Impact Of Waste Paper Utilization On Environment

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ABSTRACT

To combat the environmental pollution and also gradually depleting forest resources, maximum possible utilization of waste paper is obviously a right step. The consumption has to continuously increase but not only based on imports but also on our own indigenous resources for which a systematic and long term planning is needed.

The use of secondary fibres prevents the pollution of air significantly and a'so reduces the magnitude of handling and disposal of solid wastes otherwise generated to a large extent. The water pollution problem does exist and the magnitude depends upon the quality of the waste paper used and end-products produced, the extent the production of virgin pulp is substituted by secondary fibres and especially the method used for waste paper processing.

The paper discusses the merits and de-merits of various processes normally employed for treatment of waste paper with reference to environmental pollution.

The recycling of waste paper in the manufacture of paper and paper board is of utmost importance when viewed from the angle of maintaining ecological balance. It helps in the conservation of forests, land and water. At a time when natural resources are getting deplete and the pulp and paper industry is threatened with the shortage of fibrous raw materrials, not only in India but throughout the globe, the subject attains a greater importance for the survival and growth of the industry.

In the world, on an average, the industry utilizes 20% waste paper as the furnish though in several countries it ranges in between 40–53%. In India, it has been to the extent of 8% till 1975 only. In the last few years, the percentage has increased to around 30% due to the mushroom growth of small paper mills and off late, due to import of paper wastes even by medium and big paper mills. The percentage is bound to increase in the coming years. The trend is encouraging but we cannot and should not depend upon the imports only as the present policy of liberal import may not continue for long on account of foreign exchange limitations as well as shortage of fibrous raw materials in the exporting countries itself. The collection of waste paper for recycling has to be organised and planned systematically on a long term basis inside the country itself but our old habits and limitation for the recycling of indigenous wastes due to their inherent low strength properties need our immediate attention.

Utilisation of waste paper has its own environmental impacts. It reduces the deforestation and help in preserving the ecology of the forests. As the demand for generation of steam itsetf is reduced by around 50% in the coal fired boiler and there is no other emission of pollutants to the atmosphere from the pulp and recovery plants, the air pollution is considerably reduced in view of emissions limited to the boiler house only. It also eliminates completely the enormous problem of handling and disposal of solid wastes generated from the pulp mill and thus helps in preserving the ecology of the land. For a mill of 100 TPD capacity, the area of the land required comes to about 30 hectares with a height of four metres covering a period of ten years for the disposal of its solid wastes. Even allowing for a discharge on drying when exposed to the atmosphere 20 hectares are required. Very little area for disposal of rejects and effluent sludge compared to this requirements is needed when waste paper is utilised. Water consumption is also largely reduced. With regard to water pollution load, the reduction or increase will depend upon the quality of waste paper and the products

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made, and specially the process used for processing of waste paper as discussed in the foregoing paras. The overall impact of all these on the environment will depend on the extent the virgin pulp manufactured at the mill has been replaced by recycled waste paper.

As is evident from the above, there is some pollution of land and water while processing waste paper. The quantity and quality of solid wastes and the effluent and its overall impact on the discharges from the integrated mill will depend upon the extent of waste paper used, its quality, quality of the final product, process employed for the waste paper processing, quantum and type of internal controls, the extent of water closure system and finally the quantity and quality of the discharges obtained from the production of virgin pulp.

Processing of secondary fibres can be classified into two categories :

1. Mechanical
2. Chemical treatment as applied in de-inking process

   This is further divided into—

   a. Floatation and

   b. Washing.

The processing of secondary fibres influences the environment by emission of polluted effluent and disposal of rejects and sludge leaving the system. The discharges may influence the receiving water by its high BOD, suspended and dissolved solids, colouring substances, toxic constituents, metals and inorganic salts. When de-inking is carried out environmental aspects of the disposal of the ink mud and the discharge of waste water containing chemicals attains importance. When bleached, dissolution of organic substances increases resulting in higher load of pollutants.

The process of de-inking has its own dis-advantages from environmental view point and that is the reasos, in 1978, out of 40 million tonnes of waste paper recycled, only 5 million tonnes were subjected to de-inking process - 2/3 floatation de-inking and remaining 1/3 washing de-inking extensively used in USA. From power consumption point of view also mechanical process is preferred as it consumes a maximum of 100 KWH against 500 KWH/T in de-inking.

