THE SUGAR CANE SEPARATION PROCESS
AND COMPOSITION BOARD MANUFACTURE FROM "COMRIND"

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ABSTRACT

A process for the separation of high quality sugar cane fiber (COMRIND) has been developed. The process separates sugar cane into rind, sugar bearing pith and wax bearing epidermis i.e. into three completely separate product flows. The rind, which is 18-20% of the weight of the cane stalk, contains some 46% fiber on a wet basis. The fibers are substantially free of pith and may be washed (diffused) free of hot water solubles and without further depithing may be used for high value by-products.

The sugar cane separation process in general terms, and the down-stream processing of the rind fiber into composition board in detail, are described.

FOREWORD

In the fall of 1978 addressing a gathering of International Factory Experts during a meeting in Venice, Italy I stated:

"The recent recognition of expected difficulties in supplying competitive products from non-renewable resources and the amount of energy expended in producing such products are generating a better appreciation for one of Canada's major renewable resources - her forests.

Demand for forest products is expected to increase until, by the end of the century, the annual harvest will equal the annual growth. This expectation and the increasing demand for wood based products in construction and in secondary industry, dictate the efficient use of the forest resources."

Ladies and Gentlemen, in addressing this gathering here, sponsored by the International Society of Sugar Cane Technologists, I could use the identical text by substituting the words WOOD and SUGAR CANE, and respectively refer to SUGAR CANE PLANTATIONS as substitute for FORESTS. The
demand for food and shelter through the world continues to present opportunities for those who are fortunate enough to have resources available. Due to the fact that SUGAR CANE is a renewable resource, manufacturing plants based on the utilization of SUGAR CANE can look to continuing supplies of raw material; SUGAR CANE processing is further enhanced by opportunities to develop production facilities that are self-sufficient in energy.

By converting SUGAR CANE RIND into composite products, such as composition board and reconstituted timber, the yield of high quality products is increased over that attained by the more conventional method of converting wood into lumber or plywood because a lower value raw material is being utilized, which at the same time will conserve valuable timber stands for such end uses where SUGAR CANE RIND cannot be used. In addition, the potential flexibility of the technology for the conversion of SUGAR CANE RIND to composites is such that a variety of high value secondary products might be produced.

For this reason a distinct Canadian development, the Sugar Cane Separation Process, which results in providing a clean woody raw material suitable for further processing provides viable answers to meet the demand for a variety of product types, in supplying the future world need for structural reconstituted panel boards and structural reconstituted lumber.

Structural composition board and reconstituted lumber from Sugar Cane Rind are thus a significant beginning in the area of composite products evolution relative to products suitable for EXTERIOR applications. In presenting this paper to this gathering in the Philippines, I wish to present the framework for discussion and hope to contribute in a meaningful way amidst the thickening multiplicity of advances in Composition Board Production, a field which continues to provide exciting opportunities to mankind. By sharing my knowledge and accumulated know-how in a meeting here today, I hope to help in a small way towards building a better world in which to live, especially in relation to the pressing needs for shelter in so many parts of the world relative to providing for low-cost housing systems which are affordable in socio-economic terms.

INTRODUCTION

The Separation Process has been hailed as the greatest breakthrough in sugar technology for several decades. The Process, which was invented primarily for the separation of the high quality fibers — situated on the outside portion of the stalks of such grasses as sugar cane, sorghum, etc., — may well be an even more significant step forward in the technology for processing non-wood fiber for Pulp and Paper and for use in Composition Panel Boards.

The technology is based principally on the technique of separating the hard outer rind of the sugar cane stalk from the soft pith which forms for core of the cane.
The fundamental differences in both the chemical and physical properties of these two components of the stalk have been known to technologists for over fifty years. Noel Deerr, in Hawaii, and Prinsen Geerligs in Java, had both separated the stalk into rind and core and had carried out analysis on these components. Other work of a similar nature was also done in Louisiana and in the West Indies. The results of these investigations showed quite clearly that the sucrose in the stalk was heavily concentrated in the core of the sugar cane, and the fiber in the stalk was predominantly in the rind.

