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Effluent Treatment at Gwalior Rayons Pulp Division

Introduction

Gwalior Rayons, Pulp Division is located at Mavoor, Calicut. The mill produces rayon grade pulp using bamboo and other hardwoods as raw materials, adopting Prehydrolysis Sulphate Process of manufacturing. Daily production of the pulp is about 190 tonnes and mill uses about 12 MGD water for the process.

The receiving stream for the mill wastes is the Chaliyer river. Flow characteristics of the river fluctuates throughout the year and flow during summer months is as low as 48 Cu.sec. It is the company policiy to take all economically feasible steps to control the discharge of waste water to stream of an absolute minimum with particular emphasis of the low flow conditions.

Background

The chemicals used for pulping are relatively non-toxic. True our prehydrolysate waste and brown wash (to some extent) are great consumers of oxygen, but with sufficient aeration they are quickly rendered harmless. It is convincing to believe that waste arising out of our industry have far less effect on our ecology than those arising out of other chemical industries. However the disposal of mill effluent (untreated) could result in changes in the river environment which would exceed the tolerance limit. This does not necessarily mean that there cannot be any pulp mill waste disposed in the river. It does mean that mill will have to excercise every possible inplant procedure for the reduction of river water load and provide treatment facilities for removal of suspended solids, adjustment of pH, reduction of bio-chemical oxygen demand, possible adjustment of effluent temperature and finally disperse the effluent into the receiving river or utilise it for irrigation purpose.

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Approach to the Problem

Whatever form of waste treatments adopted, the first step for industrial pollution abatement should be to reduce waste as far as possible by inplant changes. Treatment should be the last resort and management should follow a golden rule of "keep it out" instead of "take it out". Based on this, our water pollution abatement programme has been devided in the following three phases :

Phase I Measurement of the state of pollution of receiving waters.

Phase II Study sources of pollution in the process and eliminate or reduce as far as possible. And finally.

Phase III Treatment of which cannot be eliminated.

Phase I and II are slow processes and usually take at-least few years before phase III can be started. There must be a rich store of data available on both what is necessary to restore the river and on the sources and extent of wastes in the process. This will make the most economical solution to the treatment problems. It must be remembered that solutions used at one mill, or in one country are not necessarily applicable to another location. Based on this, company immediately after the start up of pulp production took over treatment programme in three phases.

Phase I

Immediately after stabilization of the process a thorough investigation of the waste water from various departments was undertaken. As a result, enough data has been collected to characterise and measure the state of pollution due to individual drains. Table I presents the characteristics of the individual drains and from these analytical results it was realised that prehydrolysate and pH wash of the process contribute to B O D load of the river. In fact 80% of the load is only due to prehydrolysate even though it contributes 1.5% of the total flow.

Phase II

Thus our study of individual drains clearly showed that if the prehydrolysate is segregated, the BOD

TABLE–I

Mill Effluent

Drain No.	Particulars	ANALYSIS (PPM) TS	TSS	TDS	BOD	COD	%Organic on TS (Combustibles)	Total flow M^3/day
1	Brown Wash	2,000	100	1,900	300	1,150	65	12,000
2	Digester Wash (pH Wash)	10,000	100	9,900	8,000	11,000	90	1,000
3	Acid Bleach	600	120	480	65	400	65	11,500
4	Alkali Bleach	1,800	80	1,720	85	300	33	10,500
5	White Water	900	350	550	50	425	70	2,000
6	Evaporator	600	50	550	100	300	55	4,000
7	Causticizing	—	—	—	—	—	—	—
8	Prehydrolysate	50,000	1,000	49,000	40,000	50,000	90	800
9	Paper Plant	Same as White Water						
10	Combined Effluent	3,000	200	2,800	1,000	1,600	75	45,000

load carried by the combined effluent will considerably reduce. This in fact was the basis of our treatment as segregation of treatment of such small volume was economically feasible. There were two possiblities of treating this high B O D effluent.

(a) Use this prehydrolysate internally in the process either by changing process so as to avoid prehydrolysate or by burning it along with black liquor.

(b) To separate prehydrolysate from other effluents and treat it separately by a suitable biological process to reduce B O D. The treated prehydrolysate may then join the rest of the combined effluent before it being drained to the river or to agricultural land.

Possibility of using prehydrolysate internally in the process was investigated and plant scale trials were carried out by changing the process, so as to avoid drainage of liquor and indirectly getting this organic solid into black liquor. Unfortunately all these trials carried out gave rise to other difficulties in the process and resulted in poor quality of the final production.

