Technological Challenges Faced By Agro Based Pulp And Paper Mills And The Options

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INDIAN SCENARIO & MARKET DEMAND

With the recent liberalisation of industrial and economic policies persued by successive Governments at the centre the whole pattern of demand for paper and paper boards, as in the case of other industrial sectors, is growing up faster. With the opening of Indian market to international competition, the consumers would be playing a dominant role and the industry, as a whole, has to respond to the fast emerging changes.

Indian paper industry has no other alternative but to initiate larger expansion and modernisation, aiming at:

(a) Increased Supplies.

(b) Reduction in cost of production.

(c) Improved energy and environmental standards (in conserving energy & water by adopting cleaner technologies).

(d) Meeting global standards on quality.

With the thrust being given by Government of India towards total literacy programme and diverse uses of paper, The demand for more paper is expected to reach a level of 5 Kg. per capita consumption by the year 2000-01 AD. To meet this increased demand capacity, the industry has to accelerate the pace from the existing level of 2.80 million type (1994-95) to 4.37 million type by 2000-01.(1).

The demand for paper and paper board is projected from the present level of 2.6 million tonnes to 5 million tonnes by 2000 AD and further to 6.0 million tonnes by 2010.

Already there are 34 project in the Civil which would further add up another 1.3 million tonnes of capacity in the next few years. These new projects require massive investment to the time of Rs. 4500 Crores. (2).

STRUCTURE OF AGRO BASED MILLS

Data presented in **Table-1** gives the break up of the production capacities into three main segments as shown in Table-1, e.g. Forest based B. Agrobased and C. Waste paper based., thrown light on the major role played by Non-wood pulp sector contributing to 60-62% of the cumulative production. The Agro base sector comprising medium and small sized pulp & paper mills constitute 36% of total production capacity.

Table-I

Segmentwise Production of Paper & Paper Boards in 1990-91, 1994-2000-1

			Production in ,000 Tonnes	
Segment	**1990-91**	**1994-95**	**2000-01**	**Remarks**
Forest Based	971 (44.87%)	1196 (42.29%)	1585 (36.27%)	Segmen Wise Are
Agro Based	618 (28.54%)	925 (32.08%)	1440 (32.94%)	Appoxi For 19 & 2000
Other	575 (26.59%)	705 (25.63%)	1345 (30.79%)	
Total	2164	2826	4370	

COURSE: CHEM-PROJECTS-1995

(TABLE NO. 2 of Raw Material Scenario for National Pulp & Industry upto 2000-2011 PAPERES-95 TECHNICAL SEMINAR)

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The Agro based small/medium paper mills of 10-50 tpd were encouraged in early 80's with the clear cut laid down objectives:

- to encourage utilisation of annually renewable agro residues with a view to conserve dwindling forest resources.
- to meet fast growing futuristic demand of paper at the same time to create additional production capacity with short gestation periods and minimum investment.
- to promote rural employment with a firm objective of integrating industry & agriculture.

In 1980's, The Agro based paper mills were often considered to be environmentally friendly, while meeting the domestic paper making capacity as priority.

MAJOR PROBLEMS/CHALLENGES FACING SMALL/MEDIUM AGRO PAPER MILLS

RAW MATERIAL COLLECTION, STORING & PREPARATION

The major problem that confronts the industry that is not in its control, is the availability of raw material inputs on a sustained basis. Bagasse, the major potential rawmaterial source, is extensively used by many mills, both medium and large, because of fiscal concessions granted to such mills.

With the bumper sugar production of 15 million tonnes last year, availability of 40-45 million tonnes of mill wet bagasse is guranteed. Even if 50% of this wet bagasse is diverted to industry; at least 3-3.5 million tonnes of paper can be produced by 2000 AD.

