

Making the right choices for successful bagasse newsprint production: Part 1*

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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.*

KEYWORDS: *Bagasse, bleaching, depithing, history, mechanical pulps, newsprint, production, storage containers.*

I first became involved in bagasse newsprint studies during the Korean War in 1951–52, when the U.S. Congress held extensive hearings on the newsprint shortage and directed that a comprehensive study be made of alternative sources of newsprint.

I was on the advisory committee for that study, during which all of the processes that had ever been proposed for the manufacture of newsprint from bagasse up to that time were investigated, starting back as early as 1856 when great publicity was given to the use of “bagasse newsprint” in printing the *Baltimore Advocate*.

During this period in Washington, in 1951 and 1952, investigations were made of the de La Rosa process, the H.

L. Horne process, the Valite process, the Chemcell process, and others which were being publicized at that time. The advisory committee considered none of these processes adequate in anyway for the successful production of bagasse newsprint, mainly because they were all based on chemical or semichemical processes without the use of mechanical pulp. Unfortunately, the promoters ignored the recommendations of the committee, and two mills were built: one in Cuba based on the de La Rosa process and one in Louisiana based on the Valite process, both of which used prehydrolysis, followed by alkaline pulping and hypochlorite bleaching. Both were failures as newsprint mills but later became successful as writing and printing paper mills.

From 1953 to 1958, while I was with Parsons and Whittemore, Inc., the

Agriculture and Development Bank of Cuba retained our services to investigate, through pilot-plant and full machine runs, various processes which had been proposed to them as alternatives to the de La Rosa process. These included the Fleury process in Canada and the Aschaffenburg process in Germany. These again were all either chemical or semichemical processes, without mechanical pulp. None of them proved to be feasible, and we made recommendations against their use, as well as against the use of the de La Rosa process. The Bank also opposed this mill, but the Batista government financed it anyway.

In the 1960s, a process finally was proposed which involved the production of mechanical pulp from bagasse. I followed the development of this process and participated in trial runs both for producing the newsprint and for printing it on high-speed presses in the United States, Egypt, and India. At the time, this appeared to be the only process that would yield properties similar to those of newsprint produced from wood. Unfortunately, we were not able to develop full-scale projects proposed for Hawaii, Egypt, and India because we could not obtain financing. Financiers were not prepared to fund such a project without first seeing a mill or at least a demonstration plant in operation—and there was no demonstration plant available at that time.

From 1967 to 1974, on behalf of clients in Venezuela, Peru, and the World Bank, I carried out evaluation studies relative to bagasse newsprint projects proposed for Venezuela, Mexico, and Peru. This included evaluation of test runs based on the Cusi

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process and the Peadco process, both of which made use of high proportions of semichemical bagasse pulp and little or no mechanical pulp but with some long-fibered pulp.

In all cases, I submitted negative evaluation reports on such processes. However, mills in both Peru and Mexico were built. The mill in Peru, which was based on the Cusi process, failed completely. Fortunately, in the Mexpapel project in Mexico, the process design and equipment were chosen with sufficient flexibility so that new technology developments could easily be incorporated in the mill, and so that mechanical pulp could be used along with chemical pulp to produce good-quality offset printing paper. In recent years, this mill has become even more successful by installing facilities to recycle old newsprint and to obtain a high mechanical pulp content from that source.

Starting in 1972, Atchison Consultants was retained by the United Nations Development Program (UNDP) to provide technical services and advice relative to development and implementation of the large pilot plant in Cuba known as Cuba-9. This was completed in 1981, with major UNDP and United Nations Industrial Development Organization financial assistance, and has been operating successfully since that time.

The objective was to optimize the processes for successful production of bagasse newsprint and bagasse dissolving pulp, at that time the only two remaining end products which had not been produced economically from bagasse on a commercial scale. This plant is highly flexible and is capable of producing all types of bagasse pulp and many grades of paper, including:

1. Straight mechanical bagasse pulp
2. Thermomechanical bagasse pulp (TMP)
3. Chemimechanical bagasse pulp (CTMP)
4. Semichemical bagasse pulp
5. Full chemical bagasse pulp

6. Bagasse dissolving pulp

7. Bleaching all of these pulps by means of whatever bleaching sequence is optimum for each.

This Cuba-9 facility is now the finest facility in the world for research and development work relative to the utilization of bagasse, whether it be for newsprint, other grades of paper and paperboard, reconstituted panelboard, furfural, xylitol, or other products.