Thus only alternative left behind was to segregate prehydrolysate from other drains, treat it separately and then join the treated prehydrolysate with other combined effluent after removing suspended solid through clariflocculator. For treating prehydrolysate any of known biological treatment process could be sucessfully applied. At this stage effluent data was submitted to the Scientists of Central Public Health Engineering Reserach Institute (CPHERI) and as per their recommendations it was decided to use an open anaerobic lagoon for the treatment of prehydrolysate.

Phase III

Conventional activated sludge process for treating prehydrolysate was tried in the laboratory and found to give good reduction but the cost involved in treatment was enormous and as such second possibility of digesting the prehydrolysate by an anaerobic process was studied.

Experiments on anaerobic digestion showed that minimum retention of 30 days is essential and any attempt to reduce this below 30 days results in failure. Thus here again cost of investment for such digestion worked out to be uneconomical.

Finally, it was decided that for our climate it will be most suitable to treat this sugar rich effluent by an open anaerobic lagoon. These observations were also confirmed by scientists from CPHERI and with their advice a plant was designed as shown in Fig. 1, and the work started in the year 1968. At present three anaerobic lagoons with total capacity of 45,000 m³ are functioning in parallel/series. Prehydrolysate

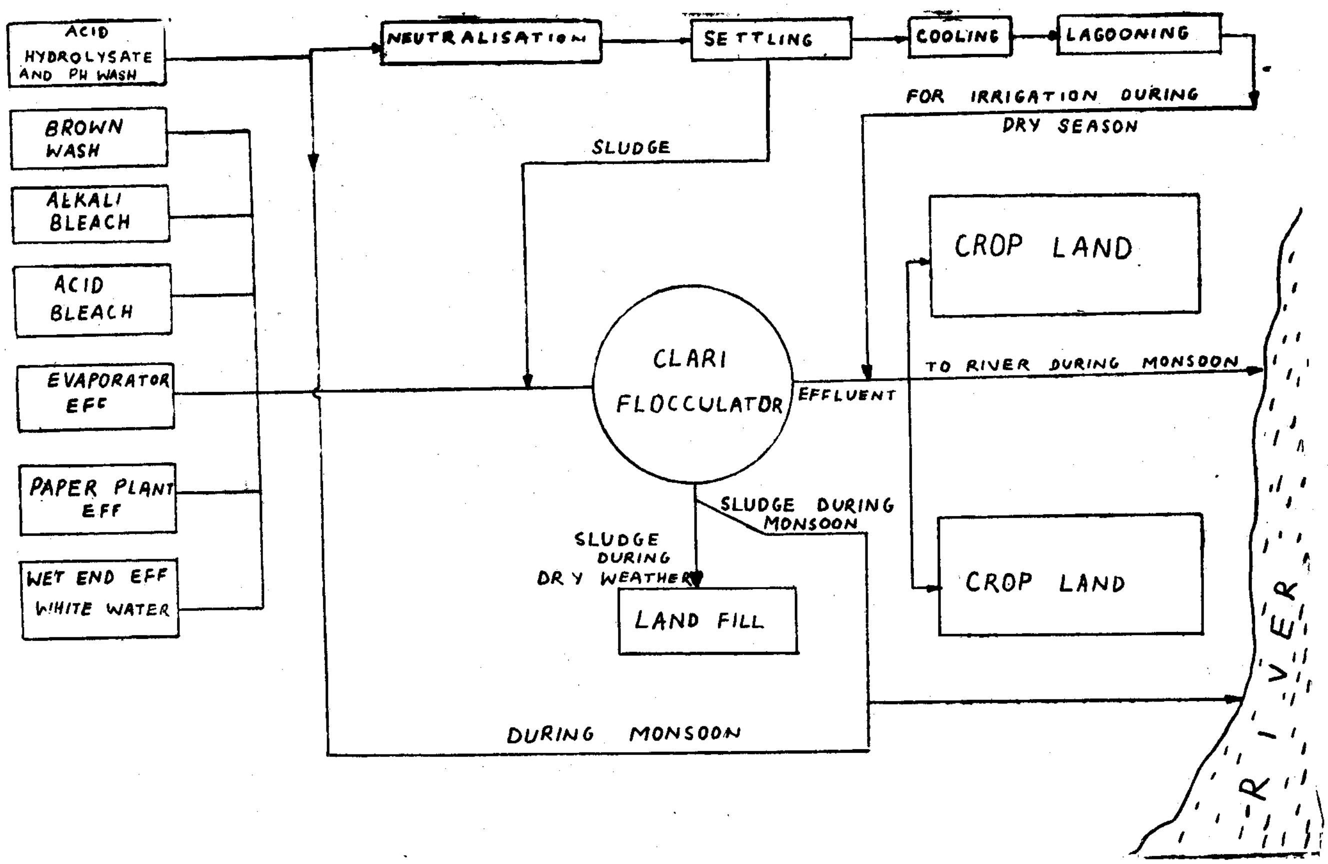

Fig. 1. Flow Sheet for Wastes Treatment Gwalior Rayon (Pulp Mill)

from the digester house is transferred to a neutralization tank wherein lime is added continuously to get a desired pH of 7–8. Neutral hydrolysate is then stored in cooling tanks and finally charged to lagoons after the addition of urea and diamonium phosphate as nutrients for the growth of bacteria. These lagoons are functioning in the parallel–cum–series and are showing 90% reduction as given in Table II. Even after treating prehydrolysate in anaerobic lagoons effluent BOD is still high and needs secondary treatment. A pilot plant lagoon for treating anaerobic lagoon effluent by aeration, was constructed and trials showed that further about

TABLE–II
Performance of Anaerobic Lagoons

Raw influent charge (m^3)	EFFLUENT Vol. Acids	COD Influent	COD Effluent	COD %Redn.	BOD Influent	BOD Effluent	BOD %Redn.