Government should therefore encourage sugar mill paper industrial complexes in major sugar cane producing states. Though rice straw and wheat straw raw materials are available in plenty their scattered availability, lack of baling practices, want of facilities for efficient collection, cleaning and transportation to close proximity, all have restricted the use of straw. Of the potential straw recovery available from the cereal, only about 1% could be made available to the, agro paper industry. Most of the surplus straw was being burnt in the fields for want of baling equipment. Resulting from the above assessment, the total straw supply to the paper industry is estimated around 1.716 million tones. (3). It would be a right step, if the import of specific type of straw baling equipment was permitted free of import duty.

RAWMATERIAL STORAGE & HANDLING

A novel but scientific practice of storage of bagasse and even straw is normally adopted in developing agro based mills. The photographic depiction of bagasse and straw storage in a standard trapezoid or prismatic shape with surface covering with straw not only preserves the bale bagasse against faster deterioration to browning but also maintain & better seasoning. The bales while building up to shape used to be sprayed with dilute Borax solution (2%) which imparts protective coverage against drastic imminent microbial attack. The brightness deterioration even after 6 months of seasoning is not prominant unlike as observed with open and untreated stacks.

PULPING PRACTICES

Mainly rotatory spherical digesters of varying size 7-8 in numbers

- not properly thermally insulated.
- improper raw material loading
- higher both ratio (1:4.0)
- lower cooking temperature between 145°C to 155°C
- having no provision for blow heat recovery.

Detailed energy Audit study conducted by UNDP-CPPRI team in a progressing Agro paper mill had thrown light on the imminent thermal losses and possibilities of saving steam to the betterment of the mill (4).

Well insulated digesters with 17 blows in a day will conserve energy radiated from digester surface to the tune of 13.7% of useful heat input. Steam saving from 17 digester blows computed to be 10.4 tonnes/day.

Bath ratio adjustment from 1:4 down to 1:2.55 for bagasse cooks in the early stage of cooking is expected from well insulated digesters to result in saving of steam 24.8 tonnes/day.

Increasing cooking temperature from 155°C to 165°C, there was every possibility of increasing the pulp production by 12.0 tonnes more per day.

Recovery of blow heat from 17 digester steam blows is expected to save 50.18 tonnes steam/day which will be mostly used up for heating the water to 70-75°C. The hot water can be used in B.S.W. III stage or in alkali extraction stage heater mixer in place of live steam.

The total nominal investment for thermal insulation, mobile packer and blow heat recovery system will be Rs. 20-22 lakhs.

As on date, the agro based mill has reaped rich dividend by implementing most of the recommendations. This had resulted in a saving of 40 tonnes per day. In addition, one of the boilers used to be shut for 10-12 hours a day giving indirect benefit to the mill. The blow heat recovered hot water at 60°C is continuously exploited in B.S.W.-III washer showers, resulting in improved washing with a washable alkali loss of 22-24 Kg. Na_2SO_4/B.D tonne of pulp, for a dilution factor of 3.5.

WASHING SYSTEM

The agro based mills mostly have potchers with or without washing drum, followed by two drum washers. Due to poor washing efficiency of washers, the mills consume huge quantities of fresh water in their washers. The carry over of black liquor in washed pulp not only affects the subsequent bleaching stages, but also results in huge foaming and consequent high defoamer consumption.

BENEFITS OF THREE STAGE COUNTER CURRENT WASHING OF PULP

The recent conversion of two stage brown stock washing in a progressing agro based mill into an orthodox 3-stage counter current washing system has refllected in overall improvement in washed pulp.

The observed data on the performance of 3-stage counter current washing system VIS-A-VIS old 2-stage pulp washing system, is presented in **Table-2-A** and **2-B.** Three stage counter current washing system diagrammatically depicted in **Figure 1.**

The improvement in washing of bagasse pulp was clearly evident from the observed lower pH from 11.2 to 9.9-10.0, alkali loss in Kg. Na_2SO_4/ B.D.T. from 40 Kg. to 22-25 Kg. and C.O.D. of the seal pit No. 3 water from 2880 mg/lit to 1340 mg/litre, all the parameters achievable at a reasonable dilution factor of 4.0.