The structure of the cane stalk was also studied in detail. A microscopic examination of the stalk, cut across the center of an internode, was carried out by Cobb, who showed that the stalk consists roughly of two parts:

1. a hard outer rind; and

2. a mass of softer tissue in the interior, interspersed with fibers, the latter being the most frequent around the periphery of the stalk. The rind was shown to consist of two components:

   a. a thick epidermis, with a strong outer cuticle often with a thick layer of wax on the outside which made it impervious to water; and

   b. a layer of thick walled cells.

The function of the cuticle is to prevent evaporation of water from the stem of the cane and to protect the soft interior part from mechanical injuries. The layer of thick walled cells gives rigidity and strength to the stalk. These thick walled cells gradually pass into the thin walled cells of the ground tissue or parenchyma, which serve to store the sucrose containing juice of the cane. The internal fibers, known as fibro-vascular bundles, consist of the wood vessels, sieve tubes and companion cells, surrounded by thick walled fibers.

Went, in Java, further separated the internodes by removing a cylindrical piece, 1.5 cm in diameter, from the middle of each internode in a longitudinal direction by means of a cork borer. The remainder after being peeled, was called the periphery, while the peelings were classified as the rind (Table 1).

In summary it can be seen from the above that workers in the sugar industry have long been aware of the fact that the sugar in the cane is concentrated in the pith cells of the internodes and that the juice of these cells is of high purity; also that the fiber in the cane is concentrated in the rind.

However, the stalk of mechanically separating the cane stalk on an industrial level was beyond the engineering capability of those days. Furthermore, the trend to larger and larger mills, accompanied by the introduction of field mechanization, made it appear impossible to process the cane stalk by stalk.

Although the above mechanical developments significantly reduced—
cost of producing sugar they, unfortunately, simultaneously reduced the value of the bagasse fibers produced as a raw material for pulp and paper and composition boards. This was caused by the effects of intensive milling, which mixed the valuable rind fibers with the internal pith cells, and the effects of field mechanization, which brought into the mill sand and soil, some of which became embedded in the fiber during milling.

**TABLE 1. Analytical Suta in the separated components of sugarcane stalk**

<table>
<thead>
<tr>
<th></th>
<th>Sucrose</th>
<th>Fiber</th>
</tr>
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<tbody>
<tr>
<td>(Center)</td>
<td>17.6</td>
<td>4.46</td>
</tr>
<tr>
<td>1. (Periphery)</td>
<td>18.5</td>
<td>6.15</td>
</tr>
<tr>
<td>(Rind)</td>
<td>9.6</td>
<td>25.13</td>
</tr>
<tr>
<td>(Center)</td>
<td>15.0</td>
<td>3.57</td>
</tr>
<tr>
<td>2. (Periphery)</td>
<td>14.6</td>
<td>6.45</td>
</tr>
<tr>
<td>(Rind)</td>
<td>–</td>
<td>28.29</td>
</tr>
<tr>
<td>(Center)</td>
<td>19.2</td>
<td>4.72</td>
</tr>
<tr>
<td>3. (Periphery)</td>
<td>19.0</td>
<td>9.29</td>
</tr>
<tr>
<td>(Rind)</td>
<td>5.99</td>
<td>41.75</td>
</tr>
<tr>
<td>(Center)</td>
<td>17.6</td>
<td>4.68</td>
</tr>
<tr>
<td>4. (Periphery)</td>
<td>17.1</td>
<td>8.60</td>
</tr>
<tr>
<td>(Rind)</td>
<td>5.21</td>
<td>46.11</td>
</tr>
</tbody>
</table>

**The Sugar Cane Separation Process**

The advantage of the Separation Process is that the sugar cane stalk is separated into its individual components prior to obtaining the sugar, i.e., the cane is separated into rind, pith and sugar, and epidermis (wax) fractions (Fig. 1). In this manner, clean, well-defined fractions which are expected to have increased commercial value are obtained. This is in contrast to conventional sugar cane processing in which the non-sugar components are in a thoroughly mixed state.

The separation process is not entirely new to sugar cane technologists. An early, primitive version of this system was demonstrated at St. Kitts in 1968 and the patents date back to 1969 (U.S. Patent No. 3,424,611 (1969) and U.S. Patents No: 3,434,612 (1969). The 1968 version of the machine had so many mechanical problems that the sugar cane industry was turned against the device. Development and commercialization efforts have been revitalized in recent years.

