How Realistic Are Expectations to Find and Use Alternative Raw Materials For Manufacture of Newsprint

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ABSTRACT

The global demand for newsprint is expected to grow at fhe present level of 2.5% per year. Wrth the cost of newsprint comprising about 40-6% of the newspaper publishing cost and with the steep increase in newsprint prices due to growing rise in pulpwood prices, there is a global concern to find alternatives to wood fibre sources. Annual plants like bagasse and kenaf seem to hold great promise. While bagasse newsprint has just been established, kenaf newsprint is well poised to take off. How these two fibres compete with wood fibres and also among themselves, while coping with quality of newsprint and constraints in commercial availability, are reviewed in detail.

INTRODUCTION

If knowledge is considered as one of the most vital factors governing the prosperity of mankind, printed matter has long since established itself as the leader of the media that will be used to spread that knowledge.

Amongst the printed matter, newspaper has been occupying a prominent position for ovcr a century and newsprint is currently the largest single grade of paper and boards. It is predicted by forecasting experts that newspaper will continue to enjoy this enviable status notwithstanding the growing threat from technological develpments in electronic communication. In fact these developments have only enhanced the proliferation and quality of newspaper publishing through computerised type setting, satellite printing etc, One of the principal factors that has contributed to the economy of newspaper industry and hence the growth in production of newsprint is, advertising. In terms of total annual advertiesment revenues, newspapers still lead other media including television, that is because public considers newspaper advertising more reliable than that of any other medium.

The growth of the newspaper industry can be judged from the growth in world newsprint consumption from 17.0 million tons in 1965 to about 28 million tons by 1958, that is, by 2.5% per year or 550,000 t/y. Growth would have been substantially higher but for the reason that publishers started to use lower grammages. During the 15 year period 1970–1985, grammage decreased from 52.0 to 47.6 g/m², thereby the real growth was only 7.2 million tons instead of 9.2 million tons, if grammage had remained same during that period. The forecast upto the year 2000 is for a world newsprint consumption of 41 million tons, a growth of 2.5% per year.

The direction towards lower grammage was taken with a view to reduce transport handling costs and press room downtime, and not with primary objective to conserve fibre though it would seem a logical and a welcome trend in today's context of shrinking fibre sources. In the Nordic countries, the average grammage had fallen to 44.8 g/m² by 1984, driven by the compulsion to con serve fibre sources. However, such a trend towards lower grammages would be retarded by trade-offs in strength and opacity levels of the sheets that would be further accentuated by raw material limitations.

Newsprint has been traditionally made out of softwood fibre sources, but with growing concern of ecologists to preserve forests, hardwood fibres (short-growth cycle), secondary fibres (recycled fibres) and

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finally non-wood fibres have been scriously considered both from point of view of economic availability and technical acceptability, as alternative fibre sources for manufacture of newsprint. There are also other considerations–countries which do not havc softwood sources or have meagre hardwood source and countries which do not have economic resource to meet the import bill are all interested in procuring alternative fibre sources. In effect, we are addressing the topic from several angles-Government policies, resource gaps, raw material constraints, environmental aspects, cost considerations. consumer acceptance etc.

The prospects of finding and potential implications of using these alternative fibre source on the techno-economic aspects of newsprint manufacture are reviewed in detail in the following sections.

Challenges of Newsprint Manufacture

The first step is to understand the demands of publisher on quality standards, the technological requirements to meet those standards and then identify the process route that can cost-effectively ensure the quality standards. Therefore, a sound knowledge of both the product (newsprint) and fibrous raw material is necessary to appreciate and accommodate the constraints of both the end user (publisher) and producer of newsprint.

Quality Demands

Of all the grades of paper and board, newsprint perhaps the greatest challenge in commercial manufacture due to the constraints in pricing and stringent specifications for quality. Newsprint is one of the few grades that is subjected to high speed printing and the rapid developments in printing technology is imposing greater/newer demands on the quality of newsprint.

