Cost Reduction Measures in Medium and Small Paper and Board Mills

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SUMMARY

This paper outlines the difficult phase through which the Indian Pulp and Paper Industry is passing and emphasizes cost reduction of the inputs as one of the valublea survival strategies that need to be adopted.

The paper also discusses inplant measures adopted at M/s PAPCO MILLS for upgradation of filler grade waste papers and also discusses the R and D efforts at M/s Parkhe Research Institute for use of Bagasse Chemi Mechanical pulp, as a substitute for filler grade waste papers in the manufacture of Duplex Boards.

Bagasse being a renewable source of fibre will be a dcminant fibre source in the near future. Detailed work carried-out at M/s Parkhe Research Institute on this fibre for the production of chemi-mechanical pulp suitable for the nse as filler in duplex boards replacing the waste paper has been discussed. Considering all the aspects concerned with this topic it will not only be a cost reduction factor but also will be an important consideration with the long term perspective in view.

Some of the practicable means of reducing the chemicals costs in the case of medium and small paper and board mills has been discussed. Though the things look simple problems are faced during their implementation and it is the proper training of the operating crew and continuous monitoring where control systems are not available, help in their successful implementation.

INTRODUCTION

The two very vital aspects for the survival and healthy growth of any industry are the "quality consciousness" and "cost consciausness" factors. This is particularly true in the case of paper Industry which uses a diverse spectrum of raw materials and converts them into a wide range of products with different specifications suited for numerous end uses. Hence the two aspects of quality and cost decide the fate of this iudustry.

The paper industry in India is classified in to three distinct categories namely large, medium and small mills. The large mills make their own pulp by using bamboo and hardwoods, the forest based raw materials. The medium mills use agricultural residues, secondary fibres and purchased pulp. The small mills are mostly based on secondary fibres and purchased pulp as their raw materials. This very reason lays emphasis on the fact that the processes used by the medium and small mills are much more simpler than the processes used in large mills. Apart from the built in simplicity these mills usually adhere to certain systems and prosesses which have not seen any changes over the years. This regidity many a times, knowingly or unknowingly, becomes a reason for the poor health of that particular industry.

It is a known fact that the performance of the Indian paper Industry is far from satisfactory for the last couple of years. This has been clearly reflected by the lower capacity utilization and poor financial performance. The survival depends apart from other factors mainly on improved productivity performance.The reasons attributed to poor performance are depleting raw-material resources, inflating input prices, recession in demand, use of outdated machinery and equipments, stringent environmental regulations, conflicting ideals of labour and management and shortage of capital. All these parameters affect the Paper Industry which is highly capital, energy and

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raw-material intensive. This needs a time bound multi dimensional approach with the active participation from the lowest cardre workman to the highest governmental authority.

The advances in science and technology on one hand is helping the paper industry with improved machinery and processes, and on the other hand it also has made other items to invade and replace paper and board from many uses. Noteworthy being the paper and board used in printing and packaging industries which is getting stiff competation from the developments in electronics/computer and polymer products.

With all these challenges and difficulties the Pulp and Paper Industry in India has to march forward successfully with its due conotribution in the national development. This not only needs a survival startegy but also to meet the challenges of future with advancing technologies The immediate task before the industry is to improve the overall performance and gain financially sound health. This in turn needs judicious use of raw-material resources maximum capacity utilization, adoption of cost saving and energy saving measures, quality and in plant controls, renovation and modernization of out-dated machinery and equipments and so an. The approach or strategy will vary from mill to mill. However one thing is certain. Any change or modification which brings quality improvement or cost benefits is welcome every where. It is the need of the hour.

In this paper we have discussed certain R and D efforts which are practicable proposition to medium and small mills in their endeavour in cost reduction.

UP-GRADATION OF WASTE PAPER

Waste paper is finding an increasing use the world over in the pulp and paper iudnstries. This is due to the depleting forest based raw materials on the one hand and on the other with the numerous advantages associated with its use. It is major raw-material in medium and small paper and board mills in India. There are many varities of waste paper suited for the production of different types of paper or board.

In the classification of waste paper the source and the impurities associated with them play an important role apart from other parameters. Thus a particular type of waste paper because of its fibre nature and impurities finds a defined end use.

LETTER RECORDS

Is a type of waste paper which is generally used as a filler in the manufacture of duplex boards. It contains many impurities which need to be taken care of in elborate caleaning systems. After this it is used as a filler in duplex boards. The impurities that still persist with the letter records such as oil spots, tar, ink, plastics stickies etc after processing mechanically in the pulping and cleaning units, make it unsuitable for use in the bottom liners of good duplex boards. Here the pulp produced from superior grade waste papers is used.

