K. P. SINHA
J. C. DHINGRA,
K. S. BHARGAVA
and
DR. J. C. AGGARWALA

Utilisation of Bagasse in India

Utilisation of bagasse in a major way for pulp and paper manufacture has been discussed in our country for more than two decades. Almost every big paper mill in the country has done research work and investigated this matter in detail. Our National Research Laboratories like F.R.I., Dehra Dun, have also done extensive work on pulping of bagasse. Numerous experts from foreign countries have visited us to sell their technical know-how and secret processes. Numerous technical personnel from Indian Mills have travelled around the globe visiting Paper Industry in other countries where bagasse is used in large quantities for pulp and paper making. In 1961 National Productivity Council, Government of India, sponsored a study team of India Paper Industry with which one author of this paper Dr. J. C. Aggarwala was also associated to go to different countries of the world and their first term of reference from India Government was "Utilisation of bagasse as pulp making raw material for manufacture of writing and printing papers as well as newsprint". This team went abroad for study of bagasse but came back talking about "mixed" hardwoods. It will be interesting to review the results of all such efforts to utilise bagasse during last two decades. Messrs Rohtas Industries Ltd., Dalmianagar, may be considered No. 1 and Messrs. Shree Gopal Mills, Yamuna Nagar, No. 2 amongst pioneers in setting up bagasse based pulping units in our country in '50s. At that time there was only one mill in Phillipines that was manufacturing high quality writing and printing papers from a furnish of 90% bagasse pulp and balance 10% long-fibred woodpulp. Bagasse pulp was manufactured by them by so-called Pomilio process. Both these Indian companies studied this process in detail at that time and it is interesting to note that they took entirely diverse courses of action. For pulping of bagasse by Pomilio process chemical requirements are relatively high. Also the process has disability that it does not provide enough flexibility to change over to other raw material like bamboos if there be shortage of bagasse. 30% caustic soda and 20% chlorine per tonne of bleached bagasse pulp may be needed for this process and there is no provision for recovery of cooking chemicals. A pre-requisite for adoption of such process was to install own electrolytic plant for manufacture of caustic soda and chlorine so that these chemicals could be available at cheaper than market prices for running the bagasse pulp mill. Fortunately, Rohtas Industries had their own sugar factory from where bagasse was available at nominal cost.

Also they had their own electrolytic plant for manufacturing chlorine and caustic soda. So this company decided to install 18 ton-a-day capacity bagasse pulping plant based on Pomilio process. One author of this paper Dr. J. C. Aggarwala was at that time conceted with Shree Gopal. He spent nearly 1½ months with Compania De Cellulosa De Fillipinas at Bias Central in Phillipines studying the economics of Pomilio process in 1951. Shree Gopal Paper Mills decided different course of action. They did not have bagasse available from own sources. They had to depend on purchased bagasse. Further they did not have their own adequate capacity caustic soda-chlorine manufacturing electrolytic plant. So they decided against Pomilio process. Instead they took action to set-up a bagasse depithing station in the premises of a sugar factory adjacent to their paper factory. Perhaps this was the first such bagasse cleaning installation in a sugar factory in our country. Plant and equipment for depithing of bagasse was imported from U.S.A. There were lot of problems encountered in operation of this plant. There were difficulties in making good bales from depithed bagasse. The depithed bagasse was transported to paper factory and it was found that good grade bagasse pulp could be manufactured by conventional soda process used for sabai grass pulping and also by using the same equipment as existing for sabai grass pulping. The cleaned bagasse from sugar factory was cooked in Sinclair design direct heated digesters available in Shree Gopal for cooking of sabai grass. Black liquor of bagasse digestion could be used for chemical recovery. The trick was to spread a few quintals of uncut sabai grass at the bottom of such digesters before loading same with cleaned bagasse. This avoided choking and plugging of vomit pipes for circulation of cooking liquor inside the digesters. Based on success of this approach that conventional method of cooking can be used for bagasse, Shree Gopal went ahead and installed a 20 tonne per day capacity bagasse pulping plant from West Germany. Such design plant had much more flexibility than Pomilio process plant and in case of shortage of bagasse other raw materials could be used. In this plant Tumbling type rotary digesters were installed for cooking depithed bagasse by soda or sulphate process and the Black liquor of digestion was to be used for recovery of cooking chemicals.

It is interesting to observe present status of these plants. Shree Gopal continues to run their plant. Rohtas Industries, however, had to scrap their plant because they no longer had free bagasse available from their own sugar factory. Their sugar factory was closed due to non-availability of enough sugar cane. Further Pomilio process plant cannot be used for processing of other raw materials like bamboo or hardwood chips .

