Present Practices and Future Trends in Pollution Abatement in Indian Paper Industry

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SUMMARY

The paper stresses the importance of in-plant central measures to minimise pollution load to the sewer. Problems encountered in mini, medium and large paper mills are discussed in detail. Present practices and trends likely to be followed in future in Indian Paper Industry for pollution abatment are outlined.

INTRODUCTION

Pollution control, a relatively neglected aspect of industrial activity so far, has assumed great significance in recent years. Pulp and paper industry requires large quantity of water for its various manufacturing processes. The amount varying from 50,000 to 1,00,000 gallons per ton of product depending upon the size of the plant, the available facility for recycling and the type of process employed. About 85-90% of water intake is discharged as waste water in large integrated paper mills.

Conventional effluent treatment plants normally installed to treat industrial waste are highly expensive from both capital and operating costs point of view. The most economical approach to cut down water pollution is to minimise the quantity of water usage, which means maximum water recycling and minimum pollution load to sewers. Consistent efforts made abroad in reducing water consumption resulted in reduction of water requirement per ton of pulp from 50,000 gallons based on old technology to 20,000 gallons using new technology. Table–I shows trends in bleach plant water consumption. Also, BOD load could be brought down from 180 lb BOD per ton of pulp to as low 30 lb BOD (1). In fact, efforts are being made to achieve zero effluent discharge through effective in-plant control measures.

IN-PLANT CONTROLS

The main areas of reducing water consumption are screening, bleaching and chipping sections. Some of the important ways for reducing pollution load are increased collection of spent liquor, effective condensate handling and reduction of organic losses from bleaching sections.

Increasing washing efficiency by way of adding extra washer helps in reducing pollution load. It may be mentioned that one of the paper mills in Finland, which installed three continuous washers, achieved a washing loss equivalent to 7.5-8.0 Kgs/ton as Na_2So_4, while another Canadian mill has reported washing loss as low as 3.3-7.5 Kgs/ton of pulp (2) as against the normal alkali loss of 20-30 Kgs/ton reported by Indian Paper Industry. Screening section effluent, 15,000–50,000 gal/ton of pulp contributes considerable amount of BOD load, closing the system helps in reducing BOD load from this section. Secondary condensate from evaporator, which contributes 5-10 Kgs/BOD/ton of pulp, if used, in Brown Stock Washer will help in reducing pollution load to a great extent. Contaminated condensate could be collected and pumped to steam heated stripper, which will remove methanol and other odours gases. These gases are burnt with other obonxious gases in lime kiln or specially built furnace.

Counter current washing system, if employed in bleach plant, will reduce water consumption and in term will generate less pollution load.

Accidental spills, which are generally neglected, are a source of pollution. Hence, the need to have provision for collection of accidental spills. Approximately upto 4 Kgs BOD load per ton of pulp can be easily reduced by implementing this simple scheme.

POLLUTION ASPECTS OF SMALL PAPER MILLS

In India, small paper mills of 10-30 TPD capacity, generally utilise agricultural residues as their main fibrous raw material. Water consumption in these mills, per ton of product is in the range of 225-300 M^3/ton of product. As can be seen from Table–II, about 200 M^3 of waste water/ton pulp with BOD, COD and TSS in the range of 700-800, 2000-3000 and 1300-1500 ppm respectively are discharged (3).

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Average pollution load from these mini paper plants having no recovery but making bleached papers is 140 Kgs BOD and 280 Kgs suspended solids per ton of product, which is nearly three times the pollution load from an average kraft pulp mill of 100 TPD capacity having recovery unit.

PROBLEMS FACED BY SMALL PAPER MILLS

Chemical recovery is not considered economically viable unless the unit is of 50 TPD capacity and above. Hence, severe problems of pollution arises due to drainage of highly concentrated black liquor from these units. Non-availability of land also poses a serious problem to the small mills for treating their waste waters by waste treatment methods like lagooning, holding ponds, etc.