At the suggestion of a number of clients who were interested in the possibilities of bagasse newsprint for the future, I have periodically made comprehensive reviews of the subject. In these reviews, information has been developed on the historical efforts to produce bagasse newsprint from 1856 to the present time (1-4). Some brief comments on these historical developments follow.

Historical developments

The first reported work on bagasse newsprint was announced in 1856—just 136 years ago—when Henry Low of Baltimore carried out experiments with southern U.S. sugar cane, and the resulting paper was used to print the *Baltimore Advocate*. This effort was described in a paper by West in 1920 (5). From that time on, proposals for producing bagasse newsprint have appeared about every 20 years with much fanfare and publicity. In many cases, editions of newspapers were printed on such papers, and great claims were made regarding its high quality and low cost. However, none of these early attempts to economically produce satisfactory bagasse newsprint was ever successful. All of them were based on using 100% chemical pulps, including a high percentage of bagasse chemical pulp in the fibrous furnish, in contrast to newsprint produced from wood, in which a high percentage of mechanical, thermomechanical, or chemimechanical pulps are used to impart to newsprint all of its required special properties.

The main reasons for the early failures were:

- Overzealous promotion of the use of bagasse by people who lacked understanding of its properties and limitations
- The lack of a satisfactory method of depithing, resulting in unsuccessful attempts to produce a salable paper because pith and epidermis cells remained in the finished product.
- The lack of a satisfactory method of storing bagasse, which resulted in huge losses when attempts were made to store it between sugar cane grinding seasons.
- The lack of understanding of the required properties of newsprint, which are imparted mainly from the use of mechanical-type pulp, including straight mechanical pulp, TMP, or CTMP.

In recent years great success has been achieved in the use of bagasse worldwide for practically all grades of paper and paperboard except newsprint. This progress has been especially impressive and is a result of the technology developed by concentrated research and development work in the 1950s. Bagasse-based mills have gradually increased in size year by year, up to 250-300 tons/day production and above.

From a pulp capacity level of only 120,000 metric tons in 1950, the bagasse pulping capacity in 1992 is expected to be 2.6 million metric tons; actual bagasse pulp production is expected to reach a level of 2.3 million metric tons.

Bagasse pulps are now used in practically all grades of paper including bag, wrapping, printing, writing, toilet tissue, toweling, glassine, corrugating medium, linerboard, bleached boards, and coating basestock.

In all of this progress, newsprint was the only laggard, until the middle 1980s, mainly because of the unwise attempts to produce newsprint without mechanical-type pulp, which was doomed to failure even if the problems of pith removal and good storage had been solved. Now, however, with the success of Tamil Nadu, combined with the excellent work on bagasse

chemimechanical pulping for newsprint at the Cuba-9 bagasse demonstration plant, the promising results at Letjes mill in Indonesia, and the success in producing good-quality offset printing paper at Mexpap in Mexico, it appears certain that newsprint with a high content of bagasse pulps also will have a rapidly expanding market worldwide.

In the comprehensive reviews that I have carried out over the past 40 years of the reasons for failure of the previous attempts to produce acceptable bagasse newsprint, it appears that one or more of the necessary basic concepts for successful bagasse newsprint production had not been considered adequately. In subsequent sections of this paper, these basic concepts critical to successful bagasse newsprint production are explained in detail.

Accepting the need for mechanical pulp in newsprint furnish

Processes using a high proportion of chemical or semichemical pulp

Based on extensive study in this field over many years, it is my conviction (and that of most newsprint experts) that a newsprint sheet produced from bagasse must contain a substantial proportion of mechanical-type pulp to provide the necessary qualities essential for producing newsprint. In fact, the world definition for customs purposes states that to be classified as newsprint a sheet must contain a minimum of 65% mechanical pulp.

It was concluded that the only successful methods of producing bagasse newsprint must follow the traditional concept in the newsprint industry, whereby a major proportion of the furnish consists of mechanical-type pulp or a high-yield pulp approaching the qualities of mechanical pulp.

In any case, where chemicals and heat are applied in the cooking of bagasse, whether it be semichemical or full chemical, there is an immediate loss of opacity and absorbency—the prime characteristics of mechanical-type pulp

which make it desirable for newsprint manufacture.

Furthermore, the economics of a chemical pulping process tend to make it noncompetitive for use as a high proportion of the newsprint furnish. Therefore, from both a quality standpoint and an economic standpoint, it is doubtful that a chemical or semichemical pulp can ever compete with mechanical-type pulp as the major component of a newsprint furnish.