AIM AND SCOPE OF THE PROJECT

A project was initiated at the M/s Parkhe Research Institute to develop a pulping condition to upgrade the pulp produced from the letter records so as to be suitable to use it as a bottom liner pulp (Ref. 1). It was also felt necessary that the method developped should be easily adopted in any medium or small board mill.

EXPERIMENTAL PROCEDURE

A solvo pulper of $2M^3$ volume was used in the experiments About I M^3 of water was taken into the pulper and heated with steam to the required temperature. Chemicals and waste paper were added to the pulper and the pulper rotor was switched on. Samples were withdrawn at different intervals of time and were analysed for flake content, freeness, strength properties etc.

A number of experiments were performed over a period of time to overcome the variation and confirm the results Some of the results have been tabulated in Tables 1, 2, 3, and 4.

Various experiments were conducted using readily available and non-toxic chemicals for removal/dispersion of impurities in waste paper. A combination of Caustic soda and Sodium Silicate has been found very effective in these trials. Typical data are shown in Tables (7) I to IV.

REMARKS AND CONCLUSIONS

1) Slushing of waste paper with sodium hydroxide and sodium silicate produces a pulp with lower content of flakes and fairly well dispersed ink. Pulp separated from contraries and flakes requires little or no refining. An efficient method of contraries and flakes separation is very important.

2) Energy savings are possible. Time required at the pulper is only 15—20 minutes as compared to the normal time of 40—45 minutes in the case of slushing without chemicals. The stock requires

TABLE I : PULPING OF LETTER RECORDS (WASTE PAPERS)

1)	Pulping consistency, %	—	3.4				
2)	Pulping temperature, °C	—	50				
3)	Caustic soda added, %	—	2				
4)	Sodium silicate added (1.5 g/cc), %		1				
5)	Pulping time, min	5	10	15	25	35	45
6)	Flake content, (+14 mesh), %	13.4	10.0	6.4	6.0	4.4	4.0
7)	Pulp freeness, ml CSF (unscreened at pH 7)	370	330	225	210	205	160
8)	Handsheet characteristics						
8.1)	Breaking length, km	1.59	1.76	1.86	1.90	1.81	2.14
8.2)	Burst factor	4.9	7.3	8.7	9.9	9.8	10.6
8.3)	Tear factor	52.9	58.7	60.9	65.0	62.6	67.2
8.4)	Bulk, Cm³/g	2.80	2.70	2.80	2.70	2.70	2.60

TABLE II : PULPING OF LETTER RECORD WASTE PAPERS

1)	Pulping consistency, %	—	4.3				
2)	Pulping temperature, °C	—	50				
3)	Caustic soda added %	—	1				
4)	Sodium sillcate added, (1.5 g/cc),%	—	2				
5)	Pulping time. min	5	10	15	25	35	45
6)	Flake content, % (+14 mesh)	12	8	5.8	4.2	4.0	3.8
7)	Pulp freeness, ml CSF (unscreened at pH 7)	310	240	220	190	165	155
8)	Handsheet characteristics						
8.1)	Breaking length, km	1.60	1.71	1.73	2.02	2.06	2.18
8.2)	Burst factor	5.80	6.50	7.20	8.50	9.80	9.40
8.3)	Tear factor	41.2	46.8	43.7	53.0	55.0	54 6
8.4)	Bulk, Cm³/g	2.80	2.80	2.70	2.50	2.50	2.50

TABLE III : PULPING OF LETTER RCORD WASTE PAPERS

1)	Pulping consistency, %	—	3.9				
2)	Pulping temperature, °C	—	50				
3)	Caustic soda added,%	—	2				
4)	Sodium silicate, (1.5 g/cc), %	—	2				
5)	Pulping time, min	5	10	15	25	35	45
6)	Flake content, % (+ 14 mesh)	23.4	18.3	16.4	16 3	16.2	15.8
7)	Pulp freeness, ml CSF (unscreened at pH 7)	350	295	285	245	220	225
8)	Handsheet characteristics						
8.1)	Breaking length, km	1.81	1.94	2.10	1.91	1.97	2.30
8.2)	Burst factor	7 80	10 30	10.90	10.70	10.50	12 50
8.3)	Tear factor	66.0	78 0	83 6	93.4	98.0	95.0
8.4)	Bulk, Cm³/g	2 90	2.80	2.60	2.70	2.70	2.60

