

# Making the right choices for successful bagasse newsprint production: Part 2\*

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**ABSTRACT:** *Successful commercial production of bagasse newsprint of a quality which is acceptable to publishers has been a long time coming—130 years to be exact. The history of bagasse newsprint, upon which so many organizations and individuals have devoted tremendous amounts of time and effort over these many years, has been strewn with failures. However, as a result of the cautious approach pursued by serious and competent investigators over the past several years, it can be safely proclaimed that successful bagasse newsprint production is now a reality.*

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**KEYWORDS:** *Bagasse, chemimechanical pulps, depithing, mechanical pulps, moisture content, newsprint.*

## The need for moist and wet depithing

All the serious work carried out on the production of high-yield mechanical-type pulp from bagasse shows that very complete depithing is essential. To accomplish this, not only is efficient moist depithing essential, but a final-stage washing and wet depithing is likewise necessary, or even two stages of wet depithing if the moist depithing stage is not used. This fact was discovered early in the extensive work by the Hawaiian-Crown Zellerbach group and accounted greatly for their success in producing a top-quality bagasse mechanical pulp which imparted the essential properties to newsprint.

It is predominantly the pith in bag-

asse which results in low opacity when producing any type pulp from bagasse, including mechanical pulp. The pith cells themselves, when separated out, prove to have extremely low opacity. On the other hand the good bagasse fiber, if the pith is all removed, results in opacity as high as pine or spruce when converted into mechanical pulp. Therefore, the greater the pith removal, the higher the opacity and light-scattering properties of bagasse mechanical pulp. With poor depithing or no depithing, as was proposed by some advocates of bagasse newsprint processes, the quality of mechanical-type pulp from bagasse is certain to be very poor. It has been proven conclusively by Nasser (1), while working under Professor Giertz at Trondheim, that any appreciable amount of pith in refiner mechanical or chemimechanical

bagasse pulp (CMP) is highly detrimental to pulp properties.

## Recommendations for degree of depithing

To achieve maximum opacity and specific scattering coefficient when producing mechanical or chemimechanical pulp from bagasse, I recommend the following:

1. A minimum of 40% of the dry weight of the bagasse should be removed in the moist depithing stage at the sugar mill using 5/16-in. (8mm) perforations in the depither screen plates.
2. An additional 10–12% of the residual weight of the moist depithed bagasse removed from storage should be removed in the final washing and centrifugal wet depithing stage, using 3/16-in. or 1/4-in. perforations in the depither screen baskets.