The reduction in C.O.D. almost to half in the washed pulp is reflected in defoamer usage which was considerably high with earlier washing system. The improvement in overall bleaching performance is being monitored by the mills. Hence keeping in view of environmental consideration, the agro mills both medium and small should consider seriously incorporating cleaner technologies in 'Raw material

Table-2A

Three Stage Counter Current Brown Stock Washing

Dilution Factor	Washing Loss, Kg/T Na_2SO_4	COD (Dissolved) Kg/T.pulp
2.0	28	123.90
3.0	18-22.0	73.70
4.0	12.0-15.0	64.30

Table-2B

Three Stage Counter Current Washers Versus Two Stage Brown Stock Washers

Parameter	Three Stage Counter Current Washers at D.F. 4.0	Two Stage Brown Stock Washer at D.F. 4.0
Consistency%	10.5-11.5	10.0-11.0
pH	9.8-10.2	10.8-11.4
Washing Loss, kg Na_2SO_4/BDt	10.0-14.0	36
C.O.D., kg/t. pulp. x	64.3	160.6

3 Stage counter current washing of bagasse pulp in a 65 t.p.d. agro base pulp and paper mill

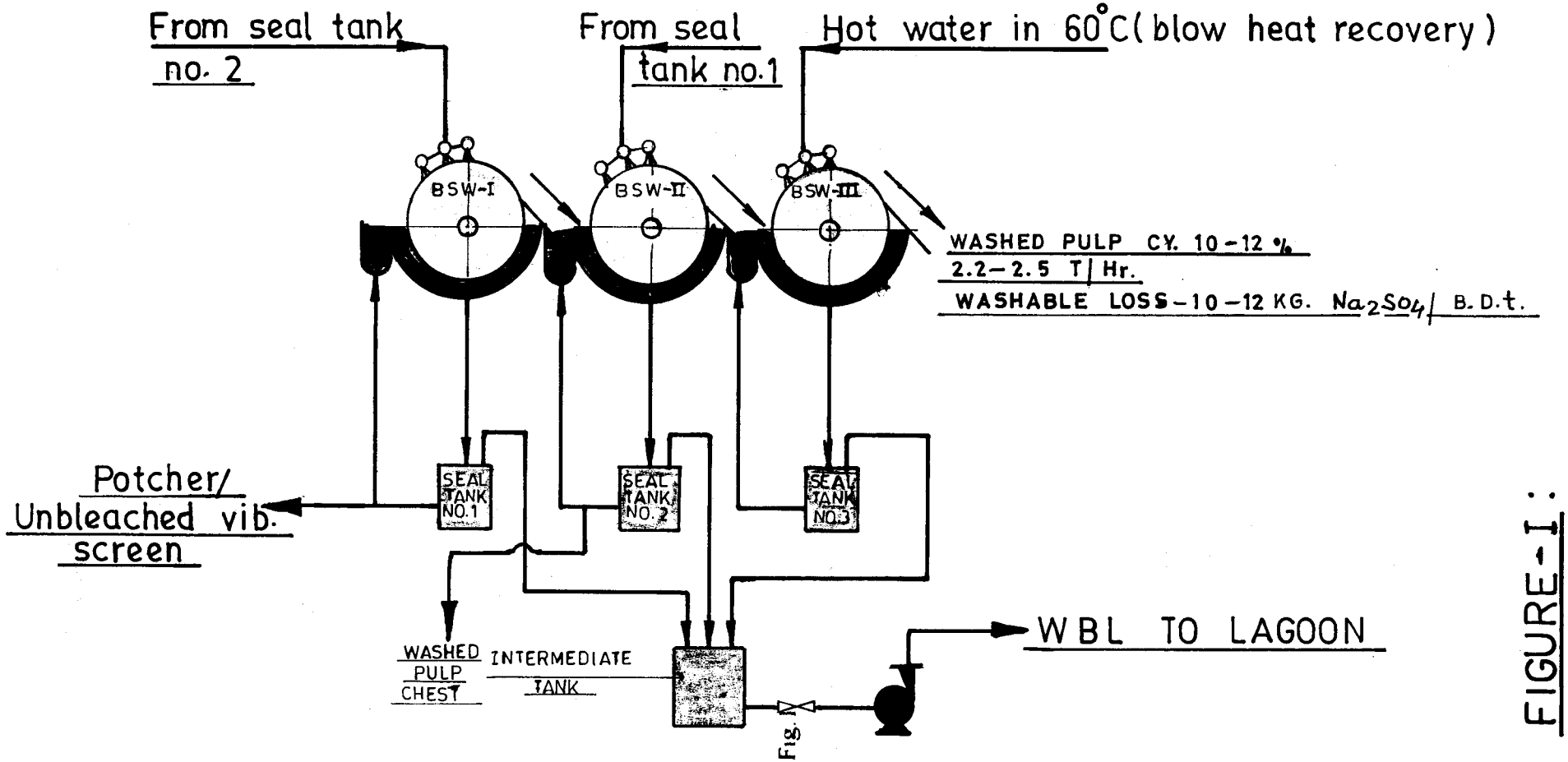

FIGURE-I :

Table-3		
Operational Efficiency With Respect to Primary Input & Their Ranges (5)		
Particulars	**Agro based**	**Waste paper based**
Raw material. T/T pulp Chemicals, Kgs/T pulp	2.9	1.5
Energy		
Steam, T/T pulp	6.0-8.0	2.0-3.0
Power, Kwh/T pulp	1100-1250	600-650
water, M^3/T pulp	150-200	60-70

preparation, Pulping, washing and subsequently in bleaching. Any extra capital investment made today will definitely be beneficial in the longer run.

WATER CONSUMPTION

Typical consumption of basic inputs as present in **Table No.3** (5) clearly indicates that the water consumption in Agro based paper mills is still on the higher side, though there were improvements in this sector. The low consistency operations, excessive dilution with fresh water, limited recycling of back waters in areas where it can necessarily be done, are the main reasons for higher consumption.

The higher consumption of water with open systems affects the production cost as increased water usage relates directly to increase in energy and chemical usage.