TABLE IV : PULPING OF LETTER RECORD WASTE PAPERS

1)	Pulping consistency, %		—	4.4			
2)	Pulping temperature. °C		—	27			
3)	Caustic soda added, %		—	NIL			
4)	Sodium silicate added, %		—	NIL			
5)	Pulping time, min	5	10	15	25	35	45
6)	Flake content, % (+ 14 mesh)	60.3	48.7	37.5	14.5	9.2	9.0
7)	Pulp freeness, ml CSF (unscreened at pH 7)	455	425	345	320	275	260
8)	Pulp freeness, ml CSF (screened at pH 7)	—	350	350	300	250	250
9)	Hand sheet characteristics						
9.1)	Breaking length, km	—	1.92	2 06	2.08	2.11	2.30
9.2)	Burst factor	—	10.3	13.4	12 0	11.7	12.8
9.3)	Tear factor	—	46.0	61 0	62 2	55.0	50.0
9.4)	Bulk, Cm³/g	—	2.40	2.30	2.30	2.50	2.40

little or no deflaking and perhaps only brushing in the refiners.

3) Slushing of waste paper with chemicals permits operation of pulper at higher consistencies since the chemicals make the mass more fluid. Also, operation at higher consistency decreases the steam consumption.

4) Combined influence of chemicals and steam will be to double the out put of the pulper. Alternatively, at the same out put rate, down stream equipments like deflaker and two pass refining systems may be replaced with single pass brushing refining.

5) Oil spots appearing in the duplex boards because of the use of letter records as filler, can be totally avoided. Oil and grease in the waste paper will either react with the chemicals or it will be finally dispersed throughout the pulp.

6) Wax can also be dispersed with satisfactory results by using 0 5% Kerosine at 60–70°C in the presence of sodium hydroxide and sodium silicate. Actual operating conditions will depend on the nature of the wax present in the waste paper.

7) Use of this chemical treatment up grades the pulp and it can be conveniently used as a bottom liner stock replacing the pulp from superior grades of waste paper. This helps in getting cost benefits. Also, its use as filler improves the board characteristics.

USE OF WHOLE BAGASSE CHEMI-MECHANICAL PULP AS FILLER, IN DUPLEX BOARDS

Bagasse is a renewable and very versatile fibre source. More than 40 million tonnes of bagasre is produced in India, every year. This is more than sufficient to meet the raw material demand of the country. However very little portion of this is used by the paper industry. With the shortage of bamboo and wood and awareness to conserve the forest resources improvements and adoption of suitable technologies to use agricultural residues, more and more quantity of bagasse will find its way in the pulp and paper industry. Hence it will be a major raw material for the Indian Pulp and Paper Industry in the very near future. An extensive study was conducted at the M/s Parkhe Research Institute, Khopoli to produce chemi-mechanical pulp from bagasse suitable for the use of filler grade pulp in the manufacture of duplex boards (Ref. 2)

AIM AND SCOPE OF THE PROJECT

The objectives of this study were :

1) To develop a suitable method/technology to get filler grade pulp from bagasse. This should be easily adoptable in the existing board mills with minor modifications and/or additions.

2) Techno-economic evaluation of this pulp in comparison with filler grade waste paper pulp.

3) Estimation of the pollution load and its probable impact on the existing treatment facilities.

EXPERIMENTAL PART

A detailed study regarding the variation of different pulping parameters, refining, fibre classification, bleaching, strength characteristics, blending etc. was carried-out, conditions suitable for getting a chemi-mechanical pulp equivalent to that of filler grade waste paper pulp were worked.out. A comparative study of the duplex board made using this chemi-mechanical pulp as filler and waste paper pulp as filler was done. The conditions obtained to get a get a good quality chemi-mechanical pulp have been tabulated in Table V. The comparative strength characteristics of the bagasse chemi-mechanical pulp and filler grade waste paper pulp has been given in Table VI. The duplex board properties with the waste paper pulp and bagasse chemi-mechanical pulp as filler has been tabulated in Table VII.