After installation of these two plants in our country two new units went into production in South India i.e. Messrs. Mandya and Seshasayee Paper Mills. These were bagasse based units and technique of continuous digestion by Pandia system was adopted. As per our information, only Mandya National Paper Mill still use bagasse as their major raw material and it appears that Seshasayee has started using bamboos and hardwoods as their raw materials.

K. P. Sinha, Chemist, J. C. Dhingra, Research Chemist, K. S. Bhargava, Chief Chemist (Paper Division); Dr. J. C. Aggarwala, General Manager (Paper Division), Rohtas Industries Ltd., Dalmianagar.

During the same period when bagasse based plants were installed in South India, Government gave industrial licences to two big industrial houses in our country i.e. to Messrs Sahujain and Birlas, to set-up newsprint manufacturing plants based on utilisation of bagasse. Those projects never matured . The following parties were also granted licences to set-up paper mills using bagasse as raw material :

1) Delhi Cloth General Mills Ltd., Durala,
2) Ugar Sugar Works Ltd., Athani, Mysore,
3) Somani Pulp and Paper Mills Ltd., Gorakhpur. (U.P.),
4) Uttar Pradesh Pulp and Paper Mill, Janseth (U.P.)
5) Northern India Paper Mills, Meerut
6) Hindustan Sugar Mills Ltd., Golagokarannath, (U.P.)
7) Shri Sohan Lal, Rahwie, Maharashtra,
8) Ashoka Paper Mills, Darbhanga,
9) Bedi & Company, Panipat,
10) K. L. Gupta & Company, Nasik.

It is interesting to note that none of the above schemes saw the light of day. In recent years Government of India invited an expert, Dr. Cussi from Latin America to help our country in bagasse pulping Technology. They prepared a report regarding setting up of a pulp and paper project in U.P. based on Dr. Cussi's patented and well advertised pulping process. This project was to be included in the programme of Paper Corporation in public sector but apparently this has been given low priority. Four cooperative sugar factories in Maharashtra have been planning jointly to set-up a Rs. 16 crores newsprint plant using bagasse as raw material. We do not know the progress made for this project.

It will thus been seen that inspite of repeated discussions at all levels and numerous committee and sub-committees of Government and private agencies having studied and discussed this matter, bagasse utilisation has still not made any major headway in our country. However, in our adjoining country, Pakistan, we understand that a large size bagasse based paper plant is under construction.

To our mind there are numerous causes of poor progress in utilisation of this valuable agricultural residue in our country by paper and board industry. This industry is highly capital intensive and huge capital involvement cannot be put to risk on vagries of nature for sugar cane growth or moods of the farmers of sugar industry. In general, there has to be proper coordination between paper industry and sugar industry and they have to come close to solve the technical and economic problems of making bagasse available for paper making. Such highly capital intensive industry should be able to produce bagasse at economic price and they have to be assured of constant and regular supplies of their basic raw material. Discussions have taken place between paper and sugar industry in the past to decide a pricing formulae. Proposals were based on determination of fuel replacement value of bagasse and alteration to sugar factory boilers were to be considered so that these boilers can use coal or fuel oil as an alternative fuel to release bagasse for paper industry. Sugar industry has, however, never come forward in a big way to accept such proposals. Reasons are not far to seek. They are afraid that alternate fuel may not be available to them in regular and assured way and they are afraid that after conversion of their boilers for burning, coal, occasions may arise when there may be coal shortages or fuel oil shortage and what to talk of making some extra money by selling bagasse they may not be able to manufacture any sugar either.

There are also other problems to be faced by sugar factory if it is to make its bagasse available to the paper mill. Enough space has to be available in sugar factories for baling and storage of bagasse in the limited period of time when the sugar factory is working. Sugar industry is a seasonal industry while paper mills run day and night throughout the year. Indian railways have to cooperate so that transport of bagasse bales to paper mills is possible as per requirements of paper and sugar industry . In India there may be imposed sudden restriction on movement of wagons or wagons may not be available at all and a 25 crore paper mill project may suffer serious set back in operations..

As regards manufacture of pulp of various qualities from bagasse, authors of this paper feel that no technical know-how or do-how need to be imported from foreign countries in achieving this objective in our country. Expertise is abundantly available for utilisation of bagasse. There is nothing like a secret process for pulping of bagasse for which we may have to pay high royalties to foreign countries. It is now well realised by technicians all over the world that secret of bagasse pulping lies in its depithing. After the pith has been removed, cleaned bagasse can be converted into pulp by any of the well known processes like soda, sulphate, neutral sulphite, mechano-chemical, semi-chemical, cold soda etc., to produce pulp of any quality needed to suit the end product. Yield of unbleached pulp from cleaned bagasse could be from 50 to 95%.