After viewing a demonstration of the process, Battelle Columbus Laboratories
FIGURE 2. Tilby Separation Process
The third set of rolls includes a cutting roll which scrapes off the epidermis cells. The fraction removed here includes wax, coloring matter, and any dirt attached to the outside of the stalk. The epidermis then drops to a conveyor from which it is carried to further processing. The remaining clean rind fiber halves then go to the fourth set of rolls.

The fourth set of rolls, which are optional together with a cutting station, slit and cut the rind material into wafers or strands of predetermined width and length. These wafers or strands then drop to a conveyor by which they are carried to a diffuser for removal of a major portion of the residual sugar.

The fate of the sugar cane (or sweet sorghum) rind is depicted in Fig. 3.

**FIGURE 3.** Sugarcane size breakdown by the Tilby Cane Separator Process

Several equipment units, of varying throughputs have been developed based on the aforementioned principles. The basic full-sized separator, which was invented by Ted S. Tilby of Victoria, British Columbia, Canada, is called the C-10 Separator and it has a rated capacity for handling 20 tons of cane per hour. In actual tests, in conjunction with the full scale Separation Pilot Plant in Florida, throughput rates as high as 25 tons per hour were achieved.

**Fraction Analysis**

Unfortunately, the only detailed analysis on the fractions resulting from the cane separator process were carried out in 1968 and 1969 when one of the earlier versions of the cane separator was being used (Laurie).
The fractions as obtained from the cane separation process have been designated as “Comfit GR” (pith-sugar juice), “Comrind GR” (rind-sugar juice) and “Dermax” (epidermis-sugar juice). Based on the original weight of the cane, these fractions are present at 79%, 19%, and 2%, respectively. Each of these fractions generally can be broken down into fiber or pith, moisture, sugar and wax components as follows:

<table>
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<th>Fiber or Pith</th>
<th>Moisture</th>
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<td>Comrind GR</td>
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<td>8.0%</td>
</tr>
<tr>
<td>Comfit GR</td>
<td>12.8%</td>
<td>72.1%</td>
<td>15.1%</td>
</tr>
<tr>
<td>Dermax</td>
<td>33.2%</td>
<td>55.6%</td>
<td>8.7%</td>
</tr>
</tbody>
</table>

Fig. 4 illustrates the quantity of each fraction component that would be yielded based on the aforementioned percentages, starting with 100 tons of millable cane. The figures are speculative and indicative only.

Potential Uses/Markets for Separated Sugar Cane Fractions

Rind

The rind segments produced by the process are expected to find use in the paper and composition board industries.

Paper

Bagasse from conventional sugar processing plants has long been used as a fiber source by the paper industry in certain parts of the world. However, the bagasse contains the pith portion of the cane and also color bodies, wax, and dirt from the epidermis. To obtain a satisfactory pulp, a depithing operation along with additional washing and bleaching steps have been required. These additional steps are costly and increase the cost of bagasse fiber for paper-making. The cane separation process would circumvent these problems by providing depithed fiber directly.

Another consideration is that bagasse fiber from conventional processing has less than optimal morphological characteristics due to the grinding and...
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FIGURE 4. Fraction yield of the cane separation process.
milling it experiences. The rind sticks produced by the Separation Process, conversely, could conceivably be cut to any length desired by the papermaker, depending on the paper to be produced. Due to these advantages, it would be expected that the papermaker would pay a substantial premium for clean rind sticks compared to what he is willing to pay for bagasse.

**Figure 5. The Tilby System**
Composition Board

There is considerable amount of activity to determine how best to use the rind sticks (after extraction of sugar juice) for production of various types of composition board (Moeltner5). The results look very promising in all areas, with the likelihood that the rind sticks would sell at a very substantial premium. Preliminary work indicates that even when standard particleboard is made with the material in random formation, the resulting board is superior to normal wood-based particleboard (Reichhold 1978). Therefore, the value of the rind segments, even for this purpose, should be considerably higher than the replacement fuel value of the rind segments and higher than the price of wood residue such as saw dust and planer shavings.

When the rind segments are split and cut to wafers or strands and are aligned by a special aligning machine for production of structural particleboard preliminary indications are that the resulting boards are competitive in strength qualities with plywood which sells at a much higher price than particleboard (Moeltner5). The segments should have a value considerably higher than its fuel replacement value or pulpwood value.