Segregation of concentrated black liquor from 30-50% of straw pulping and 20% of gunny rag pulping (from digester house) and its subsequent treatment in storage lagoon and then controlled discharge during monsoon period will help in reducing pollution load to sewers (around 34%).

Waste from other sections, if treated first in primary clarifier and then biologically in aerated lagoon or activated sludge method will bring the effluent characteristics well within the prescribed standards IS: 2490-1974 for discharge into any inland surface waters.

The segregated waste after primary treatment can be safely used for land irrigation purposes provided it is available for growing various crops like bananna, sugar cane, rice, wheat, etc. A 25 TPD paper mill (without recovery) near Poona is successfully using mill effluent for irrigation in 250 acres area of land, after treating the effluent by activated sludge method.

Also, Papco Mills at Khopoli, a medium sized paper board mill, having low pollution load in mill effluent has opted for a low cost effluent treatment method incorporating save-all, plain sedimentation tanks and holding pond to treat its waste water. Arrangements are being made to incorporate aeration facility also to reduce the marginal BOD (30-35 ppm) of mill effluent by means of surface aerator to less than 20 ppm.

As per NEERI, land required by a 10 & 30 TPD plant for pollution control (by irrigation scheme) is 27 and 29 hectares respectively as against 0.95 & 2.3 hectares needed for the conventional activated sludge treatment methods. Recovery of fibre from waste water at mill site itself and its recycling is one of the ways of reducing pollution load from small paper mills. This is being practised effectively by Papco Mills at Khopoli, through the operation of fiber recovery units.

LARGE PAPER MILLS

Since water consumed by large mills is considerable, segregation of streams needing special treatment is essential. A thorough study on sectional effluent (Table-III) of Central Pulp Mills indicated that paper machine effluent, on three hours of plain settling results in a clarified water that can be easily reused in the process, particularly in screening and bleaching section of pulp mill (Table—IV). Based on this findings, a 2 MGD capacity clarifier is being installed to treat paper machine waste water separately.

TABLE—I. TRENDS IN BLEACH PLANT WATER CONSUMPTION

Sr. No.	Technology Level	Gallons/Air dried Ton
1.	Old Technology, 1967	28,000–60,000
2.	Today's typical technology	12,000–32,000
3.	New Technology	11,000–12,000
4.	Average for 20 North American bleach plant with	
	(*a*) CEDED sequence	8,100–13,700
	(*b*) CEHDED sequence	14,200–22,700
5.	Achieved today for CEDED sequence	4,600
6.	Achievable based on laboratory experience with CEDED sequence	1,600

AIR POLLUTION

In the pulp and paper industry, digester, evaporator, recovery boiler and lime kiln are the major sources of air pollutants. Recovery boiler and lime kiln contribute particulate matters to atmosphere. Some of the in-plant control measures for controling air pollutants are listed below :

(1) Recovery boiler should not be overloaded, and never by more than 20-30% of its capacity.

(2) Oxygen in flue gas should be maintained at 2.5-4.0% of total air supply to ensure minimum total reducing sulpher (TRS).

(3) Secondary air supply to be kept at 3.0-4.0% of total air supply to furnace for efficient burning.

(4) Control on droplets of black liquor will result in less carry over of combustible matters from furnace (4).

(5) Maintaining low sulphidity below 28% in smelt.

(6) Black liquor to be oxidised to convert Na_2S to more stable stage of sodium thiosulphate to reduce H_2S emission.

(7) Direct contact of black liquor and flue gas to be avoided, as far as possible.

(8) For good control over emission of odours gases, collection and subsequent burning in lime kiln or in specially designed furnace.

(9) Electrostatic precipitator with or without ventury scrubber will help in getting reduced particulate matters going to atmosphere.

Presently air pollution standards are not set up in India. Dust fall collected from various sections of a 100 TPD partially integrated pulp mill are listed below :

(i) Chipper House	:	15,000 mg/M²/day
(ii) Recovery Section	:	5,800 ,,
(iii) Pulp Dryer	:	1,000 ,,

LAND POLLUTION

A 100 TPD kraft pulp mill handless 60 T/day lime sludge, 3-4 tons per day bamboo dust and approximately 3-4 tons per day fibres and fillers from paper machine, 1-2 tons/day screen rejects and around 70 tons per day coal ash as solid waste. Hence, the need to have effective in-plant control measures to reduce solid pollutants.