The typical requirements of newspaper for publishing industry are :

(i) Newsprint must be inexpensive
(ii) Must be capable of being run in high speed printing presses at 50000–60000 impressions/hour, i.e. both strength and printability should be good
(iii) Must be lint-free to avoid accumulation of impurities on printing plates and ink trays
(iv) It should have opacity and brightness values adequate to be accepted by the printer and the reader

Typical specifications (as per IFRA guidelines) of standard newsprint are :

(a) Basis Weight	: 40/45/48.8/52 g/m²
(b) Opacity (printing)	: 92–94%
(c) Roughness (Bendtsen)	: 75–175 ml/4min
(d) Brightness (ISO)	: 54–56°
(e) Visual efficiency (Y–value)	: 60–64%

There are a number of other properties like, oil/water absorbency,strength properties etc which are also to be controlled to ensure good printability and runnability on the printing presses. Several extraneous factors such as shives and lint can also affect runnability even though the newsprint has good strength properties such as tensile, stretch, tear etc.

The list of specifications is still growing as the newspaper industry strives to keep pace with developments in printing technology and to maintain its competitive edge. The 70s saw high speed offset printing displacing many of conventional age-old rotary letter thereby introducing the "linting" problem which is pronounced in case of offset printing as it uses more tacky inks. Surface strength in addition to smoothness has become more important. Multi-colour offset printing has justified the technical relevance of specifying brightness/yellowness which has hitherto been viewed essentially from aesthetic angles. The 80s have ushered in flexographic printing that use water-based inks which can accept newsprint of lower opacity (a highly rated and demanding property). But this might introduce yet another demand on specification in terms of water resistace necessitating use of additional chemicals for internal sizing of newsprint. Therefore, due to the multiple options in printing processes, in future, newsprint as a paper grade will most likely be classified into several sub–grades catering to specific end uses.

But the most appreciated quality is "consistency" the publisher can accommodate lower/poorer values than any target property, but cannot accept wide fluctuations in shade, caliper, linting etc from reel to reel. This aspect of quality assurance is more a question of managerial commitment which can get compounded by raw material constraints when seasonal raw materials such as bagasse, kenaf etc are used.

Raw Material Adaptability

All these specifications influence, significantly, the

cost of production of newsprint. The newsprint industy has been traditionally relying on two important inputs that can be economically obtained–good fibrous raw material and electrical power. It has been established (almost axiomatic) that for good quality newsprint, a high percentage (75-85%) of mechnical pulp has to be used in the furnish. The blance is semi-bleached chemical pulp. Fortunately such mechanically derived pulps were found to be cheaper than chemical pulps since they were based on two principal requirements–Firstly, the raw material should possess intrinsically higher strength and initial brightness so that chemical usage is minimal either in refining and/or in bleaching. Secondly, the source of electric power should be cheap enough so that it does not neutralize the savings gained due to lower consumption of chemicals and raw materials attained in production of mechanical pulp.

Since the major aud key component of newsprint furnish is mechanical pulp, the raw material should be amenable for manufacture of mechanical pulp. Mechanical pulp originally started with stone grinding process and stone ground wood (SGW) pulp together with latest pressure ground wood (PGW) pulp are steel sought after, though the refiner machanical pulps like thermo mechical pulp (TMP), chemi-thermo mechanical pulp (CTMP) and chemi mechanical pulp (CMP) have been gaining dominance in recent times. The most preferred species of wood for SGW or TMP are softwoods like spruce and pine because of their fibre morphology and colour. Their fibre characteristics enable one to produce a mechanical pulp of high opacity but a reasonable strength levels while their initial brightness (50-60°ISO) requires no further bleaching or only minimal bleaching.