Pith

Pith resulting from conventional sugar cane processing is unsuitable for many applications because it has been mixed with contaminants of the epidermis layer including wax, oil, and dirt. Pith obtained in the separation process would be very clean and would be expected to find use in a variety of applications. Such applications might include the use of pith as an absorbent filler for plastics, raw material for manufacture of chemicals or single cell protein, or for cattle feed.

a. Absorbent or Adsorbent. Bagasse pith, having an extremely high surface area, is an excellent absorbent and has been used in the past for this purpose. The material would be expected to find use in the chemical and agri-chemical industry, possibly as an oil slick absorbent or for many other purposes in which high absorbency is required.

It has been suggested (Nolan, 1967) that the physical structure of pith is probably applicable to the adsorption of gases and chemicals. The pith walls are relatively large diameter tubes with extremely thin walls. Such a material, with a very large surface area per unit weight, might make a fine medium for selective adsorption of specific gases or chemicals.

b. Filler for Plastics. It is well known that large amounts of cellulosic materials such as wood, pulp, paper, and ground shells of various types are used as fillers in the modern plastic industry. A synthetic or natural resin is rarely in a condition suitable for direct molding and its properties have to be modified by the addition of a considerable amount of filling materials. The fillers are used in plastics not only to reduce the cost of molding powder by replacing part of the expensive natural or synthetic resins with cheaper
filling materials but also to modify, improve, or introduce one or more desirable properties to make the plastic suitable for a particular use. Wood flour, or sawdust, is by far the most widely used filler in the case of phenolic molding powders. It has been reported that up to 70% of the phenolic molding powders contain it. The clean pith resulting from the cane separation process should form an excellent filler material with high bulk characteristics. It should be compatible with a large variety of resins, both synthetic and natural, including phenolics, ureas, vinyls, cellulose acetate, cellulose nitrate, melamine, and shellac. It would, therefore, be of interest to incorporate the clean, well-ground bagasse pith into resin-molding powders of different types and study their mechanical properties.

c. Raw Material for Chemicals. The clean desugared pith could also be used for production of chemicals such as furfuryl alcohol, xylene, xylitol, and levulinic acid. Furfural and furfuryl alcohol are presently being produced from whole bagasse in Florida, the Dominican Republic, the Philippines, and South Africa. Since the pith as the same chemical make-up as the bagasse fiber — namely, about 20 to 22% lignin and 27 to 30% pentosans (Paturau, 1969) — it should be possible to use the pith for production of these chemicals. The large surface area of pith renders it extremely reactive to chemicals, making it possible to use pith for production of furfural, etc., with lower consumption of acid. Furthermore, the residual pith, after the hydrolysis stage in the production of furfural, xylene, or xylitol, can still be used as fuel in the boilers. Both Cuba and Taiwan have been carrying out extensive research and pilot plant work on the use of pith for these purposes (Atchinson).

It might also be possible to further hydrolyze the residual cellulose resulting from the mild hydrolysis required for furfural or xylene after the removal of these products. By this means, glucose resulting from the hydrolysis of the cellulose can be partially converted to levulinic acid or other products, and the remaining solid residue is mainly lignin. Work also has been carried out in Taiwan on the preparation of furfural and levulinic acid concomitantly from bagasse pith by a one-step conversion. In this case, the furfural came over with the steam distillate, and the filtrate from the solid residue contained the levulinic acid. The solid residue from this operation was mainly lignin. It might even be possible to develop a commercial use for the solid lignin residue, including its chemical conversion to activated carbon. Thus, the entire pith could be used for conversion to useful chemicals of some kind. This had not been considered possible previously because of the high dirt and ash content of the pith.

d. Raw Material for Protein Manufacture. Although Louisiana State University and other research groups carried out extensive work on the use of whole bagasse for production of single cell protein, very little work has been done on the use of pith alone as the raw material for this purpose. Because of the high purity, large surface area, and cleanliness of the desugared pith, it appears that this pith could serve as a better raw material than whole bagasse for production of single cell protein. In fact, the Cuban Sugar Cane By-Products Research Organization (ICIDCA) has been working for the past two years...
on the use of pith for production of single cell protein and the results have been promising.

e. Cattle Feed. The use of bagasse pith as a major component of cattle feed has been practiced for many years in a number of countries. However, the high dirt and ash content of the pith resulting from normal depithing operations is a distinct disadvantage. Therefore, the clean pith from the Tilby separation process should sell at a premium for this country as compared to its fuel value. When pith is used as cattle feed, it is usually mixed with molasses and pelletized for easy storage, handling and transportation. The pellets can then be handled very easily in bulk, and because of the high density of the pellets, the transportation cost is low.