TABLE V : WHOLE BAGASSE CHEMI-MECHANICAL PULPING CONDITIONS AND RESULTS

1)	NaOH requirement, %	—	7
2)	Bath ratio	—	1 : 4
3)	Soaking temp. °C	—	90
4)	Soaking time, hrs.	—	3
	RESULTS		
1)	Unscreened pulp yield, %	—	67.0
2)	Screened pulp yield, %	—	57.0
3)	Rejects, %	—	10 0
4)	pH of spent liquor	—	10.4
5)	Alkali consumption,	—	92.0

TABLE VI : COMPARISON BETWEEN STRENGTH CHARACTERISTICS OF WHOLE BAGASSE CHEMI-MECHANICAL PULP VS. FILLER GRADE WASTE PAPER PULP

S. No.	Particulars	Whole bagasse CMP	Filler grade waste paper pulp.
1.	Pulp freeness, ml CSF	205	235
2.	Bulk, Cm^3/g	1.85	2.26
3.	Breaking length, km	3.90	2.30
4.	Burst factor	14.7	9.1
5.	Tear factor	40.0	54.4
6.	Double folds	12	8
7.	Brightness. °PV	34	55

TABLE VII : COMPARISON BETWEEN PHYSICAL STRENGTH CHARACTERITICS OF DUPLEX BOARDS

Sr. No.	Particulars	Duplex Boards 1	Duplex Boards 2
		Imported hard-wood pulp, 30% of board as top liner and waste paper pulp 70% of board as filler	Imported hard-wood pulp 30% of board as top liner and whole bagasse chemi-mechanical pulp 70% of board as filler
1.	Bord GSM	284	298
2.	Bulk, Cm^3/g	1.42	1.64
3.	Breaking length, km	2.40	4.80
4.	Burst factor	18.6	23.5
5.	Tear factor	65.2	66.7
6.	Double folds	9	5
7.	Brightness, °PV	75	75

RESULTS AND CONCLUSIONS

1) A high yield chemi-mechanical pulp from whole bagasse can be produced wiih 7% chemicals as NaOH, with a bath ratio of 1 : 4 for a cooking period of 3 hrs. at 90°C.

2) The strength characteristic of the bagasse chemi-mechanical pulps were superior to those of filler grade pulp obtained from letter records waste paper excepting the folding property.

3) The duplex boards produced using the whole bagasse chemi-mechanical pulp as filler were superior to those produced using letter record pulp as filler. Also the uniform quality of the bagasse chemi-mechanical pulp will ensure uniform board quality and easy standnrdisation of the processing parameters. The process difficulties usually associated with the contraries in the waste papers will be eliminated.

4) Though the costing of the bagasse pulp (Ref. 3) is slightly higher than that of waste paper, it depends on many factors.

5) With a view on long term planning and the availability potential of bagasse in the future years on one hand and the uncertainty associated with the availability, steady quality and the increasing number quantity and complexity of the contamination in the waste paper on the other band. it is quite safe and certain that the bagasse chemi-mechanical pulp as a filler in duplex boards is a cost saving proposition. If the board mill is in the vicinity of the sugar mills, then it is one of the best propositions.

6) The uniformity in quality of the bagasse chemi-mechanical Pulp mill help in the reduction of the costlier top liner pulp.

7) The pullution load in terms of BODexisted by a board mill using purchased chemical pulp for the topliner and waste paper pulp for the filler is in the range of 10—15 kgs/ton of the board produced. The BOD load with the use of purchased chemical pulp and produced bagasse chemi-mechanical pulp will be in the range of 100—105 kgs/ton of the board produced. Hence without an elaborate treatement system this is not a safe proposition.