In addition to the mills in Cuba and Louisiana, which went into operation in the 1950s and failed to produce newsprint economically based on prehydrolysis followed by pulping, the mills in Peru and Argentina also have failed to be competitive using a high proportion of semichemical pulp. An exhaustive review of the literature reveals similar proposals presented many times over the years. I have carried out many technical and economic studies of various bagasse newsprint processes based on using a high proportion of semichemical or chemical bagasse pulp for various governments and private companies during the past 40 years. In all cases, such studies, including several full-scale paper machine test runs, have resulted in conclusions that such processes would neither produce the quality newsprint necessary to meet world market standards nor produce it at an economic price.

Processes using a high proportion of mechanical pulp

In the spectrum of paper grades, newsprint is a low-priced sheet. However, it is not often recognized that newsprint is a highly technical sheet with very specific requirements. It is fortuitous that mechanical-type pulp, which is one of the leading contributors to the low cost of the grade, also imparts the following essential technical qualities.

Newsprint must have good opacity. Printing on one side of the sheet must not be seen from the other side. Of all wood pulps, mechanical pulp is the most opaque. Opacity of mechanical pulp is at least 50% greater than chemical and semichemical pulps.

Newsprint must dry newsprint ink by absorption. Newsprint ink is made from carbon black and an oil or water carrier to make it as cheap as possible. The carrier cannot be dried quickly in the true sense. Therefore, newsprint must absorb the liquid carrier, leaving the dry carbon black on the surface, and it must do so fast enough to make it possible to run the sheet on modern high-speed rotary printing presses capable of producing 50,000 copies per hour. Mechanical pulp has this ability to absorb the liquid in newsprint ink, while chemical and semichemical pulps are very poor in this respect.

Newsprint must have a good printing surface. Mechanical pulp, because of its fineness, can produce a smooth, level surface. Further, because of its bulk, a sheet of normal newsprint can compress under the type face, giving better contact, and, therefore, better printing quality. Chemical and especially semichemical pulp fibers are coarser and stiffer, so the texture of the surface is uneven. The sheet produced is harder and less resilient, so contact with the type cannot be improved appreciably by compression.

Bagasse newsprint should have a high level of mechanical pulp. Over the past 25 or 30 years, a number of top-level research organizations and large-scale manufacturers of newsprint have, from time to time, become interested in the long-term dream of making newsprint from bagasse. Knowing from long experience that the key use properties of newsprint are furnished by the mechanical pulp content, the emphasis of the work these companies and research organizations have carried out has been on utilizing some type of mechanical pulp as a major portion of the furnish.

I would like to review some of these efforts which have led to almost universal acceptance of the fact that, for production of bagasse newsprint acceptable to publishers, it is necessary to have a relatively high percentage of mechanical-type pulp. This is the approach that I have consistently advocated for the past 40 years.

Using bagasse chemical pulp to replace major portions of the long-

fibered chemical pulp, but using mechanical pulp from wood. A number of large-scale trial runs have been made in Canada, Sweden, and Mexico in which a major portion of the long-fibered wood pulp was replaced with bagasse chemical pulp. Runs of this nature took place in Canada as early as 1949 (6) and at Tuxtepec in Mexico in 1960–61 (7). In these test runs, it was proven conclusively that bleached bagasse chemical pulp could replace a major portion, if not all, of the long-fibered chemical pulp. Sunds Defibrator in Sweden also reported, in 1982, on work with a mixture of bagasse chemical pulp, with chemimechanical pulp from eucalyptus or other hardwoods (8).

As a result of all this work, there appeared to be no doubt, even in the 1950s and 1960s, that high-quality newsprint could be produced with a blend of mechanical wood pulp and bleached bagasse chemical pulp, with only a small amount of long-fibered chemical pulp and possibly without long-fibered chemical pulp at all. However, these efforts did not go far enough to satisfy many of the developing countries with limited wood supplies, who insisted upon a much higher content of bagasse-based pulps for newsprint.

The Hawzell process. During the early 1960s, the Hawzell process for manufacture of bagasse newsprint was developed through collaboration of the Hawaiian Sugar Planters' Association (HSPA) and the Crown Zellerbach Corp. (CZ). I have described this work at some length in several papers, and it also has been described in papers by the HSPA-CZ Group (1–4, 9–12).

Their approach was to simulate mechanical wood pulp by grinding well-depithed bagasse in disc refiners with mechanical treatment only. This pulp, with characteristics similar to mechanical wood pulp, imparted good opacity, good ink absorbency, and a good printing surface to a newsprint sheet. In addition, a maximum yield was obtained from the bagasse.