Few in-plant control measures which are absolutely necessary are given below :

(*a*) Lime sludge should be effectively removed in solid state and dumped in low lying area instead of allowing to join main sewer of mill. However, to solve the problem completely, lime sludge reburning should be practised.

(*b*) Remaining solids from recovery sections, which are mostly inorganic in nature, should be allowed to settle separately for TSS removal, as these have a faster settling rate.

(*c*) Chipper house dust sould be collected in cyclone to remove it, as far as possible, in dry state.

(*d*) Paper machine white water could be treated in DSM screen and side hill screen to remove fibre and fillers going to drain. A good save-all will help in recovering more fiber and in recycling white water leading to less water consumption. Recovery of solid waste, if effectively practised, will help in meeting the recurring cost of costly pollution abatement methods.

Some of the suggestions for efficient utilisation of waste are as under :

(1) Bamboo dust, if cooked separately, will give a pulp of quality suitable for coarse boards.

(2) Bamboo and wood dust having calorific value around 4000 K cal/gm are a source of fuel for the mills multi-fuel boilers.

(3) Lime sludge can be converted to cheap quality lime. Manufacture of low grade cement from lime sludge is an attractive proposition.

(4) Similarly, coal ash, a solid waste from coal-fired boiler, can be considered for use in the manufacture of cement and light weight concrete blocks.

(5) Wood bark can be converted to compost. Abroad, in Canada, this is being widely practised.

(6) Primary clarifier sludge, rich in fibres and fillers, can be used as filler in making coarse boards.

TRENDS ABROAD

Because of stringent pollution abatement standards, abroad, following schemes are employed to keep the environment clean :

(1) West Germany are planning to have pollution free new mills from 1981 onwards.

(2) Direct contact of black liquor and flue gas are avoided to have low odour kraft pulp mill.

(3) Collection of gases and subsequent burning in lime kiln is practised.

(4) Continuous diffusion washers and multi-stage drum filters are employed to have lowest soda losses in pulp washing. With these arrangements, recovery efficiency of 97-98% is achieved.

(5) Screening is completely closed to have zero effluent discharge from this section.

(6) Multi-stage bleaching with counter-current washing, substitution of chlorine with chlorine dioxide in sequential chlorination, bleaching commonly known as Papri Bleach, etc. are followed to have low effluent volume, low steam and chemical consumption and getting higher pulp strength.

(7) Thermo-mechanical pulping, oxygen alkali pulping, are some of the latest useful developments from pollution angle as well.

(8) Dynamic bleaching, presently gaining wide recognition, requires very little water per ton of pulp, only 5 M³/ton. Hindustan Paper Corporation intends to go in for dynamic bleaching in one of its projects.

TABLE—II. CHARACTERISTICS OF WASTE WATER FROM SMALL PAPER MILLS

Sr. No.	Particulars	Digester Black Liquor		Straw pulp washer	Gunny rag pulping	Bleach plant	Paper Machine	Combined waste
		Straw	Gunny rag					
1.	Flow (m^3/ton)	..	..	70	..	8.33	130	200
2.	pH	10.8–12	11–11.8	8.8–9.8	9.0–9.1	8.1–9.4	..	8–9
3.	Total solids (mg/L)	44000	37600	7614	2690	2387	2150	3548
4.	Suspended solids (mg/L)	9100	8000	1570	570	713	1517	1428
5.	COD ,,	38800	3240	6657	2286	763	1237	2676
6.	BOD ,,	12250	4890	2100	357	330	350	780
7.	Sodium ,,	7160	12000	1228	857	..	..	423