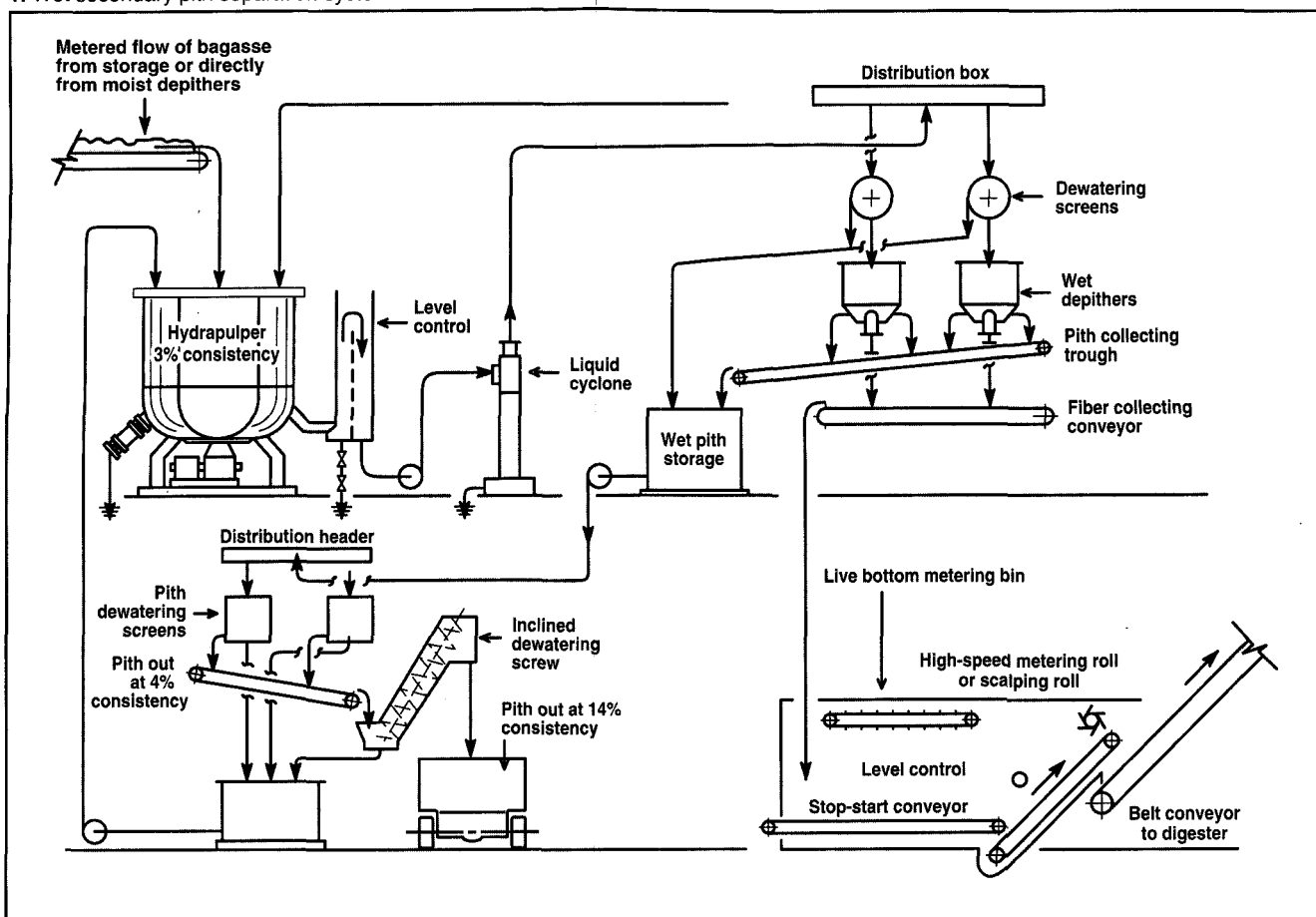
This procedure results in very high opacity and specific scattering coefficient when producing bagasse mechanical-type pulp.

## Depithing procedures available

There are a number of excellent bagasse depithers available on the market, most of which are of U.S. design because the technology for bagasse depithing was entirely a U.S. development of the 1950s. The importance of efficient depithing processes has been stressed in many publications in the literature from 1941 to the present time (2–26). These investigations have repeatedly pointed out that efficient methods of depithing represent the

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1. Wet secondary pith separation system



key to successful utilization of bagasse for manufacture of all grades of pulp, paper, paperboard, and reconstituted panelboard products.

For mechanical pulp or chemimechanical pulp, in addition to the efficient moist depithing that all bagasse-based mills now practice, it is also necessary to wash the moist depithed bagasse thoroughly and to carry out a final wet depithing step at the pulp mill just before the bagasse goes to the mechanical or chemimechanical pulping process. This system can follow immediately after the moist depithing stage during the sugar cane grinding season if the bagasse is to be pulped immediately, or it can be applied to the moist depithed bagasse being brought back from storage during the period between cane grinding seasons. I also have described in some detail excellent methods of washing and wet depithing of bagasse in a num-

ber of papers (21, 22, 26-31).

**The Atchison method of washing, cleaning, and final wet depithing.** For more than 25 years, I have been including in process designs for bagasse pulp mills a washing, cleaning, and wet depithing system which includes the following items of equipment:

- A means of metering the bagasse to the system either by use of twin-drum pin wheel feeders or metering bins
- A belt conveyor to receive the bagasse from the metering system and to feed it to a pulper
- A hydrapulper of appropriate size to slush the moist depithed bagasse at 2.5-3% consistency in the same manner as waste paper. The pulper is equipped with plates with 4-in. x 6-in. openings and a Weir box to control the level in the pulper, and it also

is equipped with a junk box with a double gate-valve discharge arrangement. Heavy materials such as rocks, tramp metal, etc. are thrown out to the junk box from above the plates, and the heavy material of large particle size which passes through the plate openings is caught behind the Weir box and removed by a double valve arrangement.