The ground-bagasse pulp was subsequently bleached and mixed with

semibleached softwood kraft pulp in the ratio of 70%:30%, and newsprint was made in the normal fashion from this mixture. The semibleached kraft imparted strength to the sheet that is needed both in the papermaking process and in the final high-speed printing. This pulp mixture was similar to that of standard newsprint.

Other blends proposed consisted of 60% bleached bagasse mechanical pulp, 30% bleached bagasse chemical pulp, and 10% bleached or semibleached kraft long-fibered pulp.

I was involved with intensive efforts to develop projects in Hawaii, Egypt, and India based on this process, which was sound technically. However, the larger financial agencies were reluctant to finance these projects unless they could actually see a similar mill in operation on a sustained basis—Cuba-9, for example. Therefore, after spending several million dollars on this development, Crown Zellerbach and the Hawaiian Sugar Planters' Association made an irrevocable decision in 1966 that they would not devote any further time, energy, or money to bagasse newsprint.

For many of the developing countries, this decision was indeed unfortunate, because the development of the optimum formulation for production of an acceptable newsprint with maximum percentage of bagasse pulp of various types was delayed by an additional 20 years. From the standpoint of quality as viewed by publishers, no one has yet equaled the work of the HSPA-CZ Group in producing fully acceptable bagasse newsprint without the addition of fillers or opacifiers.

Work by AB Karlstads Mekaniska (KMW) and Sunds Defibrator AB in Sweden in 1964–65. Work by this group confirmed the work of Crown Zellerbach in many respects, and it definitely was concluded that for production of high-quality newsprint a high proportion of mechanical pulp was necessary, and that bagasse mechanical pulp could be used for all or part of this mechanical pulp. It was further confirmed that bagasse mechanical pulp

resulted in particularly high opacity and ink receptivity.

Atchison efforts to develop a bagasse newsprint experimental mill or demonstration plant in 1967–72. After the projects in both Egypt and India failed to go through and Crown Zellerbach and HSPA discontinued work on bagasse newsprint in 1966, I became convinced that the next step in this development should be a large pilot plant or semi-industrial demonstration plant for studying bagasse newsprint. With such a plant, all of the proposed processes could be tried and rigidly evaluated so that optimum technology for bagasse newsprint production could be developed as a solid basis for convincing the financial institutions of the feasibility of full-scale projects. Therefore, during the period from 1967 through 1972, I made a concentrated effort to convince one of the existing bleached bagasse pulp and paper mills to install a bagasse mechanical pulping line so we could demonstrate the feasibility of producing bagasse newsprint. These efforts were made in Argentina, Egypt, Venezuela, Mexico, and India. Unfortunately, however, even with the promised support of the UNDP for such a project, it was not possible to develop such a demonstration plant during this period. The breakthrough came unexpectedly when the Cuban government presented such a project to UNDP for financial support in 1971, which eventually resulted in the Cuba-9 plant.

Activities of ICIDCA and the Cuban Research Center for Industrialization of Sugar Cane Bagasse. I have covered the historical development of the Cuban Research Center for the Industrialization of Sugar Cane Bagasse, commonly referred to as Cuba-9, in a number of papers (1–4). Other papers describing the excellent work being carried out by Instituto Cubano de Investigaciones de Los Derivados de la Caña de Azúcar (ICIDCA), which operates the Cuba-9 project, have been presented by various members of the ICIDCA and Cuba-9 staffs at many international

conferences (13-23). Officials of Cuba-9 updated the results of their work at the First International Nonwood Fiber Pulping and Papermaking Conference held in Beijing in 1988. I was involved in some way in this project, on behalf of UNDP, from its conception until 1988, and have been greatly impressed with the excellence of the work carried out. Needless to say, they adopted the mechanical pulping approach to produce chemimechanical pulp from well-depithed bagasse.

The Tamil Nadu newsprint and paper project in India. The 300-ton/day bagasse newsprint mill, which was preceded by intensive development work starting about 1978, also adopted the mechanical pulping approach. The SPB Consultancy Group, which had overall responsibility for developing the project, first made an exhaustive evaluation of all bagasse newsprint processes proposed and then made projections of the additional R&D work they felt should be carried out to assure the success of the mill. I had several meetings with S. Viswanathan, who headed the group; T. S. Venkataraman, the chief technical representative; and others during the period of decision making.

It was concluded that the process for producing mechanical bagasse pulp, upon which the Beloit Corp. Jones Division had been working for several years, offered the best possibility for success. However, we recognized that a tremendous amount of work remained to be carried out to optimize the process from both the technical and economic standpoint, and a joint SPB Consultancy-Beloit R&D Group was immediately established to carry out this work at the Jones Division. Fortunately, they were able to convince the World Bank that the optimization work would be completed by the time the mill started up, and the World Bank showed its confidence with a loan of US\$ 1 million.