Since softwood resources are fast depleting and not available in tropical countries, hardwoods such a birch, aspen etc and tropical hardwoods such as eucalyptus, salai (Boswellia Serata) "gewa" (excoecaria agallocha) etc have been introduced long time ago in the newsprint furnish as mechanical pulp and the balance either softwood chemical pulp or locally available bambo pulp. The mechanical pulp from such hardwoods consumes more chemical not only in refining (chemiground wood, CTMP/CMP end even cold soda) but also in bleaching in order to achieve adequate strength and brightness levels. Besides, pulp yields are also lower compared to SGW/CMP from softwoods. Of all the hardwoods, eucalyptus has been used widely for manufacture of newsprint in countries like Australia and India. But eucalyptus also requires land for plantations and some ecologists do not recommend growing certain species of eucalyptus because its impact on ground water and fauna.

Use of recycled waste paper through deinking of newspaper/reclaimed newsprint has become a very attractive alternate source of fibre. There are quite a few mills in USA and Mexico using 100% reclaimed newsprint in their furnish. However, since these are "secondary" fibres these are not considered as alternative to primary and virgin fibre sources. A more realistic alternative to wood fibre sources can come only from non-wood plants, especially the annual plants such as bagasse, kenaf, straw etc. Since bamboo, which has been the leader of the non-wood plant fibre source for chemical pulping, is becoming increasingly unavailable even in countries like India and China and further bamboo plantations/rejuvenations require high capital investments, bamboo is not considered as a potential alternative. Likewise, straw being inherently weak in strength properties and contains a high percentage of silica, is also not technically suitable.

How bagasse and kenaf compete technically and commercially as the most potential alternative to wood fibre sources, will be reviewed in detail in the following.

3. Newsprint from Bagasse-Now a Reality :

3.1 Factors that Influenced Translation of Expectations to Reality

There are two principal factors that impeded the commercialisation of manufacture of newsprint from bagasse, viz. appropriate technology and substitute fuel for release of bagasse. Right from the first reported work on bagasse newsprint in 1856 when Hendry Low of Baltimore carried out experiments with Southern US Sugarcane, all the process routes proposed for manufacture of bagasse newsprint were based on chemical and semi chemical pulping of bagasse, until 1960 when the Hawzell Process was based on use of 70% mechanical bagasse pulp and 30% semi-bleached softwood kraft pulp-a historical account of all these process is given by Atchi on[1]. Therefore, all the process routes based on semi chemical pulp route were not only unacceptable

from technical point of view (low opacity, oil absorbency etc.) but also due to the increase in the cost of raw materials arising out of lower yields and higher chemical consumption for such pulps compared to mechanical pulp.

The lower yield has greater significance when the bagasse has to be procured by substituted fuel. For most of the sugarcane growing countries such as Peru, Mexico, Argentina, Cuba, Indonesia etc., the substitute fuel is not so expensive as they have adequate reserves of fuel oil which can be directly used in bagasse boilers, whereas for countries like India, China, Australia etc., the main energy source is coal which requires installation of new coal fired boilers in the sugar mills. Therefore, manufacture of bagasse newsprint was not commercially attractive at such low levels of yields.

Notwithstanding the Hawzell Process recommendation to use a high percentage of mechanical bagasse pulp, three bagasse based newsprint mills were built in the latc '70s in 3 countries viz. Peru, Mexico and Argentina based on Cusi's Process which advocated high percentage af semi chemical bagasse pulp in the furnish, probably because of their fuel oil resources. While Peru and Mexico did not succeed, the mill in Argentina is still running today using 75% of semi chemical bagasse pulp and balance imported softwood pulp. However, it is learnt that this mill's newsprint is yet to secure publishers' acceptance.

Around the same time, for India, which is the leading producer of sugarcane in the world, a long time dream to produce newsprint out of bagasse matured into a realistic expectation when the SPB's Project and Consultancy Division picked up the gauntlet and took the lead in securing a new technology for bagasse newsprint and using coal as substitute fuel for releasing bagasse through installation of coal fired boilers at the cost of the newsprint project in five sugar mills. The World Bank, from the view point of technology development and the renewable resources development, readily came forward with an assistance of 100 million US Dollars, thereby giving shape to a global expectation. The rest is all history.