Epidermis

The epidermis fraction, which is scrapped off the outside of the cane stalk in the Tilby separator process, represents about 45% of the dry weight of the stalk (after juice extraction). It contains a high quality wax, various coloring matters, and other substances. In the normal sugar milling process, a major portion of the wax, which is broken into fine particles, is part of the cane mud formed in the juice clarification process. Because the weight of the wax represents such a small portion of the total weight of the mud, processes for recovering the wax have proved to be uneconomical. However, the epidermis material from the Tilby process contains the wax from the surface of the cane in a more concentrated form, and its recovery should be simplified greatly. The cane wax is similar to Carnauba wax which now sells at a very high price for coating and other purposes.

Implications

The overall Separation Process is summarized in Fig. 5. The input is sugar cane or sweet sorghum. The outputs, depending on the market situation include pulp or construction materials, fuels and/or sugars. Energy self-sufficiency is achieved (or approached) by burning low value by-products. The major implications of the Tilby process are:

1. The rind fiber product has a value that probably exceeds $40 per ton instead of a fuel value of approximately $20 per ton.

2. Because the splitter cuts between the fibers rather than across them, high fiber cane is as easy to process as low fiber cane, which means that with high fiber cane there is more product to be sold. Also, less energy is consumed to achieve separation.

3. The pith is a simpler raw material from which to extract sugars.

4. The desugared pith is a clean source of glucose.

The Separation Process opens vistas in sugar cane agricultural technology,
as well as in processing technology. One of the consequences of the Separation process then is that the present low fiber sugar cane varieties may be sub-optimal choices. A new sugar cane breeding program is needed to adjust the overall sugar cane agricultural system in order to exploit the advantages afforded by the Separation Process. The ultimate benefit is the potential achievement of lower cost fermentable sugars with a smaller expenditure of energy.

Conceptional Plant Design considerations

In order to illustrate the method of Composition Board production with a manufacturing facility specifically designed for this purpose, a Process Flow Diagram was prepared. This Process Flow Diagram depicts the operation of a Composition Board Plant in two configurations namely: utilizing wood wafers or wood strands as raw material alternately and using Comrind wafers or Comrind strands as raw material for the production of a Structural Composition Board. As can be seen from this Process Flow Diagram, the board making section comprising the unit operations with both alternate preparation line layouts, i.e., the board making section of identical design can serve either raw material form. The proof for this has been ably demonstrated during the trials on commercial scale facilities on three different occasions (Waferboard Hydex, Sico, 1978).

To show the effect of utilizing comrind as raw material as opposed to wood, the following description is given:

Utilizing the Separation Process, the separated COMRIND fiber from sugar cane is immediately, following separation, cleaned from residual sugar and residual pith. This is best accomplished by applying a Diffuser. Cleaned from the residual sugar and pith in the diffuser, the Comrind fiber is transported into one of two wet silos shown on the Process Flow Diagram as the first unit operation of the Composition Board Plant. The first of the two wet bunkers serves as a buffer storage feeding to the bale storage section of the plant, whereas the second wet bunker serves as a buffer storage feeding directly to the Composition Board Plant.

The chemical composition of the fibrous lignocellulosic Comrind of sugar cane after separation and extraction of residual sugar and simultaneous wet depithing in the diffuser is very similar to wood. Physical properties of boards produced have proven conclusively by the sound competitive position of Comrind Composition Board, in particular Comrind based structural particle board such as Waferboard or Strandboard made from Comrind wafers or Comrind strands in comparison to presently produced structural particleboards such as wood based Waferboard or Strandboard, the latter often referred to as O.S.B. It was not on account of the physical properties of cane fiber that in the early days of bagasse utilization for particleboard production a number of misconceptions arose, but due to the lack of understanding, on the part of the promoters of bagasse particleboard mills, of the physical and chemical properties of bagasse, and how it differed from wood. These early bagasse particleboard promoters and machinery suppliers did not even take advantage of the technical
advances made in storing, handling and depithing bagasse for use in production of pulp and paper. Therefore, in the early bagasse particleboard mills, bagasse was stored improperly thus resulting in hydrolysis and deterioration of the fiber.