- A centrifugal pump with large inlet opening to discharge the pulper through a low-gravity-drop centrifugal cleaner or cleaners which removes the sand and other small-size heavy material
- A headbox or distribution box to distribute the bagasse slurry to drainers and wet depithers or to a pump leading to the wet bulk storage system. Overflow from the headbox goes back to the pulper.

- A drainer or dewatering mechanism before each depithing to dewater the bagasse from 2.5–3% consistency to about 10% or 12% consistency, which is the optimum consistency range for wet depithing. The dewatering devices can be perforated drums, vibrating screens, double screws with perforated bottoms, drums with slotted screen plates, etc.
- An adequate number of centrifugal-type wet depithers for the amount of bagasse required by the digesters or refiners
- A belt conveyor for collecting depithed fiber from the wet depithers, feeding a metering surge bin, which in turn feeds an inclined belt conveyor leading directly to the digester room floor, with the belt conveyor being equipped with a powerful electromagnet and a weigh meter before the bagasse enters the digester or the processing system for production of mechanical or chemimechanical pulp
- An equalizing screw about 10 meters long before the digester screw feeder, to equalize the flow of bagasse to the screw feeder when producing chemical, semichemical, or chemimechanical pulp, or a metering system to feed the disc refiners when producing straight refiner mechanical pulp or chemimechanical pulp, or both, at atmospheric pressure
- A system for dewatering and disposal of or use of the wet pith for fuel. Variations of this system have been installed at EDFU in Egypt, Ledesma in Argentina, Siam Kraft in Thailand, Mandya in India, United Pulp and Paper Co. in the Philippines, and Taiwan Sugar Corp., and they have worked very successfully. **Figure 1** shows this system for bagasse washing and wet depithing.
- A bagasse chemimechanical pulping system, showing the Cuba-9 technology, is displayed in **Fig. 2**. By using this technology, bagasse CMP content of as much as 80% has been

used to produce newsprint fully acceptable to publishers. In the Tamil Nadu mill in India the Beloit-SPB technology is used, involving a pressurized reaction tube with screw feeder, with the first refiner being pressurized and the second refiner operating at atmospheric pressure to produce chemithermomechanical bagasse pulp (CTMP). In addition, a bleached chemical bagasse pulp line is included so that the total content of bagasse pulps can be 85% or more. In the Leces mill in Indonesia, the PEADCO technology is used with a two-tube horizontal digester with screw feeder and a two-blow system with pressurized refiners after each tube to produce CTMP. Leces also has bagasse and rice-straw chemical pulping lines so that a high content of bagasse and rice-straw pulps are used.

### The need for a good bagasse storage system

Since bagasse first became a fibrous raw material for industrial products, starting with the Celotex operation in Louisiana in the 1920s, its storage between grinding seasons has been a major problem. In areas which have relatively short grinding seasons of 3–6 months, the proper methods of storage are vital to success; some of the early plants which used bagasse failed because of a lack of knowledge related to bagasse storage.

In general, for best preservation in storage, bagasse must either be dried to a moisture content below 20% and kept covered during storage or be kept wet with an 80% moisture content or above during the entire period of storage.

Both of these methods seek to control the fermentation involving residual sugar, thereby preserving the bagasse fiber to the greatest extent possible and minimizing the losses in storage.

I presented a comprehensive report on modern methods of purchasing, handling, storing, and preserving bagasse at the TAPPI Nonwood Plant Fiber

Conference in 1971 (32). This information was updated in a paper I presented at the 19th International Particleboard/Composite Materials Symposium at Washington State University in 1985 (26) and in other more recent papers (27–31). Excellent papers on the traditional Celotex method of bale storage have been presented by Chapman (33) and Keller (34).