The excessive waste water discharges into sewer also overloads the effluent treatment plant. Some of the medium size agro based pulp and paper mills mostly making kraft liners of both M.F. and M.G. grades and writing and printing grades are exceptions where reasonable degree of water recycling is practiced. (6).

Recommended steps for reducing fresh water consumption included:

Installation of krofta. Air floatation save all in the machine and the clarified machine while water to be recycled in centriccleaner rejects pit dilution, dry broke pulper, decker and vacuum washers. The reuse of clear krofta water will save 2200-2300 KL/day of fresh water in a 45-50 tpd agrobased P&B mills.

- Sealing water in vacuum pump and popered cooling water should be recycled.
- All back waters in deckers, bleach plant washers except C-stage.
- The counter current system of 3-stage brown stock washing in place of 2-stage drum washers further adds up to reduction of fresh water usage.
- Rejects from tertiary centricleaners can be further scrcened up in sand trap cum riffler type system for removal of non fibrous solids & accepted water can be recycled.

In this way, small or medium size mills can recycle atleast 60 percent of the useful back waters within the process.

ENERGY STATUS

The thermal and electricity are two forms of energy which needed careful control. In the absence of any co-generation system or captive Diesel power generating sets, the small and most of the medium size agro base paper mills have to draw their electricity requirements from the state power grid. The steam is generated from their own boilers using primary fuel, coal and secondary fuels such as bagasse pith, bagasse and rice husk. The capacity utilisation of the mills mostly vary between50-60%. The lower utilisation may be attributed to

- The old second hand imported paper machines being operated on unconventional raw material resulting in less out put.
- frequent power failures and cuts leading to reduced capacity utilisation which in turn has a cascading effect on both thermal and electricity specific energy consumption.
- Lack of thermal insulations on steam lines, poorly managed traps & leakages, disproportionate fuel-air mix, higher

oxygen (air) % and less CO_2, % in flue gas reducing thermal efficiency of the biolers.