Both batch type digesters and continuous digester could be used for pulping of depithed bagasse. Spherical rotary, tumbling type digesters have certain advantages and the conventional indirect heated, forced circulation type digester used for cooking of chips are not considered best suited for this purpose. Pandia continuous digester, Peadco digester, Bauer system as well as Kamyr continuous digester system can be used for treatment of this material if tonnage rate is high and continuous cooking system is economically feasible. Numerous methods, plants and equipments are available for bagasse depithing. A mill could remove nearly 1/3rd of pith from bagasse by simply willowing it through a 16 mesh willow screen. With more costly equipment and complex system removal of pith from bagasse fibre could be achived to a better degree. It is, however, to be realised that even with best system there cannot be any clear cut separation of pith and fibres. Some pith invariably still adheres to the fibres and some good fibre still tends to go alongwith pith.

The bagasse pulp cooked by soda, sulphate or neutral sulphite process bleaches readily and it is very easy to beat bleached bagasse pulp. If writing and printing papers are to be manufactured at high paper making speeds it is very necessary to mix some higher strength pulp with bagasse pulp for good runnability of high speed paper machines High yield pulp produced from depithed bagasse by neutral sulphite semi-chemical process is considered excellent quality pulp for manufacture of certain packaging papers like corrugating medium.

Such corrugated board has very high crush resistence. Bleached bagasse pulp is suitable for manufacturing Glassine, grease proof paper, bleached tissue and towelling as well as writing and printing papers.

There are advancements in technology of Disc refiners in the last few years. We feel that by adoption of suitable Disc refining technique it should be possible to manufacture newsprint grade bagasse pulp with very little or no consumption of chemicals. So it should be possible to plan a newsprint plant based on use of 60-70 per cent bagasse in the furnish and balance long fibred pulp. Since utilisation of this valuable agricul tural residue is of national importance we are sure many paper mills in the country are still busy doing experimental work on utilisation of this material especially by certain pulping process which have come into lime-light only in recent years. Recently Rohtas Industries undertook extensive work on manufacture of bleachable grade pulp from bagasse by Cold Soda process. Brief results are given below :

The whole bagasse taken for our experiments was of approximate chemical composition as given in Table I.

TABLE I

Moisture	7.5%
Cellulose	51.0%
Alpha-Cellulose	37.0%
Pentosano	28.0%
1% NaOH soluble	36.0%
Lignin	22.0%
Pith	30.0%
Ash	2.6%

Depithing was done using Sprout Waldron Disc refiner. The disintegrated material was washed on 10 mesh screen with water under pressure. About 31% pith was removed along some amount of good fibres. The cold caustic pulping conditions are given in Table II except cook number B-5. where bagasse pulping was done by conventional soda pulping process using 15% active chemical for comparison. The cold casutic pulp was refined in Sprout Waldron Disc refiner and the approximate freeness of refined pulp obtained was about 22°SR. The bleaching data are given in Table III. The well washed bleached pulp was beaten in laboratory valley beater at 45°SR and the hand sheets were made and tested as per Tappi standards. The physical strength properties of beaten pulp are given in Table IV.

During the above experiments, study was also made regarding effect of time of soaking on caustic consumption. The test results are reported in Table IIB and are shown in Graph No. 1.

Discussion and conclusions :— With the increase in the strength of steeping liquor, the caustic soda consumption goes up, yield of pulp and chlorine demand decreases and there is slight improvement in tensile strength.

Above studies reveal that there is no appreciable improvement either in chlorine demand for unbleached or in physical strength properties of bleached pulp if the concentration of steeping liquor is increased from 20 gm. per litre to 30 to 50 gms. per litre. On the other hand there is appreciable increase in caustic soda consumption and reduction in the yield of unbleached and bleached pulp.

We are yet to evaluate the relative disadvantages and advantages of cold soda pulp process form bagasse Vs other processes. We are yet studying the properties of cold soda pulp bagasse in details and economic comparison shall be possible only after the quality of pulp has been thoroughly evaluated.

