Utilization of E1 - Stage Back Water and Combined Effluent an Approach Towards Closed System

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ABSTRACT

Pulp and Paper manufacture processes require a huge quantity of water ranging from 200-300 m^3 per ton of paper produced. In this area, attempts have been made to reduce water consumption by recycling few wastewaters like E1- stage back water as well as total combined effluents in the processes itself which simultaneously will reduce the total pollution load in the Effluent Treatment Plant. A portion of E1 - stage back water at the rate of 20 m^3/hr was used in dilution of Lime mud slurry in Slurry tank. The laboratory scale study showed very promising results with no adverse effect, except a little colour value of 240-260 PCU in filtrate. Approximately, 480 m^3 of hot water can be saved by replacing the same by E1- stage back water per day. The after effect on combined effluent showed a colour reduction of 3-6%, COD reduction 2-2.5%, and BOD 2.2-3.3%. A set of another Laboratory scale study on the use of total paper mill combined effluent in Ash handling plant saved approximately 1500 m^3 of water per day. Also the adsorption process that played a key role in reduction of pollutants from this combined effluent is also encouraging, with colour reduction 9.5-15.8%, COD 8.6-22.3% and BOD 17.1-21.3%.

INTRODUCTION

An integrated Pulp and Paper Mill generally uses 200-300 m^3 of water per ton of paper produced and almost the entire amount of water used comes out as wastewater. This waste water is normally deep brown in colour due to the presence of lignin and its derivatives that form the substantial part of the non-cellulosic materials of bamboo or similar raw materials used in manufacture of pulp (1, 2). During the various unit processes in the mill, the lignin in the effluent get structurally modified and fragmented and together they impart a high COD load (3, 4). Since Pulp and Paper Industry is one of the major polluting industries in the world, attempts are made from all concerns all over the world to reduce the total discharge by modification, adopting new technologies or by recyling.

The bleaching operation produces more colour load then pulping and the dominant colour stream in the bleach plant is the caustic extraction stage. For a representative bleached kraft mill, 136 kg of colour per ton might be generated. The pulping unit would contribute 30 kg/ton and the bleach plant 90 kg/ton of

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which caustic extraction stage would contribute 66kg/ton (5).

An UNEP report (6) reveals that canadian pulp and paper industry lunches land mark 88 million dollars research drive to develope system closure technologies. it is going for 5 years research programme to develop next generation paper mill technologies that shift the environmental focus from pollution treatment to prevention, the programme, a joint undertaking by industries, Govt. and Industry suppliers will be cararied out by the Pulp and Paper Research Institute of Canada on system closure, if it is successful, it will be applied by all Canadian paper mills and later may be commercialised and exported. The ultimate goal of the programme to operate any mill virtually "effluent free".

In this work, attempts have been made to locate the utility of waste waters in the process itself, so as to make use of it by recycling to reduce the pollution load as well as to reduce the cost of production.

EXPERIMENTAL

The effluent under study is taken from **M/s Nagaon Paper mill, Kagajnagar** with a view on closed cycle concept. The aim of the present investigation is to reduce effluent load in effluent treatment plant as well as to minimise the water consumption.

a) Use of E1- stage back water in Lime mud sluury tank

E1- stage back water was mixed with final Lime mud in Lime Mud Slurry tank instead of existing hot water addition system. The dark coloured back water is mixed with the Slurry in the ratio 1:5 and allowed to settle and filtered. The filtrate is then tested for colour, COD and total titrable alkali.

Its effect on the quality of combined bleach plant effluent is also studied by mixing the effluents from different stages proportionately in the Lab itself before and after diversion of $20m^3$/hr E1- stage back water to slurruy tank. The sequence CE HHD generates approximately $1000m^3$ of effluent per hour out of which E1- stage generates approximately $150m^3$ alone.

b) Use of untreated effluent in Ash handling plant

A laboratory scale study was conducted to see the impact of coal ash on effluent quality to find its suitability to replace the water by combined effluents in Ash handling plant. The coal ash and combined paper Mill effluent was mixed and allowed for a contact time of 15 min in the ratio 1:10 respectively since in the existing system 100 g of ash is available for 1 lit. of effluent. The conditions are maintained similar to that of plant. After the stipulated contact time, the slurry is filtered and determined for pH, colour, COD & BOD.