3.2 Technological Breakthrough at Tamil Nadu Newsprint and Papers Limited (TNPL)

"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. Therefore, the accomplishments of SPB Consultancy and Beloit Corporation in achieving success in the Tamil Nadu bagasse newsprint project are all the more remarkable'-so said Dr. Atchison while delivering his key note address at the International Seminar on Bagasse Newsprint held at Madras in 1986. The key to the successful manufacture of bagasse newsprint was the breakthrough achieved in mechanical pulping of bagasse on a commercial scale and the demonstration of runnability in paper machines at speeds exceeding 600 mpm, using a furnish composition of 85% bagasse (50% mechanical and 35% chemical) and balance 15% eucalyptus chemical pulp.

The newsprint made out of this furnish was then printed at "The Hindu" (a reputed daily newspaper based at Madras) at 35000 copies per hour on a modern offset machine on 28th October 1985. When the quality was accepted, the news spread all over the world that bagasse newsprint has indeed arrived and has come to stay.

Following close on the heels of TNPL was yet another commercial production of bagasse newsprint at Letjes IV, Indonesia, using a furnish composition of 45% bagasse CTMP, 40% semi-chemical pulp from a mixture of bagasse and rice straw, and 15% imported softwood pulp. While TNPL was built on Beloit-SPB Process, Letjes IV was built on Peadco Process. Detailed report of these two mills' operations have been published in various journals[2,3,4,5].

These two mills have shown the world that non-wood plant fibres, especially bagasse, are indeed a proven alternative to wood as a source of fibre supply for manufacture of newsprint and TNPL not only pioneered the global effort towards this objective but went a step ahead by demonstrating the runnability of newsprint furnish containing 100% bagasse pulp.

4. Newsprint from Kenaf-Great Expectations

4.1 Visionary Thrust Given by USDA/ANPA in Promotion of Kenaf

Since the early 1930s, the United States Department of Agriculture (USDA) has considered the possible use of non wood plant fibres especially crop residues (such) as sugarcane bagasse and grain straw) in pulp and

paper. Beginning in 1956, the USDA identified new plant species that could compete with pulpwood in furnishing satisfactory fibre for pulp and that can provide farmers income from a new crop. Of the 387 species, kenaf and sunhemp were the most promising, but however they decided to concentrate on kenaf due to the ability of kenaf to produce consistently higher yields.

Kenaf (hibiscus cannabinus L) is a rpidly growing plant and can be cultivated under a wide range of conditions and requires relatively little care. Kenaf, as a tropical plant, is widely grown in India, Thailand, Australia etc. and received commercial attention initially as a possible substitute for jute. The bark constitutes 20-30% of dry weight of stem and contains soft bast fibres which are used for cordage and cigarette papers. Kenaf is an annual plant related to okra and cotton, capable of growing from seedling to 14-ft maturity in five months.

American Newspaper Publishers Association (ANPA) took enormous interest in promoting kenaf for production of newsprint as a defence against rising pulp wood prices in North America and Southern United States, in particular. Feasibility report([6]) carried out by Soil and Land Use Technology Inc (SaLUTE), Columbia, Maryland, on behalf of ANPA surveyed 13 production processing areas and determined that kenaf can make significant contribution to newsprint production in the next 5 years at Southern Alambama, Central/ Eastern Georgia, South-Eastern Texas, Arizona and South-Eastern Arkansas.

Also, this report indicates that in 1980 daily newspapers in the south accounted for 3% of newsprint supplied in USA and the newsprint prices increased nearly 100% between 1972 and 1976 as a result of shortages of newsprint and increased prices of pulpwood and energy. During the period 1970-80 average pine wood prices increased approximetely 109%.

All these indicate that ANPA's efforts to identify kenaf as alternative raw maetrial in Southern USA are well directed.