TABLE IIA COOKING CONDITIONS

	COLD SODA				SODA
Cook No.	B-1	B-2	B-3	B-4	B-5
Bagasse Liquor ratio	1:7	1:7	1:7	1:7	1:4
Concentration of steeping Liquor gms/L	15.0	20.0	30.0	50.0	37.5
Temperature, °C	30	30	30	30	165
Time, Hrs.	4	4	4	4	3½
Yield, % on b.d. Bagasse	78.5	75.1	72.3	68.0	54.8
Alkali Consumption, %	6.1	7.8	8.4	9.0	13.7
% Chemical used on b.d. Bagasse	10.5	14.0	21.0	35.0	15.0

TABLE III : BLEACHING CONDITIONS

	Chlorination				Alkali Extraction			First Hypochlorite Treatment				2nd Hypochlorite Treatment			Total Chlorine Consumption on pulp %	Bleached pulp yield	Brightness °GE
Cook No.	Time mts	Temp °C	pH	Consumption %	Time Hrs	Temp °C	% Caustic	Time Hrs	Temp. °C	pH	Consumption of Cl2 %	Time Hrs	Temp °C	pH	Consumption %			
B-1	45	Room	2	11.0	2	45	3.0	3½	38	8-9	5.0	2½	38	8-9	2.0	18.0	64.8	60
B-2	45	Room	2	10.0	2	45	3.0	3½	38	8-9	4.7	2½	38	8-9	1.9	16.6	64.0	60
B-3	45	Room	2	9.2	2	45	3.0	3½	38	8-9	4.1	2½	38	8-9	2.0	15.3	61.5	62
B-4	45	Room	2	8.3	2	45	3.0	3½	38	8-9	4.2	2½	38	8-9	1.7	14.2	59.8	65
B-5	45	Room	2	4.0	2	45	1.5	3½	38	8-9	2.8	2½	38	8-9	—	6.8	49.6	76

TABLE V. COOKING CONDITIONS AND SINGLE STAGE BLEACHING DATA OF BAGASSE

Cook No.	Total Alkali as NaOH on b.d. Bagasse	Bagasse Liquor Ratio	Concentration of Cooking Liq. gms/L.	Cooking conditions: Temp raising, time mts.	Cooking conditions: Max. Temp. °C	Cooking conditions: Time at Max. Temp. mts.	Cooking conditions: Relieving Time mts.	Cooking conditions: Total Time Hrs.	Unbleached Pulp Yield %	Consumption on b. d. material	Permanganate No—	Single Stage bleaching: % Consumption	Single Stage bleaching: Time Hrs.	Single Stage bleaching: Temp. °C	Single Stage bleaching: pH	Bleached Pulp Yield	Brightness ° GE
1.	15.0	1:4.2	35.714	105	165	105	30	4	53.6	14.5	12.2	6.85	4	38	8-10	48.4	73.0
2.	16.0	1:4.2	38.095	105	165	105	30	4	52.3	14.53	11.6	6.3	3½	38	8-10	47.3	76.0