Furthermore, efficient and adequate depithing was not practiced, which resulted in excessive use of resin and a poor quality panelboard. In addition, the particleboard processes which had been applied to wood were utilized on bagasse and it was not generally realized that other processes and equipment should be considered when converting bagasse to composition board. Most of the present day bagasse particleboard plants which are in trouble, as well as, most of these which have failed are the evidence to my statements.

In the few cases where sugar mill owners, who also had knowledge of advanced methods for utilization of bagasse for pulp and paper as well, developed bagasse particleboard plants, these have been successful and the product, of all density, from insulating board to hardboard, has completed fully with wood-based particleboard. In these cases the bagasse was completely depithed and dried before storage and the resulting bagasse fiber proved to be excellent.

However, it is most important to distinctly differentiate between conventional bagasse as it results from traditional sugar mills and Comrind as it results from applying the separation process. The pith has already been separated from the Comrind more efficiently than can be done with any depithing process. Furthermore, the fiber length of the rind fiber in the cane has been preserved completely, as contrasted to the tremendous damage done to the bagasse fiber in the conventional sugar milling process. Furthermore, the cane fiber are perfectly aligned within the Comrind segments.

Just as in the case of bagasse-based composition board plants due to the seasonal nature of the sugar cane harvest in most countries, a Comrind based Composition Board Plant will normally operate during the cane harvesting season on green fresh Comrind and during the period between harvesting seasons, on stored Comrind.

The green Comrind comes from the separation station with an average moisture content of 50%. In this state most of the residual sugar has already been removed by the diffuser of the Separation Battery with partial removal of the small amount of residual pith, which adhered to the Comrind, as well. The Comrind in this state is very flexible and therefore it is rather difficult to completely remove the final particles of pith which adhere to the inside of the Comrind. For standard conventional top quality particleboard, it is not necessary to remove this small amount of residual pith because the Comrind coming from the separator process is already more completely depithed than it is possible to depith bagasse with the best commercial depithers. However, in order to prepare the Comrind so that it is suitable for top quality structural composition board production, it is desirable to remove as much as possible of this residual pith from the inside of the Comrind. Because of this it is best to pass the green Comrind through a special dryer to reduce the moisture content to a degree optimal for elimination of any remaining pith and/or
fine substance. It is important to stop drying at the right moisture content, since excessively dried Comrind is too brittle, which results in too much dust and damaged fiber during the screening process which follows drying. The final moisture content in the Comrind destined for baling or bulk storage will have a moisture content of 12-15% whereas the Comrind fiber immediately utilized in the boardmaking process will be dried to a moisture content of 4-6%.

The best of the existing bagasse particleboard plants, with a proven operational record as to product quality, utilize a similar technique, including complete moist and wet depithing, drying, screening or dusting to remove residual pith and fines, then compressing the clean fiber into large pads for storage. However, most of the existing conventional bagasse particleboard plants, which use baled and stored bagasse, do not depith adequately, and do not dry the bagasse prior to baling, claiming it is not necessary because of the fermentation which will take place during storage. When the bagasse bales are properly stored, the fermentation of the residual sugar in the bagasse, as well as other low molecular water soluble components are converted to acids, with the reaction generating heat. This tends to dry the bagasse to less than 20% moisture content if the bales are stored so as to provide proper ventilation so that the heat and acid fumes can escape.

Unfortunately, however, many of the bagasse particleboard mills do not store the bagasse properly, so that the heat and acid fumes can escape. In such cases, the combination of high temperature and acid pH results in hydrolysis of the cellulose to shorter chain length molecules. As a result of this partial decomposition of the cellulose by hydrolysis, the strength of the fiber bundles is reduced considerably, thus resulting in board or low physical properties. Likewise if hydrolyzed bagasse is used for manufacture of pulp and paper the quality is also very poor.

These considerations have been taken into account in the Conceptional Process Design and Plant Layout of a Composition Board Plant as depicted on the Process Flow Diagram shown. Once the Comrind particles, strands or wafers have been cleaned and dried, the down-stream process of converting Comrind into a composition board is, as already mentioned, identical relative to Process Design and Plant Layout, as is a wood based composition board plant. This situation has been ably demonstrated during three mill trials on the facilities of commercial operating composition board plants in Canada and Germany, which normally produce wood based products, thus we have converted Comrind Sugar Cane fiber into Particleboard, Waferboard & Strandboard (OSB).