BENEFITS

Reduction in energy consumption due to lesser running of tube wells.

Simply bringing down the water consumption from 220 KL/ton to 150 KL/ton has resulted in a flat saving of 1,00,000 units of power per month.

Reduced volume of drainage prevents overloading of Effluent Treatment Plant.

ENVIRONMENTAL ISSUES

A generalised flow sheet of Agro based pulp and paper mills showing high pollution loads is depicted in **Table-4** (7).

In the absence of a viable chemical recovery system in small and medium size rice straw based mills, huge amount of chemically rich biomass as water products are discharged, aggravating the environment.

The primary reason for such a heavy pollution in agro base mills is traceable to the discharge of spent liquors carrying high proportion of non-biodegradable organic matters. The contribution of bio refractory lignin to the waste water is estimated as 215-225 kg/t of paper. Loss of sodium in the discharge without any provision of recovery is also high. Net caustic drain from 100 medium size and smaller size of 10 tpd pulp mills, is estimated as 0.3 million tons per year, incurring a recurring national loss of Rs. 45 crores.

Table-4

Pollution Loads, kg/T Paper in The Combined Waste Waters From Pulp and Paper Mills

Parameter		Large Paper Mills With Recovery (Avarage)	Small and Medium Paper Mills Without Recovery	
			Agro residue based (Avarage)	Waste paper based (Avarage
1.0	O.S.S.	168	155	150
2.0	B.O.D.	65	176	20
3.0	C.O.D.	246	741	70

Part of The Table-3.4 as recorded in Vol. II of draft report of Executive summary on 'Back ground & Technological trends in India Paper Industry submitted to Development Council for paper, pulp & Allied Industries (JAN. -96)

The statuatory and stringent pollution control laws have made it mandatory to treat and regulate the quality of effluents discharged by agro based mills having a capacity of 50 tpd.

FULL FLEDGED CHEMICAL RECOVERY SYSTEMS FOR THE MEDIUM AND SMALL SIZED AGRO BASED PAPER MILLS

The foremost requirement for the mills having capacity over 50 tpd is to install a technological viable chemical recovery system. Most of the bagasse based paper mills of 50 tpd and above have already opted for viable technological systems available in the country.

However, in the case of smaller mills and some of the medium sized agro based mills, the raw materials mix and wide variation in black liquor properties are some of the limiting factors coming in the way of processing of black liquors. The properties of black liquor hindering the processing can be:

- High silica content and high proportion of suspended solids leading to scale formation in evaporators and lime sludge reburning difficult.
- Poor combustion due to poorly dispersed organic matter in black liquor.
- low dissolved solids.

In addition to the search for a sound technological options for chemical recovery, the incorporation of following equipments at various stages of the recovery plant are:

- Efficient pulp washing system to improve black liquor dissolved solids.
- Filteration of black liquor prior to evaporation.

- Desilication of the liquor to reduce soluable silica to 0.8 g/l.
- Multi effect evaporation and thermal treatment.
- Lime reburning.

For handling straw based black liquors, the chemical recovery options undergoing demonstration and trials:

(1) Copeland Fluidised Bed Reactor

(2) Wet air oxidation.

(3) DARS-Direct ALKALI RECOVERY SYSTEM.

Exclusively for the straw based paper mills small and medium, a task force has been formed by IAPMA and CPCB to find out a lasting solution to the vexed issue within a time frame. CPPRI scientists co-ordinate the activities in compiling data on various mills and the characteristics of black liquors for the suitability.

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