OPTIMISATION OF WET-END CHEMICALS USAGE

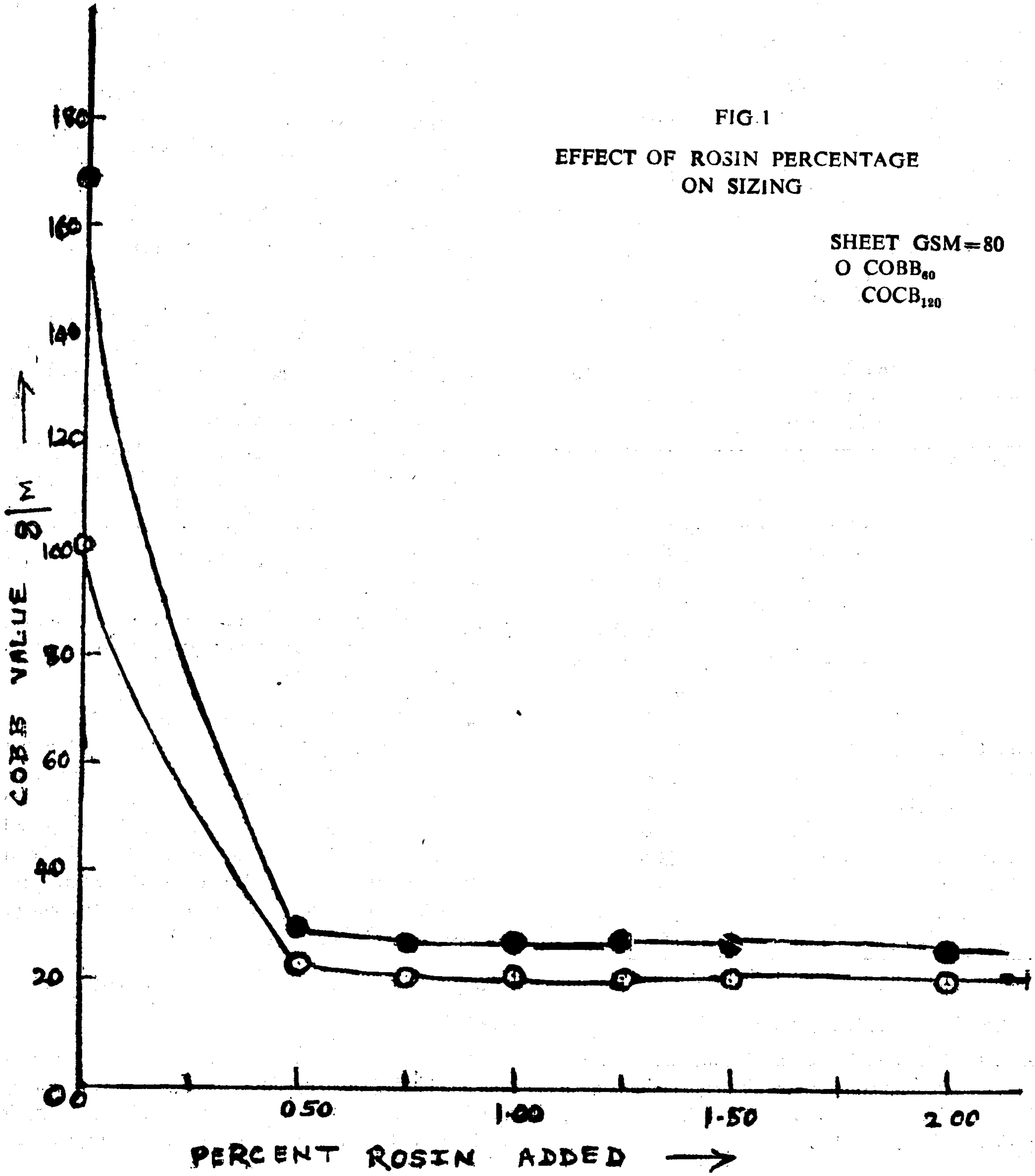
A number of chemicals are in use at the wet-end such as sizing chemicals, drainage aids, retention aids, chemicals to improve the wet strength and dry strength slimicides and so on. But the chemicals that are generally used by all the industries big or small are sizing chemicals mainly rosin and alum. A project was initiated at the M/s. Parkhe Research Institute, Khopoli to workout the optimum quantities required in the case of duplex board mill and impliment the same (Ref 4).