4.2 Kenaf Takes-off from Trial Stage :

A 72000 copy run of "The Bakersfield Californian" last year demonstrated that kenaf is out of the trial stage, ready to stake its claim as a newsprint furnish.

"The Bakersfield Californian" is a Joint partner in Kenaf International, a private venture company in US. Pilot Plant Pulping by two stage CTMP Process was carried out at Sprout-Bauer, Spring Field, ohio facility and then paper machine trials were carried out on the modern twin wire-paper machine both at Beloit Rockton Research Centre facility and also at full commercial speed on Black Clawson twin-wire paper machine of CIP Inc in Trois Rivieres, Quebec. The furnish composition was 82% kenaf CTMP pulp and 18% kraft Full details of chemical consumption, yield etc are not available but published reports[7],[8] claim that kenaf requires only 80% of the energy required for pulping wood chips, but much higher chemcal consumption both in refining and bleaching by peroxide. Consequently, kenaf newsprint is expected to have much higher strength but iower opacity.

Based on the above pilot plant trials, CIP Inc is proposing to set up a 215000 t/year kenaf newsprint mill in Southern Texas. Meanwhile, in India, parallel efforts were undertaken by pulping kenaf at pilot plant scale and testing the newspring at "The Hindu" who together with RIND, Madras, have been giving the thrust to kenaf for several years.

5 Future Potential/ Prospects for Bagasse and Kenaf

5.1 Problems in Commercial Technology

Unlike wood species non-wood plants, especially annual plants like bagasse and kenaf, pose problems in procurement, handling and storage because of their bulk and seasonal availablity. while bagasse availability is restricted to 6-7 months during the crushing season (excepting some countries like Peru), kenaf is also grown and harvested only for 4-5 months in a year. Therefore, storage for the remaining period becomes a complex issue in terms of fire hazard, ease of handling and more critically in respect of preservation of fibre and brightness. Today, if there is a singular factor that could change the economic complexion of bagasse newspriut, it is the brightness preservation on storage. Established storagesystem such as the wet-bulk storage system is not the answer when it comes to mechanical pulp since brightness drops from initial value of 38-40° to a final value of 32-34° at the end of storage.

While thc brightness of unbleached CTMP from fresh kenaf is reported to be around 46°, it is not presently known how much brightness will drop after kenaf has been stored. Kenaf may have to learn a lesson here from bagasse.

Likewise, commercial experience in refining of bagasse, as opposed to pilot plant trials, have opened out problem areas in terms of feeding, identification of suitable plate pattern, plate fife etc. Kenaf is yet to go through this "grinding" process as bagasse has done, before it can be mature enough to claim a status equal to bagasse. A dtailed account of all these was presented by the author in a paper entitled "Bagasse Newsprint-Issues and Options" at the International Non-Wood Pulping Conference held In China during July 1988[9].

However, both bagasse and kenaf are heterogenous in nature and requires very discrete treatment right from raw material preparation through pulping. Kenaf's strength comes from its "bast" fibre. as bagasse has it from its' "rind" fibre. Future R&D is to be directed towards exploiting the latest fractionation techniques to separate the strength component from the rest (optical component) for fully developing the fibre potential. Therefore, it is not a question of bagasse Vs kenaf, it is, instead, bagasse and kenaf complementing each other. In fact, kenaf can act as a reinforcing fibre for bagassc and a newsprint furnish comprising 75% bagasse and 25% kenaf could compete with any international newsprient quality.