Typical Plant Facility

With the exception of those sugar cane growing areas where harvesting is possible on a year round basis of typical composition board plant will have to operate partially on the basis of freshly harvested sugar cane rind and partially on the basis of pre-dried and baled stored sugar cane rind.
The following description of a typical plant facility applies to the Process Flow Sheet No. B 401 and Plant Layout C 101 developed for a facility in Guatemala, Central America (1978).

The wet end of the Comrind preparation section of the Caneboard plant consists of two parallel lines of unit operations with the sequence Wet Bunker, Conveyor, Dryer, Screen, Conveyor, and Dry Bunker in the first, baling station in the second line. Both lines run in parallel during the harvesting season for a period of 150 to 180 days. During the off-season the bale storage serves as a supply depot in order to assure the continuation of a year-round board production downstream from the dry bunker. The unit operations Dry Storage, Blending, Forming, Forming Line, Hot Press, Trim Saw and Board Stacking form the integrated board making process, converting the Comrind on a year-round basis into a high quality structural particleboard of either the wafer or strand type.

Automation of the whole process is governed via an Electrical Control System utilizing either a conventional relay system or optionally programmable controllers.

The freshly harvested Comrind comes from the Separation Station with an average moisture content of 100% based on dry weight. In this state residual sugar has already been removed by the washer/diffuser of the Separation Battery with partial removal of residual pith as well. From the wet bunker where the prepared and washed Comrind fiber is collected, metering equipment feeds the material in a continuous flow into a rotary bundle dryer. After drying, the Comrind fiber is screened, that is to say, separated from undesirable fines and most of the remaining residual pith. Due to the shrinkage in drying and to the reduction of adhesion between the humid fibers and the remaining pith, and last but not least, due to the friction during the drying process, a good quantity of remaining pith loosens from the fibers which has to be eliminated prior to further processing of the Comrind fiber.

Glueing and forming of the Comrind mat is done by machinery which has proven reliable for many years in particleboard production from wood. Only slight modifications had to be made for the dosing and forming machines, as Comrind has a somewhat different behavior pattern in material handling.

For pressing and curing of the Caneboard a heavy hydraulic press installation is used, operating according to a tray-caul system. This particular system was developed specifically for producing structural particleboard, and is employed successfully in five existing waferboard plants in Canada and the U.S.A.

The principle of operation of the tray-caul system with reversible forming line can be seen from the Process Flow Diagram No. B-401 and the General Plant Layout No. C-101. One of the main features of the tray-caul system is the moulding case. It consists of two parts: a stainless steel caul as bottom and a moulding frame made from steel as top. The moulding case is conveyed at constant speed from the reversing conveyor located in front of the press.
loader to the spreading machine up to the end of the forming line. Passing underneath the spreading machine, the moulding case is filled with half the quantity of Comrind wafers or strands needed for one board. From the end of the forming line the case is reversed and conveyed back to the press loader, pressing again underneath the spreading machine, the case is filled with the same quantity of Comrind wafers or strands as before, now forming a complete board. Then the filled moulding frame is elevated off the caul plate. Then the filled moulding frame is elevated off the caul plate, following which the caul plate with the board mat is moved into the press loader.

As soon as the press loader is filled with board mats and the hot press open, previously pressed boards are ejected from the hot press into the unloader and the board mats are charged into the hot press by means of the stainless steel and caul plates being moved into the hot press by a charging device. The press is closed, heat and pressure applied via a pre-set pressing cycle and the board mat converted to a Caneboard. The previous press load now lying in the press unloader is being discharged onto a separation station where the pressed Caneboard is separated and moved into a board scale for weight and quality control, and the empty caul plate is being returned to the starting point of the reversing forming conveyor. Following the weight and quality check the pressed Caneboard is first moved longitudinally through a side trim saw, following which it is transferred into a cross cut section for division into individual sheets measuring 4' x 8' stacking into standard packages, which is the final function of the board making process.