TABLE IIB: EFFECT OF TIME ON CAUSTIC CONSUMPTION — FOR COOKING

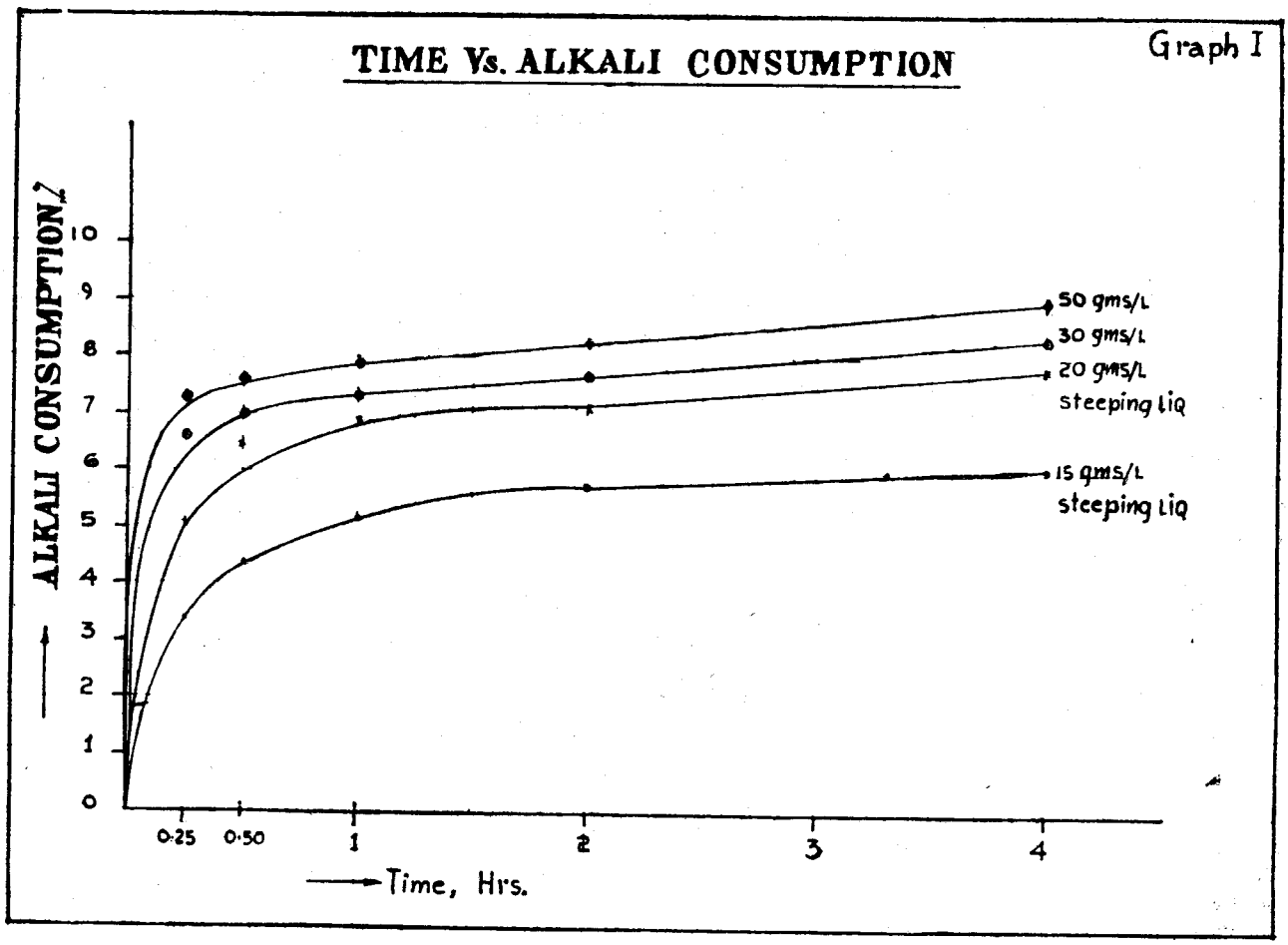
Time	% NaOH Consumed on b.d. Bagasse			
	B-1	B-2	B-3	B-4
15 mts	3.4	5.1	6.6	7.3
30 mts	4.4	6.5	7.0	7.6
1 Hour	5.2	6.9	7.3	7.9
2 Hours	5.8	7.1	7.7	8.3
4 Hours	6.1	7.8	8.4	9.0

TABLE IV: PHYSICAL STRENGTH PROPERTIES OF BLEACHED PULP

Cook No.	Breaking Length	Burst Factor	Tear Factor
B-1	3800	32.1	38.8
B-2	4250	32.0	36.0
B-3	4345	32.3	38.9
B-4	4410	32.0	38.0
B-5	5240	40.6	42.9

TABLE VI. PHYSICAL STRENGTH PROPERTIES OF SINGLE STAGE BLEACHED BAGASSE PULP

Cook No.	Copper No. of the Bld. Pulp	Breaking Length metres.	Burst Factor	Tear Factor
1.	1.27	4920	33.9	36.6
2.	1.78	4580	35.0	37.0



Bagasse as a Raw Material for Paper Industry

TEK SINGH

In this write-up, personal views have been expressed about suitability of bagasse as a fibrous raw material for paper industry. It has been suggested that research/development work should be carried out to optimise conditions for the use of this material along with hard woods for the manufacture of news print and cheap type writing/printing papers; guidelines have been put forward for such an approach.

INTRODUCTION

The papers to be read and discussed in this Seminar on the above subject are likely to cover almost everything in so far as theoretical considerations for the utilisation of this material as a fibrous raw material for paper industry in India is concerned. In my opinion, stage has now reached when Indian technicians working in the paper industry should come out of what sometimes is erroneously called 'ivory tower' and come down from the domain of theoretical considerations regarding use of this material to the practical realities.

It may be added that the papers to be discussed in this Seminar are likely to deal with data such as composition of bagasse, its availability, pulping processes, characteristics of paper made from this material, economical considerations etc., etc. It may be added that these data/information are already known and have been discussed on more than one occasion; steps should now be taken to make use of them and they should be

Tek Singh, Chief Technical Superintendent, Tribeni Tissues Ltd.