The universally adopted and extensively used process should have the adequate capacity facilities *to remove contaminants preseni in the waste paper furnish* like hpdrapulper purge loop, junk box, the stock cleaning and screening system etc. Such contaminants include wire, staple, rag, string, tags, plastic, glass, metal and similar other foreign matter. The discharges from the system are excess white water, rejects from slushing, screening and cleaning stages besides accidental discharges, cooling and scaling water etc. All solid wastes, if disposed off separately with high consistency, there is water pollution of a small magnitude only. The recovery of the secandary fibre can be anywhere between 80–93%. The fines and other solid constituents, if any, passing on to the paper machine can be taken care of along with the effluent from the paper machine as discussed later. By proper closing of the water system, the water consumption can be brought down to $1m^3$ per tonne of recycled waste paper though $5—10m^3$ is common. BOD and COD values in dissolved solids form would be generally very low, almost negligible. In extreme cases of poor quality waste paper. it may go upto 15 and 40 kgs respectively. The impact on the reduction of pollution load in the effluent when the integrated mill operates only on virgin pulp and when it utilises partly the waste paper can easily be visualized from table—1. Of course, variation in wide range are possible from mill to mill depending upon their operating conditions and parameters. The only question mark is how much virgin pulp is replaced by the recycled secondary fibre.

It is essential that the effluent from the paper machine along with the filtrates from the waste paper processing plant at various stages of processing and also concentrating the rejects is necessarily settled and clarified separately. Clear water is reused back and the sludge is disposed off in a beffitting manner. This will help in reduction of pollution load-SS by 90%, BOD_5 by 80% and COD by 90% in this combined wastewater, which otherwise would have gone to the mill's combined effluent. This suggestion is of prime importance for the small paper mills either based on waste paper alone or in admixture with virgin pulp.

TABLE—I

POLLUTION LOAD

	Effluent (M^3)	TSS (Kgs)	TDS (Kgs)	BOD (Kgs^5)	COD (Kgs)
			Per tonne of paper finished		
A. For a sulphate mill using bamboo and hardwood with a chemical recovery efficiency of 90% and moderate internal controls.	267	111	227	39	171
B. Ditto but with the paper m/c effluent settled and clearified. The clear water recycled and					
(i) sludge screened over 60 mesh and filtrate joining the effluent.	211	88	199	32	136
(ii) All sludge disposed off separately in a befitting manner.	201	71	199	29	131
			Per tonne of installed capacity		
C. Eor integrated pulp and paper mills with chemical recovery	305	131	339	51	217
D. For small mills with pulping facility but no chemical recovery.	223	288	855	174	580
F. Waste paper processing.					
(i) Mechanical	5–10	Varies widely	—	5–15	20–60
(ii) De-inking	10–100 (20–40)	200–300	100–200	50–100	100–200

DE-INKING PROCESS

This process not only removes the printing ink but also tends to remove fillers, coatings, starch, chemicals and fines etc. De-inking wastes, in general, are characterized by high pollution load due to the nature of the process. Further is a wide variation in the characteristics depending upon the type and source of secondary fibre, the quantity of additives and fillers present and whether the pulp has undegone the process of bleaching.

Turbidity is frequently a problem with de-inking waste because of significant quantity of clay solids, colloidal matter and very fine fibres, Since a large portion of the turbidity is due to settleable BOD is much less when compared to the total BOD because the majority BOD in the de-inking waste is soluble or colloidal as organic materials like additives and degraded fibres are washed out of the pulp. This is difficult to remove either by setiling or chemical coagulation combined with settling. Since the waste has a high BOD, biological treatment helps in reducing the remaining turbidity.

Total suspended salids can vary in wide range. even upto 50% for a glossy magazine type of furnish with an ash content of 20-30% besides organic coatings and binder etc. Obviously, severe water pollution and sludge handling and disposal problem is expected to be encountered in such cases.

In case of newsprint de-inking, petroleum type oils pose a problem in the de-inking wastewater treatment particularly where hexane soluble oils and greases are restricted by regulations. Newsprint inks are 11-13% carbon black, 78-85% petroleum based ink oils and about 5% petroleum based additives. Assuming 20-25 kgs of ink per tonne of newspaper. 85-90% of it to be removed in de-inking process, with a consumption of 20 m^3 of water per tonne, concentration of hexane soluble oils and greases comes to about 900 mg/l in the wastewater. The problem can be easily visualized.

Water consumption in a de-inking process varies in wide range from 10-100m^3/tonne of pulp but 20-40 m^3 is common. With efforts, it has been brought down much lower, even at 1 m^3 in advanced countries. BOD varies in betweeu 50 to 100 kgs, TSS 200-300kgs, COD and VSS 100-200 kgs in case of de-inked bleached pulp. In case of unbleached pulp, BOD and COD may be around 60 and 140-200 kgs More than 50% of the BOD is generally in the dissolved form. Similarly, about 30-35% of COD is in dissolved form. (All expressed per tonne of pulp). The wastes are generally alkaline in nature having a pH around 9.0 especially if bleaching is also carried out and are associated with high temperature.