Economic Constraints

The cconomy of scale available to wood based newsprint mills is not applicable to non-woods due to following conventional reasons :

(a) Procurement difficulty-avaiability of substitute fuel for bagasse and cropland for kenaf

(b) Under rating of paper machine capacities on account of speed limitations due to lower strength properties of furnish, particulary the initial wet-web strengths

As regards bagasse, a 300 tpd newsparint will requuire sugar mill (s) of about 10000 t/d can crushing capacity (6 months crushing season) and increasing the capacity of newsprint mill to typical scale of 600 tpd would mean extending the economic radius of sugar miil locations and also increasing number of paper machines. Whereas in case of kenaf, faster paper machine can be employed but the limiting factor would be kenaf procurement according to Sholton ([10]). Kenaf yields in the tropics are estimated to be 12 ADMT/hectare and for a 100000 t/y newsprint mill, a dedicated crop land of 10000 hectares may be required. In developed economies like USA. with organised agricultural sector, procurement may not be a problem but in developing countries like India. Thailand etc, this would mean dealing with thousands of small farmers. A case in point is rhe world's first kenaf based pulp miil of capacity 70000 t/y In Thailand which had serious problem in procurement of kenaf and the mill had to eventually switch over entirely to bamboo.

As regards the problem of economic radius of sugar mills, dedicated new sugar mills can be set-up to feed newsprint mill and the sugar mill/paper mill complex can have common steam and power generation system. But kenaf still has a better edge over bagasse in that it enables energy conservation and higher economy of scale of operation.

Bagasse or Kenaf-At What Priee ?

The cost of newsprint as % of newspaper publishing costs is around '40% in USA and as high as 60% in India. Therefore, raw material pricing bears an important factor.

The cost of raw material as a percentage of the cost of newsprint (excluding interest and depreciation) is 30% in North-West USA and 25% in South-East USA; in India for a typical 300 tpd newsprint mill based on wood and bagasse the corresponding figures are estimated to be 20 and 23% respectively. In case of bagasse, the value is arrived at basing coal as substitute fuel and after giving credit for equivalent fuel value for pith.

If kenaf is found to be competitive with current pulp wood prices in USA it might be so due to extensive land availability, whereas in other tropical countries like India it may have to compete with the sugarcane areas, cotton belts etc, as kenaf also requires rainfall and irrigation during the growing season to the extent of 2-4 acre-feet in order to get acceptable yields. It is vary difficult to predict the opportunity cost for the farmer. But considering typical yields of 100 t of sugarcane per hectare. it fetches an Indian farmer abut 1800 US Dollars per hectare, giving the industry approximately 10 t of sugar and 6 t of newsprint. If knnaf has to compete with sugarcane, based on its 12 ADMT/hec-

tare yield, price of kenaf should be around 150 US Dollars/ADMT at which price it can still be within 25% of cost of newsprint.

In other words, where land is available kenaf pricing would have to match at least pulpwood prices and where land is unavailable kenaf price would be dictated by price of competing crops,

Therefore, the selection of bagasse and/or kenaf depends on various geographic, economic and technical factors and eaeh country has to decide after carefully evaluating all these factors.

REFERENCE

1. Historical Develoment of Bagasse Newsprint–J E Atehison–TAPPI Non–wood Plant Fibres Pulping Progress Report No. 10.71-79 (1979)

(2) Tamilnadu a Success with Bagasse Newrints–PAPER, May 1986

(3) TNPL Solves Bagasse pulping Problem-PPI, Nov 1986

(3) Kertas Leces and Growth of Paper Mill-PAPER, 13 July 1987

(5) Kertas Leces and Technip Indonesia Challenge–PAPIER CARTON & CELLULOSE, Jan-Feb 1987

(6) General Feasiblility Study-Kenaf Newsprint System-Prepared for ANPA by SaLute–1982

(7) Production of Newsprint from 100% Kenaf-K S Schoen-thaler and E Fuentes-Tappi Pulping Conference 1983.

(8) Kenaf Newsprint is a Proven Commodity-Jum Young-Tappi-Nov 87

(9) Bagasse Newsprint–Issues and Option.- T S Venkataraman–Intcrnational Non-Wood pulping Conference, Beijing, Chlna–July 1989

(10) Kenaf for paper Pulp in the Tropics–Erwin J Sholton–Tappi Non–Wood Plant Fibre Pulping Progress Report No. 9