### Special problems in storing bagasse

In addition to losses in quality, which have been solved satisfactorily for chemical pulp, there are other special problems that arise when storing bagasse for manufacture of mechanical-type pulp. These relate to color and brightness.

When bagasse comes fresh from the sugar mill, and the moist depithing is efficient, the moist depithed bagasse is usually light in color, with a GE brightness exceeding 40 and sometimes as high as 45, if the cane is relatively clean. However, by the traditional bale storage methods or moist bulk storage methods, as fermentation proceeds, the bagasse becomes very dark and may lose 20 or more points in brightness, bringing it down to 20 GE or less.

Since the brightness of the bagasse mechanical-type pulp depends almost entirely on the brightness of the well depithed bagasse reaching the refiners, this means that with traditional storage methods, the mechanical-type pulp will also have a very low brightness when produced from stored bagasse.

Therefore, since the maximum brightness increase that can be achieved by using peroxide or hydrosulfite, or a combination of the two, is about 20 points, if the stored bagasse has a GE brightness of only 20–30, the maximum brightness which can be achieved for the bleached bagasse mechanical pulp will be 40–50 GE, which is not adequate for newsprint. On the other hand, if by proper storage methods bagasse brightness can be maintained between 35 GE and 40 GE while still maintaining a good open structure, the mechanical pulp then can be bleached to

55GE and 60GE, respectively, a brightness acceptable for newsprint.

Based on the experience to date, it appears certain that if the proper storage procedure is not used, the production of acceptable-quality bagasse mechanical pulp, from the standpoint of color and brightness, will only be possible when using bagasse coming fresh from the sugar mill during the grinding season.

In view of these facts, it appears conclusively that the storage problem will continue to be the greatest problem when attempting to produce bagasse mechanical or chemimechanical pulp throughout the year. This problem has still not been solved completely, and much additional research and development work will be required.

Let's look deeply into the bagasse storage methods available which have the greatest promise for producing bagasse mechanical pulp.

### The Ritter biological pretreatment process

The Ritter biological pretreatment process for bulk storage of bagasse, which was developed by the late E. A. Ritter and his collaborators in South Africa, is now being used in many new bagasse pulp and paper mills and appears to have many advantages over any of the old bale storage methods and over the other methods of wet bulk storage as well.

This process has been described in detail in the literature by MacDonald (35), Moebius (36), Salaber and Maza (37), Wang (38), Botes (39), and Brujin *et al.* (40). Many of you have seen an improved version of this storage process in operation at the Cuba-9 plant in Cuba.

The general principle of the Ritter process involves the impregnation of the bagasse with a biological liquor and flushing the suspension to a bulk storage area through elevated channels or by means of a pump-up device. The addition of a small amount of molasses to the initial culture solution provides adequate biological liquor for treatment of the incoming bagasse and

refortification of the liquor used for flushing the bagasse to storage. The flushing liquor is recycled.

The storage area consists of a receiving slab of special construction (acid-resistant concrete or special asphalt on compacted earth) which is traversed in one direction by a number of parallel channels provided with removable, slotted wooden or concrete covers.

These openings provide an under-drain system for recovery of the flushing liquor, and when the covers are removed the parallel channels are used for reclaiming the bagasse.

This method of storage or variations of it are in successful use in South Africa, Argentina, Brazil, Mexico, Taiwan, Cuba, Venezuela, Iraq, and Iran, and the method is being considered for use in several other bagasse pulp and paper mill projects in various parts of the world.

Based on the excellent results which have been obtained with the true Ritter method of storage or modifications of it, it is very likely that this method will prove to be one of the best for production of mechanical pulp from bagasse because, if properly practiced, it does a good job of retaining the brightness of the bagasse.

In summary, the Ritter process is a microbiological process in which an acid medium and anaerobic conditions combine to provide an environment which will allegedly prevent the development of undesirable microorganisms (cellulose destroying bacteria) and thereby facilitating the storage of bagasse over long periods of time with minimum fiber deterioration and minimum losses. This condition is maintained by recirculating the liquor so that all of the sugars in the bagasse are retained as food for the lactic acid-producing bacteria. By this procedure, final pH reaches a level of 3.8–4.2, temperature reaches 30–40°C, and moisture reaches 75–80% at different levels in the pile; these appear to be ideal conditions for preservation of the cellulose in bagasse.