**Product Potential**

The only type of Structural Composition Board manufactured commercially at the present is wood-based Waferboard & Strandboard. The product has an end use history of some 15 years and is used throughout North America, (Canada and the U.S.A.).

The end use of Waferboard indicates the potential for Comrind-based Structural Composition Board as it can be safely assumed that Caneboard can substitute Waferboard in all its present applications I will indicate.

Over the years, industrial and do-it-yourself customers have expanded to hundreds the applications for this indoor-outdoor structural grade composition board, and one can now find this product used in floor, wall and roof sheathing for homes, shipping crates, fences, garden sheds, flower boxes and in just about every structural and decorative use where formerly sheathing grade plywood was used.

Today Waferboard panels are produced in 1/4", 5/16", 3/8", 7/16", 1/2", 5/8" and 3/4" thickness mostly in standard panel size of 4' x 6', although sizes up to 8' x 20' are available on special order. Some of the principle end uses may be classified as follows:
Wall Sheathing

Waferboard panels are an excellent sheathing material under all nail-on type sidings and stucco. The product adds strength and rigidity to frame structures. The usual thickness acceptable for wall sheathing applications are either 1/4" or 5/16".

Roof Sheathing

Waferboard panels provide a flat solid base for all finish roofing materials. The panels can be applied lengthwise parallel to the rafter, to minimize horizontal joints, or across the supports in the usual way. Most Waferboard panels used as a roofing material have a so-called skid resistant surface to provide good traction for sheathing crews and roofing contractors working on pitched roofs.

Sub-Flooring and Combined Sub-Floor Underlay

Waferboard panels have been developed for the professional builder after extensive research and testing by Canadian manufacturers. The strong WAFERBOARD panels provide a stiff, solid feeling sub-floor or combined sub-floor underlay. Tongue and Groove edges add to the good fit under all types of flooring. Panel edges are protected with a sealer to help prevent swelling caused by moisture contact before installation. Panels can be placed in the usual way, or parallel to the floor joints to minimize the blocking required when no subsequent underlayment is to be applied.

Speciality Panels

Four Speciality Waferboard Panels have been recently introduced by the MacMillan-Bloedel Company of Vancouver, British Columbia into the Marketplace in Canada and the U.S.A. These are Aspenplank, Aspenstripe, Aspengroove and Aspentile. Aspenplank and Aspenstripe are used as an exterior siding material for residential construction. Aspengroove is used for interior decorative paneling, as well as, for various exterior sheathing applications, and Aspentile is becoming a popular ceiling material very quickly for do-it-yourselfers who want an inexpensive textured tile look without the high cost. Panels are light weight 5/16" x 4' x 4' for easy handling.

As an example for the potential CANEBOARD panels hold for home construction in general and a low-cost housing program in particular, two Model Houses are shown on the layout drawing entitled "LOW COST CANEBOARD HOUSE BUILDING by INTERCANE SYSTEMS INC." Wherever there is a pressing need for shelter, Canecboard products hold a viable answer for the supply of suitable building materials and provide a raw material, which will help to develop good quality housing units at an economical cost.

With most countries desperately short of housing and the awesome prospect facing the world of another 2 billion people to house before the end of the century, any product which can help towards mass production of low
cost houses must be welcome. Caneboard is such a product.

REFERENCES


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EL PROCEDIMIENTO DE SEPARACION EN VARIAS CALIDADES
EL BAGAZO DE LA CAÑA DE AZUCAR, Y LA FABRICACION
DE TABLA-COMPUESTA DE ALTA CALIDAD (COMRIND)

Helmut G. Moeltner y Compania

RESUMEN

Se ha desarrollado un procedimiento para la separacion de la fibra de caña de azucar de alta calidad (COMRIND). El proce-
dimiento separa la caña de azucar en corteza o hollejo. El meollo que contiene azucar y la epidermis que contiene la cera i.e. manar completamente en tres productos separados. La corteza, que es de 18-20% del peso de la caña, contiene unos 46% fibra en base mojasa. Las fibras son substancialmente libres de meollo y se pueden
lavara (difundira) libres de solubles de agua caliente y sin mas demecollar
se pueden utilizar para sub-productos o derivados de alta calidad.

Este papel describe el procedimiento de la separacion de la caña de azucar en terminos generales, y el procedimiento “down-
stream” de la fibra-corteza en tabla-compuesta, en detalle.