RESULTS AND DISCUSSION

a) Use of E-1- stage back water in Lime Mud Slurry tank

The effect of lime mud in E1-stage back water quality is shown in Table-1. The back water which is very dark in colour due to the presence of Lignin containts about 0.8-1.0 gpl alkali as Na_2O with 45-50°C temperature. This back water is one of the major sources and responsible for coloured pulp and paper mill effluent. Because of its high organic content, the COD value is also high ranging from 1500-1600 mg/l as observed. Since the total contribution of E1 stage backwater is approximately $150m^3$ per hour, the over all load in combined effluent is also tremendous. The characteristics of lime mud slurry before and after addition of back water reveals that the colour of the back water is reduced to 250 PCU from 33000 PCU

TABLE-1

EFFECT OF LIME MUD ON E1-STAGE BACK WATER

No. of obs.	Back water as such				Lime mud slurry as such				Back water & lime mud in the ratio 1:5, 1 hr. settling time.			
	pH	Colour PCU	COD mg/l	Na_2O gpl	pH	Colour PCU	COD mg/l	Na_2O gpl	pH	Colour PCU	COD mg/l	Na_2O gpl
1.	11.0	30,000	1600	0.92	12.6	30	22	5.2	12.6	240	40	4.2
2.	11.2	33,000	1400	0.88	12.5	22	16	4.5	12.7	260	44	4.0
3.	11.6	34,200	1520	1.00	12.5	20	20	3.8	12.6	265	40	3.0