Overall, based on many extensive studies of the Ritter system and other

wet bulk storage systems for bagasse, it appears that the greatest contribution which the late E. A. Ritter made, as a result of his 30 years of efforts in the field of wet bulk storage of bagasse, was his technique of distribution of bagasse in dilute suspension, vertical drainage, and recirculation of the drainage fluid, with possible improvements by adding additional nutrient, such as a small amount of molasses, to the fluid.

Many experts have questioned the need to add additional microbes, as claimed for the Ritter fluid, because bagasse already contains all of the microorganisms necessary, as confirmed by the Cuba-9 group. However, the techniques developed by Ritter continue to be very important.

### Advantages of the Ritter process

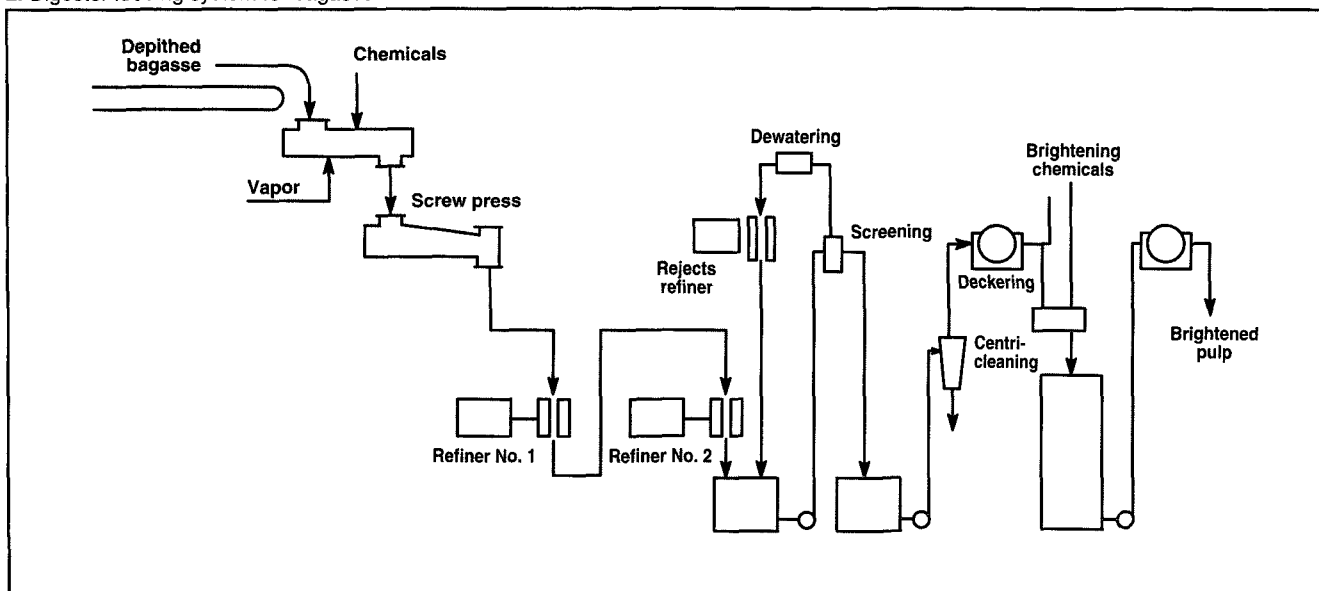
When using the Ritter wet bulk storage system or modification of it, certain procedures are important to obtain best results.

**Advantages of distribution of bagasse in dilute suspension.** When the bagasse is distributed onto the storage field in dilute suspension, either by a high-level flume or a pump-up tower, complete saturation is assured, which is not true when using spray nozzles. Therefore, the bagasse is all fully wet to its maximum water holding capacity so that oxygen is excluded, assuring an anaerobic condition in the pile.