300	630	62950	6656	89.4	—	—	—
200	450	72540	6433	88.8	—	—	—
450	480	72740	7241	89.9	39000	1900	94.9
450	438	72640	6304	90.5	—	—	—
300	570	71600	7281	89.0	—	—	—
550	720	70500	7328	89.2	35550	1850	94.6
550	630	66400	7413	86.2	—	—	—
600	1800	67170	10030	85.2	—	—	—
600	960	54280	8682	83.4	31000	2262	92.6
600	—	58150	9028	83.9	—	—	—
600	1714	56040	9344	83.0	—	—	—
600	1577	57150	9809	82.2	32250	2800	91.0
600	1046	64370	9886	84.0	—	—	—
600	960	61310	10880	81.5	—	—	—

Note:—A portion of the lagoon 1 effluent is directly fed to experimental pilot aerator lagoon.

85–90% B O D reduction takes place in aerated lagoons with a retention time of 15 days. A plant scale lagoon is under construction based on these studies.

In addition to this treatment of prehydrolysate by anaerobic and aerobic lagoons combined effluent is passed through a clariflocculator to remove all suspended solides before it being let to the river. The treatment plant is functioning and a considerable river water load has been reduced though colour of the effluent water cannot be changed. Use of treated effluent water which is rich in fertilizers for the growth of crops such as paddy is also under consideration and it is hoped that irrigation department will come forward and carry out necessary work so that mill effluent can be used for growing more paddy which is of immense importance to the nation.

TABLE III
Performance of Aerated Lagoon

Previous day lagoon I overflow (m^3) to Aerated lagoon	Previous day lagoon I effluent COD (mg l)	Aerated lagoon effluent COD (mg/l)	%COD reduction	Previous day lagoon I effluent BOD(mg/l)	Aerated lagoon effluent BOD (mg/l)	%BOD reduction
—	5292	2834	—	—	—	—
—	7813	2564	—	—	—	—
50	8880	2814	68.31	2625	737	72.0
100	8794	4177	52.5	—	—	—
100	9120	2757	69.8	2225	275	87.6
100	8682	2742	68.4	—	—	—
100	9729	2830	70.9	—	—	—
100	9436	3104	67.1	2412	350	85.5
100	10230	3463	66.1	—	—	—
100	11050	3166	71.3	—	—	—
100	10580	4214	59.2	3300	340	89.7
100	12030	4789	60.2	—	—	—

Conclusion

1. Reduce chemical losses in the process by strict control in the plant. Chemical losses have been brought down considerably by in-plant changes and by installing equipments.

2. Treat the effluent rich in organic matter by lagooning after adding nutrients such as urea and phosphate.

3. Remove all suspended solids in clariflocculator before it is allowed to go to the river or use this water for irrigation purpose.

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