TABLE—III. CHARACTERISTICS OF SECTIONAL EFFLUENTS

Particulars	Pulp Dryer	Washing & Screening	Cyclean rejects	Chlorination	Alkali extraction	Combined Recovery	Chipper House	Paper Machine	Mill Composite
Flow, MGD	0.2	0.9	0.1	2.1	0.4	0.5	0.3	1.3	5.8
Temperature, °C	35	38	31	26	42	40	31	31	31
Colour (Pt Co Units)	20	2000	800	280	20000	10	300	10	1000
Conductivity (Micro-Mhos)	300	1775	990	3340	8360	350	410	500	1500
pH	7.4	9.2	8.6	2.4	10.2	9.1	7.6	6.5	8.6
P Alkalinity as $CaCO_3$, ppm	Nil	90	7	Nil	124	20	Nil	Nil	15
M Alkalinity as $CaCO_3$,,	156	520	184	Nil	1980	130	160	80	200
Total suspended solids ,,	100	400	900	100	165	700	3200	700	400
Total dissolved solids ,,	240	1740	920	1300	5330	730	520	450	1400
Chlorides as Cl ,,	46	56	10.6	700	700	17.7	28.4	27	400
Oxygen absorbed (4 hrs) ,,	56.8	578	192	140	1268	16	280	60	280
BOD_5 at 20 °C ,,	45	410	200	80	460	15	70	80	170
COD ,,	380	1560	1300	475	3246	40	900	700	1000

TABLE—IV. COMPARATIVE ANALYSIS OF SETTLED EFFLUENT (PAPER MACHINE)

Sr. No.	Particulars		Paper Machine Effluent		
			Before Treatment	After Treatment (settling time 3.0 hrs)	Cenpulp clarifier water
1.	Colour (Pt Co Unit)		10	10	10
2.	Temperature,	°C	28	29	29
3.	pH		5.2	5	7.8
4.	Conductivity (Micro Mhos/cm)		585.2	585.2	292.8
5.	P Alkalinity as $CaCO_3$	ppm	Nil	Nil	Nil
6.	M Alkalinity as $CaCO_3$	,,	4	4	127
7.	Suspended solids	,,	800	32	12
8.	Total dissolved solids	,,	660	570	380
9.	Chlorides as Cl	,,	53.25	56.8	21.3
10.	Iron as Fe	,,	..	0.60	0.07
11.	Sulphate as So_4	,,	..	257.08	13.18
12.	Oxygen Absorbed (4 hrs)	,,	56	16	0.8
13.	COD	,,	924	61.2	55.1
14.	BOD_5 at 20°C	,,	95	5	0.5

(9) Zero effluent discharge concept of Rapson-Reeve has found commercial application in Great Lakes Paper Company in Ontario, Canada.

PROBLEM FACED BY INDIAN PAPER INDUSTRY

(1) Chlorination stage effluent (40% of total effluent discharge in a paper mill) is not recycled due to its highly acidic nature and non-availability of expensive 317 SS pumps in India.

(2) Rapson-Reeve process cannot be used because of using calcium hypo-chlorite in hypo-bleaching in Indian context. Also, chlorine has to be substituted by chlorine dioxide.

(3) Maximum recycling of wastes poses problems of heat accumulation, slime growth, etc. needing extra expenditure and use of expensive slimicides and biocides for controlling slime growth in the system.

FUTURE TRENDS IN INDIA

(1) Soon, as in developed countries, we will also have to think of going in for modern trends like thermo-mechanical pulping, multi-stage diffusion washing, closed screening system, use of chlorine dioxide for bleaching, etc. to minimise pollution load.

(2) Use of electrostatic precipitator, elimination of direct contact evaporator, utilisation of evaporator, condensate in Brown Stock Washing, will have to be adopted.

(3) Collection of obnoxeous gases and their steam stripping or incineration, and also change over from high sulpher containing furnace oil to LSHS for achieving low So_2 emission in air will have to be practised.

(4) Steps should be taken to use mill effluent for irrigation purposes, the cheapest way of water pollution control.

(5) Adoption of realistic standards on land, water on air pollution by the pollution control authority will enable the paper industry to implement economically the pollution abatement methods.

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