### Advantages of vertical drainage.

When using a wet bulk storage method, it is highly desirable to provide for vertical drainage to obtain the best results relative to degree of compaction, stability of the pile, and for best preservation over long periods of time. This is one of the key features of the true Ritter process, with cross-drainage channels covered with heavy perforated wooden or concrete covers located about every 15–20 meters. This system is used at Felixton in South Africa, Ledesma in Argentina, Taiwan Sugar Corp. at Pingtung, and in one of the storage fields at Pars Paper Co. in Iran. The results have been outstanding with wet bulk storage when ad-

## 2. Digester feeding system for bagasse



equate vertical drainage has been provided. The pile becomes so tightly compacted that no oxygen can get to the bagasse from about one meter from the surface inward. This results in perfect preservation of the fiber properties and a high degree of preservation of the color and brightness, with the exception of the outer layer of about one meter, which can be used for chemical pulp.

**Advantages of recirculation of the drainage fluid.** Another key feature of the Ritter process involves the recirculation of the fluid drained from the bagasse as it is stored. This has a number of advantages which have been proven over the years at both Felixton and Ledesma and more recently at Cuba-9.

In the first place, if this drainage fluid is all allowed to go into the waste effluent system during the grinding season, because of the high content of water-soluble sugars it results in an excessively high BOD which requires that the waste effluent treatment facilities be unduly enlarged to handle the high load during the grinding season only. By spreading this load out evenly over the entire year, the waste effluent treatment requirements can be reduced.

Furthermore, during the period of

wet bulk storage the fermentable sugars are converted to other compounds which are volatile and which escape into the air during the recirculation process, further reducing the load from wet depithing after storage of the bagasse.

In the true Ritter technique, as practiced at Ledesma, Felixton, and Cuba-9, a culture of lactic acid-producing bacteria is developed in the presence of molasses and the residual sucrose in the bagasse. These bacteria multiply at a desirable rate and at negligible cost (about 1 or 2 liters of molasses per bone-dry metric ton of bagasse), yielding a liquor with a pH of slightly below 5. At this level of acidity, the development of undesirable microorganisms is allegedly prevented and bagasse degradation is contained. Additional "biological liquor" is added to the recirculated fluid at a regular rate to maintain the initial pH, and the small amount of molasses is added to feed the lactic acid-forming bacteria, with the amount of additional molasses depending upon the sucrose content of the bagasse. In some cases, where the bagasse has a high sucrose content, no additional molasses is required.

One might theorize that the sugar-loving microorganisms feed on the sugar and continue to multiply so that

they apparently kill off the cellulitic microorganisms, which tend to destroy the cellulose under certain storage conditions. When the bagasse is stored by the true Ritter system in the proper manner, the cellulitic microorganisms do not develop, therefore the bagasse actually is protected by the rapid development of the sugar-loving organisms. After the sugar is exhausted in the pile under anaerobic conditions, one might theorize further that the sugar-loving organisms then also die, and the pile becomes almost sterile.

In view of the many proven advantages of the Ritter system and variations of this system for wet bulk storage of bagasse, I believe that this method of storage and preservation of bagasse will be used more and more in new pulp and paper mills around the world. This is especially true for mills which produce bagasse mechanical or chemimechanical pulp for newsprint.

### The Bagatex-20 process

One possible alternative to the Ritter technique of wet bulk storage to preserve brightness and pulp properties might be the Bagatex-20 process.

This process, developed at Usina Santa Lydia in Brazil, is a truly unique process for the rapid drying of bagasse in large 600-kg bales from 50% mois-

ture content to 20% moisture content or less, within 20 days or less, by adding a biochemical catalyst to the raw bagasse or moist depithed bagasse before baling. The catalyst accelerates and controls the microbiological fermentation of the residual sugar, gum, waxes, etc., and the bales dry rapidly to 20% moisture content without the use of external fuel.

The heat generated in the fermentation process results in a temperature of 60–70°C in the center of the bale and a pH of 3 or below, which results in the rapid release of moisture and the volatile reaction products. At the same time, due to a combination of high temperature (above the pasteurization temperature), low pH, and absence of food (as the sugars are consumed), the microbes are practically all killed or those that remain alive have their activity reduced to almost zero as the moisture content goes down to 20% or below.