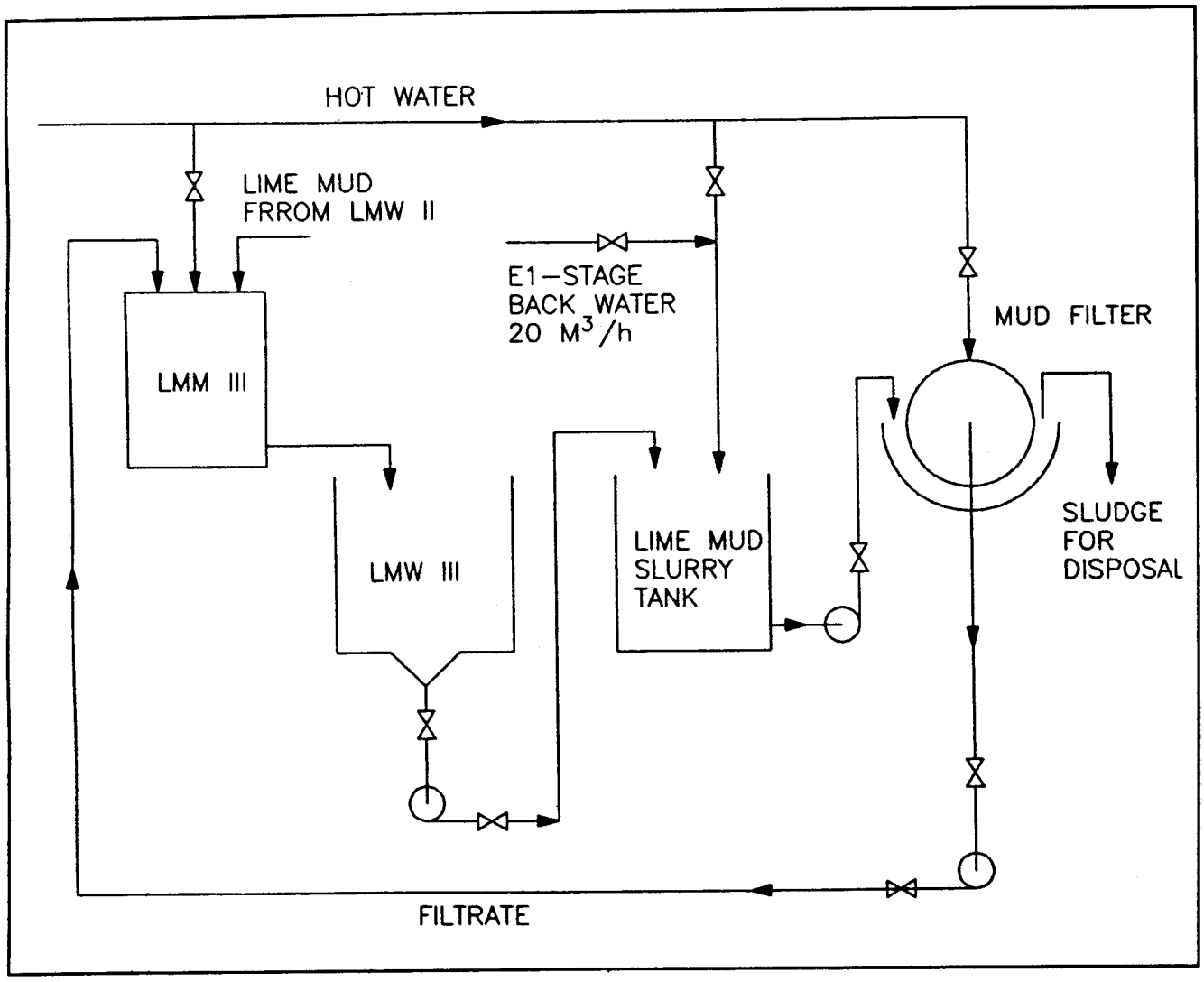

FIG. 1 SCHEMATIC FLOW SHEET OF BACK WATER ADDITION IN LIME MUD SLURRY TANK.

because of coagulation and dilution. Though the liquor is left with a little colour, its effect on the process parameters should be negligible compared to heat and alkali recovery from back water. Laboratory scale study was conducted only in lime mud slurry tank, where approximately 20m³ per hour hot water is added normaly. This replacement of hot water by back water, amounts to approximaterly 480m³ per day. After successful implementation of the scheme. The addition of back water to other areas in Causticizing plant may also be extended after proper investigation on the matter, since the lime mud play a major role in coagulating the highly coloured lignin derivatives in back water. The schematic flow sheet is in Fig.1

A study on E1 - stage back water treatment by Stora lime method reported that 15% of colour, 5% of COD and 5% organic chlorine could be reduced (7).

a) Effect of diversion of E1-stage back water on combined bleach plant effluent

The impact on combined bleach plant effluent after diversion of 20m³/hr back water to lime mud slurry tank is shown in Table 2. The data revealed that, the percentage reduction of colour was in between 3.8-6.0 after proportionate exclution of E1-stage back water from combined effluent. Simillarly COD reduction varied from 1.8-2.5% percent and BOD from 2.2-3.3% percent.. Though the reduction of pollutants are very minimum because of minimum quantity diversion, the trend is very encouraging.

TABLE-2

IMPACT ON BLEACH PLANT COMBINED EFFLUENT QUALITY AFTER DIVERSION OF E1-STAGE BACK WATER

No. of obs.	Bleach plant combined effluent as such				Bleach plant combined effluent as such after diversion of 20m³/h b/w to Lime mud slurry tank				% Reduction		
	pH	Colour PCU	COD mg/l	BOD mg/l	pH	Colour PCU	COD mg/l	BOD mg/l	Colour	COD	BOD
1.	8.2	9000	800	150	8.0	8510	780	145	5.4	2.5	3.3
2.	7.8	8400	810	135	7.7	8080	790	132	3.8	2.4	2.2
3.	8.5	9800	840	180	8.3	9210	825	175	6.0	1.8	2.7

b) Use of untreated effluent in Ash Handling plant

The impact of coal ash on effluent quality before and after addition of ash is shown in Table-3. The schematic flow sheet is in Figure 2. It has been observed that, after mixing the coal ash with the untreated effluent for a contact time of 15 min., the colour of the effluent decreased in the range from 9.5-15.8%, simultaneously, the COD and BOD values are also reduced to the extent of 22.3% and 21.3% respectively. The reduction in pH value is due to the presence of sulfur in coal.

The coal ash normally contain 5-10% unburnt carbon that plays an important role in the reduction of pollutants by the process of adsorption. Adsorption of colour and other pollutants on carbon based adsorbents were studied by many and found satisfactory results (8, 9). Bamboo dust carbon that derived from Bamboo dust were used to remove colour, COD & BOD from paper mill waste waters (10) and it was revealed that, the colour reduction was high as 90% under specific conditions.