As many of you know, this mill, which started up in 1986, has been very successful as a bagasse newsprint producer, and consideration is being given

to doubling its capacity, again with financial assistance from the World Bank. A number of papers have been presented at various pulp and paper conferences on the Tamil Nadu development over the past few years (4, 24-27).

The P.N. Kertas Letjes bagasse newsprint mill in Probolinggo, East Java, Indonesia. The contract for this 300-ton/day bagasse newsprint mill was given to the Technip Group in France, and the PEADCO Group of W. R. Grace furnished the basic technology to the contractor. Based on information obtained from officials of both PEADCO and Letjes, this mill has three pulping lines as follows:

- A 150-ton/day pulping line for production of mechanical-type pulp from bagasse
- A 100-ton/day pulping line for production of semibleached chemical pulp from bagasse
- A 75-ton/day pulping line for production of semibleached rice-straw chemical pulp.

It was contemplated that the fibrous furnish would consist of about 40-50% bagasse mechanical-type pulp, about 40% of a mixture of semibleached bagasse and rice-straw chemical pulps, and 10-20% imported long-fiber semibleached kraft pulp. The surplus bagasse and rice-straw chemical pulp were to be used in other grades of writing and printing paper in this huge pulp and paper complex at Letjes.

This mill was officially inaugurated in 1985. After the usual startup problems, the mill is now producing newsprint of a quality that is acceptable to Indonesian publishers. Although they have not been able to use quite as much as 50% bagasse mechanical-type pulp in the furnish, total bagasse pulp content is about 70%, with the remainder being rice-straw semichemical pulp and long-fibered pulp, and sometimes some mechanical pulp from wood. Therefore, the mill must be considered a success.

The Mexpape mill in Mexico. Al-

though the Mexicana de Papel Periodico (Mexpape) mill in Mexico was initially designed to use a relatively high content of bagasse chemical or semichemical pulp, the process design and equipment were chosen with sufficient flexibility so new technology developments could easily be incorporated in the mill and so mechanical wood pulp could be used to produce a good-quality offset printing paper. In recent years, this mill has become even more successful as a newsprint producer by installing deinking facilities to recycle old newspapers and using that source to obtain a high mechanical-pulp content. This mill has been described by Arturo Rodriques Ulloa (28).

Other work on mechanical pulping of bagasse for newsprint. In recent years, most of the major efforts toward processes for bagasse newsprint production have shifted toward the mechanical pulping approach as more experts in the production of conventional newsprint from wood have become interested in this field. This has been particularly gratifying to me since I have advocated this approach for the past 40 years.

Therefore, a considerable amount of additional work on the production of mechanical pulp from bagasse has been carried out by various R&D organizations all over the world.

These organizations include:

- Sprout-Bauer at its pilot plant in Springfield, OH (29)
- Forest Products Research and Industries Development Commission in the Philippines (30)
- Department of Cellulose Technology of the Technical University of Norway in Trondheim (31)
- Hitachi Zosen and the Japanese Government Industrial Research Institute in Japan in collaboration with Sprout-Bauer (32)
- Enzo Gutzeit Oy in Finland (33).

Conclusions on processes proposed for bagasse newsprint utiliz-

ing a high proportion of mechanical-type pulp. Based on the excellent work which has been done by leading companies and research organizations in this field, it is obvious that if production of newsprint from bagasse is to be technically and economically possible, a high proportion of mechanical pulp or chemimechanical pulp of some kind must be used in the fibrous furnish.

Rather than using mechanical wood pulp only, it appears more logical in the sugar cane areas, where softwood is usually scarce, to produce at least part of the mechanical pulp or chemimechanical pulp from bagasse or tropical hardwood, or both, and to blend this pulp in the initial stages with the minimum amount of long-fibred chemical pulp or chemical pulp from eucalyptus or tropical hardwoods, with the remainder of the pulp being semibleached

chemical pulp produced from bagasse. The ultimate objective will be to use 100% local raw materials in each country to replace the imported long-fibred chemical pulp entirely with bagasse chemical pulp and chemical pulp from locally grown fibers such as eucalyptus, rice straw, bamboo, sisal or kenaf bast fiber, or even mixed tropical hardwoods. It now appears likely that the optimum fibrous furnish for bagasse newsprint, for most countries, will prove to be a combination of various types of bagasse mechanical and chemical pulps, along with pulps of other raw materials, whether from wood or nonwood plant fibers. ■

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