After 20% moisture content has been reached the bale is, in effect, pasteurized and can be stored in covered piles for two years or more without deterioration or additional loss of weight (moisture-free basis). The temperature gradually goes back down to ambient temperature, and as the volatile acid fumes are released the pH goes back up to between 6 and 7.

Based on observations at Usina Santa Lydia, it appears that by means of this Bagatex-20 process the color and brightness of the bagasse are preserved as well as its other chemical and physical properties. I have described this process in recent papers (41, 42).

The potential disadvantage relates to the fact that, once bagasse is dry, it is difficult to rewet again, and for production of mechanical-type pulp the fiber must be wet and flexible when it goes to the refiner. This process has not yet been applied to bagasse for use in manufacture of pulp, paper, or paperboard. Therefore, extensive trials would have to be carried out before it could be included in the design of a bagasse mechanical or chemimechanical pulp mill.

### **Recommendations for storage of bagasse**

For storage of bagasse for manufacture of mechanical or chemimechanical pulp, I recommend either the true Ritter process, a modification of it, or the new Bagatex-20 process for storing the moist depithed bagasse in bales.

For the wet bulk storage system I recommend:

- Distribution of the bagasse onto the storage field in dilute suspension
- Adequate cross channels in the storage field to assure vertical drainage and the tightest possible compaction. No further compaction by bulldozer is necessary if vertical drainage is combined with distribution in dilute suspension.
- Recirculation of drainage fluid to maintain a pH of 3.8 to 4.0.
- Addition of molasses to the make-up fluid unless the bagasse already has a high residual sucrose content.

For use of the "Bagatex-20" bale storage system I recommend consideration of the procedure in use at Usina Santa Lydia in Brazil.

### **The need for a good bleaching system**

Excellent bleaching systems for the bagasse mechanical pulp have been developed by the Cuba-9 group and also are being practiced by Tamil Nadu in India and Leces in Indonesia. Use of hydrogen peroxide, by various techniques, is the key to successful bleaching of bagasse mechanical pulps.

### **Conclusions**

With the commercial success of the Tamil Nadu mill in India, the Letjes mill in Indonesia, the Mexpape mill in Mexico, the pilot-plant success of the Hawaiian-Crown Zellerbach work (which initially proved it could be done), and the tremendous amount of work at the Cuba-9 demonstration plant in op-

timizing the process for production of bagasse newsprint, there appears to be no question that bagasse newsprint has arrived. Fortunately, all of these organizations have come to realize the critical factors that must be considered for the successful production of bagasse newsprint and have implemented the necessary procedures.

I believe that the accomplishments of these organizations will all prove to be of great importance in leading the way toward fully optimizing a bagasse newsprint technology that can be used worldwide. These developments will undoubtedly be of great benefit to all of the cane sugar producing areas of the world, especially those which are not blessed with a plentiful supply of suitable pulpwood for newsprint but which do have large quantities of bagasse. These countries include India, Cuba, Pakistan, Thailand, Egypt, Peru, China, Iran, Venezuela, Colombia, Brazil, Indonesia, Argentina, Mexico, The Sudan, and others, all of which are now large consumers of newsprint, for which many of them are paying extremely high prices for imports.

The newsprint consumption in many of these countries is already severely curtailed because of inadequate foreign currency. Furthermore, if newsprint were available in plentiful supply within these countries, very likely newsprint-quality paper could also be utilized for many other purposes, which would serve to alleviate other shortages.

In view of these facts, it easily can be seen that successful operations of the full-scale plants at Tami Nadu and at Letjes in Indonesia, the successful bagasse-based plant in Mexico for production of school textbook paper of 60-g/m<sup>2</sup> basis weight, and the successful Cuba-9 demonstration plant are certain to have worldwide impact.

In fact, many of the other developing countries of the cane sugar producing areas are following all of these developments with eager anticipation of a technological breakthrough in bagasse newsprint production.

The impact on these countries re-

sulting from the successful solutions to the bagasse newsprint problems could be very great indeed. The availability of adequate newsprint from domestic sources is vital to every country for both their economic and cultural development. □

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