In the present study. It is estimated that approximately 1500m³ of water per day can be saved by utilising effluent in the Ash handling plant, that amount to Rs. 6 lakhs per annum approximately.

CONCLUSION

It is revealed from the laboratory scale study that E1-Stage back water which is one of the major contributors of colour, COD, BOD etc. to the combined effluent of Pulp & Paper Mill can be used as dilution hot water in place of fresh hot water in lime mud slurry tank. The slight colour which is left after the treatment not likely to affect the causticizing system or pulping process. The addition of E1-stage backwater or slurry available may be varied from time to time becuase of flactuations in plant conditions. The mixing of backwater and slurry was not proportionate and addition of slurry was kept slightly on higher side to have

TABLE-3

EFFECT OF COAL ASH ON UNTREATED EFFLUENT QUALITY

No. of obs.	Untreated Effluent as such				Untreated effluent after mixing with coal ash, 100g/l, contact time 15 min.				% Reduction			Unburnt Carbon in ash (%)
	pH	Colour PCU	COD mg/l	BOD mg/l	pH	Colour PCU	COD mg/l	BOD mg/l	Colour	COD	BOD	
1.	8.5	8400	760	120	6.1	7600	590	98	9.5	22.3	18.3	8.6
2.	9.0	8800	810	140	6.5	7880	740	116	10.4	8.6	17.1	6.2
3.	8.6	7600	780	150	6.0	6400	700	118	15.8	10.2	21.3	5.8

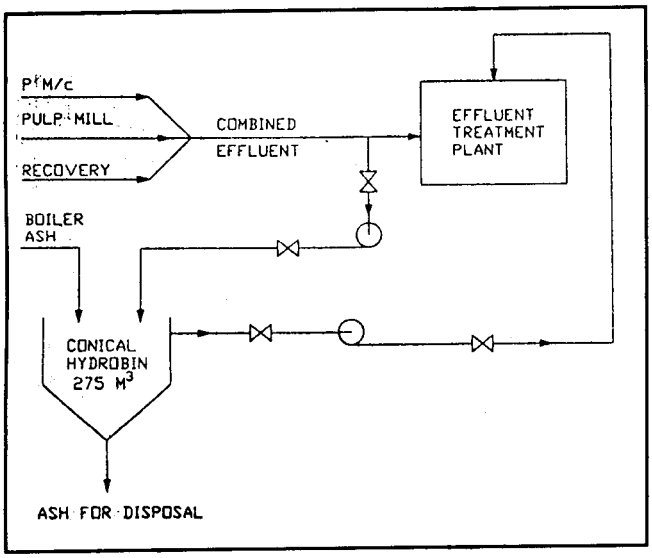

FIG. 2 SCHEMATIC FLOW SHEET OF USE OF EFFLUENT IN ASH HANDLING PLANT

However, a through investigation may be needed to expand its use to the other areas of the plant to save water as well as to reduce pollution load. The use of untreated effluent in Ash handling plant may be a good practice after considering all engineering aspects. This practice may reduce the water consumption as well as the pollution load too. Pollution cannot be eliminated, it can only be reduced alongwith the reduction of cost of production, if one's waste become the other's rawmaterial. Closed - cycle concept which is a major task before the paper plant technocrats to-day, needs many more invetigations in the field to make proper utilization of these wastes.

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REFERECNES

1. Krik TK, Biotech Bioengg. Symp, 5, 139 (1975).
2. Couillard D, Water Res., 28, 1261 (1994).
3. Naik BN, Polln. Management in Industries, Env. Publication, Karad (1989).
4. Parekh R.C., Industrial Safety and Polln. Control Handbook, 387 (1991).
5. Springer M. Alln; Ind. Env. Control- Pulp and Paper Ind., 181 (1986).
6. NEIM News, Nov. 5 (1998).
7. UNEP report; 187 (1992).
8. Bokaade S.S., Thergaonkar V.P. and Deshkar A.M., Indian J. Env. Health, 32 (4), 385 (1990).
9. Murthy B S A, Sihorwala T A, Tilwankar H.V. and Khillender D J, Indian J. Env. Protc. Vol- II (5), 360 (1991).
10. Bhattachaaryya K.G. and Sarma Nikhileswar, Indian J. Chem. Tech., Vol.-IV, 237 (1997).