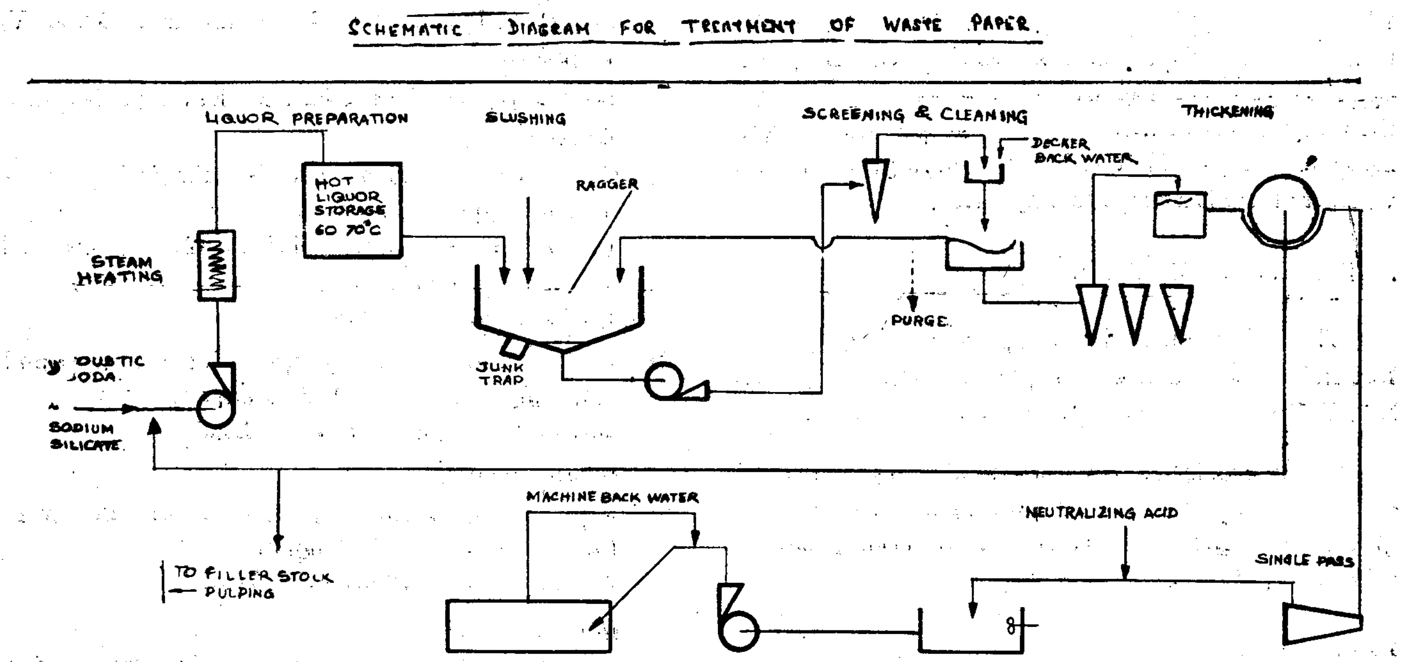
REDUCTION IN ROSIN CONSUMPTION

A detailed experimental study was conducted to findout the optimum dose of rosin required to get the desired Cobb values in the case of duplex boards. While doing these studies the different plant working parameters that have the direct influence on sizing were also considered. A set of results that show the effect of various additions of rosin size on cobb values have been given in fig. 1. These results were successfully implimented in a duplex board mill with the following benefits.

FIG 1

EFFECT OF ROSIN PERCENTAGE ON SIZING





LIOUR REUTILIZATION BOARD MACHINE STOCK CHEST BRUSH REFINIT

1) The rduction in rosin consumption was brought down from 2–2.5% to 1 to 1.2% with considerable savings in money.
2) The sizing as suggested by cobb values were unchanged.
3) The pollution load was reduced because of the reduction in sizing chemicals.
4) The brightness stability of the board improved.

REDUCTION IN ALUM CONSUMPTION

Here again a systematic study was conducted and the results were found to be practicable by successfully adopting it in a duplex board mill (Ref. 5).

The following parameters are important in its adoption and success :

1) Addition of sulfuric acid to the content of 8–10% on alum.
2) Use of dilute solution gives better results.
3) Better mixing ensures better sizing results.
4) It is essential to educate the operating personnel.
5) Where instrumental controls are not available, it is necessary to monitor the consumption pattern regularly

The following benefits were derived :

1) Considerable savings in money because of the reduction of alum consumption.
2) Acid added alum solution (ferric alum) becomes clear and this in turn gives 2-3 points higher brightness than the use of ferric alum solution.
3) Sizing results are obtained even at a higher pH range i.e. 5 to 6.

USE OF A CHEAPER WET END ADDITIVE

A number of wet end additives for better bounding and drystrength improvements of paper and boards were evaluated (Ref. 6) and (Ref. 7). Basing on these results and the plant trials that were conducted the following conclusions can be drawn :

1) A good grade of tamarind kernel powder is as effective as many wet-end additiues used for the drystrength improvement.
2) It is cheaper than most of all these additives and and hence its use is a cost saving factor.

The following precautions need to be taken in its use.

1) It has to be dispersed in cold water first and then to be heated to around 70°C.
2) It should not contain impurities. If it contain any visible impurities, the solution has to be filtered.
3) Its use should be restricted to 0.3 to 0.5% on pulp.

All the foregoing examples are very easy to adopt in medium and small paper and board mills. The mills which are not having even fairly good instrumental controls, still can adopt ,them successfully educating the operating personnel and with close monitoring. Though the things discussed here are quite simple, their implimentation, results in considerable savings in money wherever there is a scope to impliment.

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