O. Box 7017, Pedro Carbo 304, Guayaquil
The mill produces 15,000 tonnes/yr unbleached bagasse pulp for
use in the manufacture of kraft bag and sack papers.

Mexico

1. Celulosa y Papel de Michoacan SA (Cepamisa)
Michoacan
Battenberg and de la Peza (62) described the start up in 1976 of
stage one of the Cepamisa mill in Central Mexico. The mill uses
local woods, including pine and oak woods, for production of
200 tonnes/day of bleached kraft pulp. A 150 tonne/day fine paper
machine is planned for the second stage.
2. Kimberly Clark de Mexico SA
Escamela, Municipio de Ixtaczoquitlan, Vera Cruz
Williams (63) described the Kimberly-Clark Orizaba mill soon after
start up in April 1970. The mill can produce up to 40,000 tonnes/yr
bagasse pulp; K-C is a licensee of the Grace Peadco process for
bagasse pulp and paper manufacture. The bagasse pulp is used in
uncoated business papers, coating base papers and tissues.

3. San Cristobal SA
San Cristobal Ecatepec, Edo. de Mexico
Tetlow (64) described the successful manufacture of newsprint from bagasse at the San Cristobal mill. The process which is also used for higher brightness papers and tissues, basically consists of two-stage soda digestion and chlorine and/or hypochlorite bleaching. The second stage digestion is carried out in a disc mill. For newsprint manufacture the digestion soda is lowered to a minimum before the strength and bleachability of the pulp fall to an unacceptable level.

Peru

1. Papelera Trujillo SA
(Subsidiary of Sociedad Paramonga Ltda)
Casilla 130, Trujillo
A description of the Trujillo plant was given when it started up in 1970 (65). The mill has a plant for production of soda bagasse pulp, which together with waste paper and kraft pulp is used in the manufacture of corrugating medium.
2. Sociedad Paramonga Ltda
Augusto Tamayo 180, P.O. Box 2488, San Isidro, Lima
Evans (66) has given details of operations at the Paramonga bagasse mill of W.R. Grace and Co., as well as mentioning other activities of the company in South America. The Paramonga mill was the first in the world to make pulp and paper from bagasse and started up in 1939. Research on the use of bagasse led to the development of the Peadco process in 1957, and this process is currently used at this and other Grace mills, and by licensees. The pulp is cooked with caustic soda in three horizontal single tube continuous digester lines, with the necessary refiners and three-stage washers. A three-stage bleaching system is also in operation. In 1968 the mill supplied 60% of the paper market in Peru, including wrappings, writings, printings, tissues, bags and sacks and corrugated boxes.

Australia

1. Associated Pulp and Paper Mills Ltd.,
459 Collins Street, Melbourne 3000
A summary of the experiences of the company in eucalyptus pulping, particularly at the Burnie mill in Tasmania, was published in 1964 (68). The manufacture of cold soda pulp at the Wesley Vale mill, for use in both machine finished and publication grades has been described by Clarke (69).
2. Australian Newsprint Mills Ltd.,
Boyer, Tasmania 7400
The history of Australian Newsprint Mills and the manufacture and properties of newsprint from eucalypt woods has been described by Pearson (70). The furnish used for the newsprint comprises 18% semibleached kraft from *Pinus radiata*, 20% semibleached cold soda pulp from eucalypts, and the remainder groundwood from mature eucalypts produced by grinding in the presence of caustic soda, and after washing, brightening with zinc hydrosulphite.

SMALL SCALE WASTE PAPER RECYCLING

The number of articles written on waste paper recycling must amount to many thousands. The following section will consider only small-scale manufacture of recycled paper, but it may be of use to refer to the following sources which have discussed recent technical developments in waste paper stock preparation.

Norton (79) has summarized recent trends in stock preparation and de-inking and considered future developments in recycled fibre use in different grades.

A general literature review of recycled paper developments was published by Forsythe (80) in 1972, covering the state of the art in process requirements and equipment design.

Felton (81) described in 1974 the current technology of waste paper stock preparation systems with flow diagrams and operating costs of systems for different paper grades.

The current status of small-scale waste paper recycling has been reviewed by Thomas (71) in an appendix to the booklet 'The Paper Chain'. The booklet itself examines the situation of waste paper recycling in the UK and suggests ways in which more secondary fibre might be included in paper products. Reference is made to equipment supplied by I.T. Development Techniques Ltd. (a subsidiary of Intermediate Technology Development Group, 9 - 10 King Street, London WC2). This organization also supplies consultancy advice on small-scale pulp and paper manufacture and is in contact with manufacturers in Britain, Germany and India offering production units in the range 10 - 80 tonnes/day output. The economics of small-scale production and management problems which can occur are referred to. The capital investment for the I.T. Development Techniques plant has been estimated at £200,000 for a 5 or 6 tonnes/day capacity. A similar plant for moulded pulp production is in the region of £35,000 - £40,000.

Anthony Hopkinson, an English businessman, has developed a semi-automatic small-scale paper machine, suitable for developing countries, which costs only £1500 (72). The equipment is being manufactured by an engineering firm in Essex. It is hoped to develop a simple corrugating machine to complement the paper machine. The papermaking unit consists of a semi-automatic waste paper pulping unit and paper forming tank with pressing and forming roller table. The sheets produced, at about 100/hr, are about the size of a newspaper page; they are hung up to air dry.

A locally built small-scale machine at a converted handmade paper mill at Ambert in France (71) turns locally collected waste paper into packaging paper which is used by local farmers as liners for their fruit boxes.

A West German paper machinery manufacturer, Carl Krafft und Sohne of Duren, have developed a small-scale unit (70 tonnes/day, width up to 2450 mm) for production of containerboard from waste paper. The machine has the following advantages: low building investment costs as the machine does not require basement foundations or a boiler house (an inexpensive steam heater is sufficient); low operating costs, as the Turbo-Formers do not require vacuum pumps, the jet dryer consumes 5% less heating energy than conventional drying systems, and with automatic break control and start-up equipment only a minimum of operators is required. A description of the Krafft machine has been given by Shulman (74), who also mentions that Seyfert Wellpappe, of Reichenbach, West Germany have had extensive experience with the Krafft machine. Another user is Hans Kolb, of Kaufbeuren, West Germany

The economics of small-scale recycling units has been discussed by Iannazzi (75). It is pointed out that a 100 tonnes/day plant could operate with a supply of waste newspapers collected from a population of about 2 million. In this respect the idea of a mini-machine is outlined and details are given of the ECHO machine (Eli Cowan-Holder), a concept developed by Eli Cowan of E. and B. Cowan Ltd. of Montreal and Holder Associates Ltd. of Bury, England. The machine would include a traditional twin-wire forming section and non-traditional modified drying techniques for more efficient water removal. Substantial energy savings could be realised by using a gas turbine drive on the machine, and vapour recompression of the exhaust from the dryers. A table shows the estimated investment, operating costs and profitability of a 100 tonnes/day ECHO machine making recycled newsprint.

A brief reference (73) has been made to the activities of Mr. and Mrs. Kayes Van Bodengraven, a Dutch-born couple now living in Australia, who are operating a handmade paper mill using waste paper as raw material.

In 1967 it was reported (76) that Kartonfabrik Hergiswil in Switzerland was using waste paper to manufacture coated and uncoated boards (0.3 - 6 mm thick, 280 - 560 gsm) on two hand paperboard machines, built by Karstads Mekaniska Werkstad of Sweden.

The technology of making paper by hand has been described in the booklet by Barcham Green (77) and also by Hunter (78) in the McGraw Hill textbook on pulp and paper manufacture.

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