De-inking wastes usually contain sufficient sulphur compounds causing odour generation if prolonged anerobic conditions are encountered when SO_4 is converted to sulphides. As long these sulphides are maintained at a pH higher than 8 to 8.5, there is no odour problem. The activated sludge process creates so much CO_2 that this pH instantly drops down to 7/7.5 on entering into the aeration tank. In such instances, it is advisable to operate primary clarification at a pH of say 9/9.5. Further, such treatment units where organics and S compounds can stay under anerobic conditions for more than 3-4 hrs. are to be avoided. To maintain a higher dissolved oxygen in the aeration tank to a level where higher organics such as protozoa can survive will be helpful in this direction as they will consume the anerobes. H_2O_2 and sodium hypo chlorite are also useful. The former is costly but works fast whereas the latter is cheap but works slow.

Primary clarification of de-inking wastes usually results in BOD and TSS reductions of around 40 and 80% respectively. Better efficiency may be possible by chemical coagulation and flocculation but the cost is prohibitive because of

a) Wastes being typically alkaline consume high dose of chemicals for pH adjustments for chemical treatment

b) Large quantity of alum and expensive polymers are required

c) Sludge produced being highly hydrous poses difficulty in its de-watering

d) Final values of BOD_5 are much below the desired standards, requiring again biological treatment.

Though ths wastes are amenable to biological treatment, due to super high concentrations of BOD and TSS, the reductions attained with the present available technology will not meet our ISI standards. In USA for a de-inking waste, recommended limits for discharge af wastewater based on best available technology economically available (BATEA), 1983, the limits arei:

Max. BOD in kgs/T		Max. TSS in kgs/T	
Month	Day	Month	Day
2.3	4.4	3 0	5.2

Even an advanced country like USA is finding it difficult to meet these limits. Furthermore, the biological treatment process and the effluent there-from are subject to a great degree of variations which fact has also to be recognized by the regulating authorities.

The above difficulties arise only for the wastes of de-inking mills. For the integrated mills using de-inked stuff only as a part along with other virgin pulps, de-inking waste can be mixed with the rest of the mill's effluent to dilute it. In such a case, the problem would be eased out. The extent will depend upon the proportion of the virgin pulp made and de-inked stuff processed.

The merits and de-merits of two types of de-inking processes are briefly discussed below to disualize the difference on their impacts in respect of environmental pollution.

FLOATATION

The yield is high and can be generally expected in the range of 85 to 95%. As it is easier to close the water system, fresh water consumption is much lower. However, inorganic fillers and fines are not removed by floatation and therefore control of these components is more difficult than in washing. The quality of the waste-water with respect to pollutants is comparatively much better.

WASHING

Dilution water is normally circulated in counter current system and the excess white water containing ink particles is discharged from filtrate tank of Ist stage washing. To clean this large volume of process water containing diluted ink, some recently built systems use an ink floatation stage, making it possible to close the system.

The advantage is that inorganic fillers and the short fibres are removed and/or the amount in the system is controlled. The dis-advantage is that the yield is much lower, even to an extent of 50%. Fresh water consumption and thus the contaminated effluent volumes are normally much higher than the floatation. This volume and the pollutants contained in it be removed by internal cleaning of the white water by floatation. The quality of the effluent is very much inferior and the quantity of de-inking sludge high.

For illustration, an idea of the difference in two processes can be had from a typical example given below :

SYSTEM CLOSURE

System closure forms a vital step in waste paper processing especially de-inking. It is an environmental measure considered important with technical and economical advantages and energy savings. The discharge from secondary fibre system as well as virgin pulp manufacturing process and paper machine in an integrated mill must be considered and minimised to avoid fibres and fines going to the effluent drain.

To avoid the problem encountered with the carry-over of substances to the paper machine, the pulp should be thickened to a high degree and washed properly. Further, it is very essential to ensure that all rejects are thickened to the maximum and discharged as solid wastes separately. This will reduce largely the pollutants going out with the effluent and thus reduce the pollution load. Though a costly proposition, the sludge and rejects may be considered for burning.

CONCLUSION

To maintain the ecological balance and thus a clean environment and also accept the challenge thrown by the scarcity of fibrous raw materials, the movement for increased utilisation of waste paper by the pulp and paper industry has to gain momentum: In this direction, a systematic long term planning is desired to make available the indigenous resources to the industry to the extent possible.

Utilization of waste paper reduces deforestation with its obvious impact on the ecology of the forest. The pollution of land and air is largely reduced. However, pollution of water continues in wide range. In machanical processing of waste paper, the reduction in water pollution is significant whereas in de-inking process it is negligible. In comparison to de-inking process, mechanical treatment involves low capital investment, low operating cost, ease of operation, low

Fresh water consumption M^3/T		BOD Kgs/T		COD Kgs/T		TDS Kgs/T
		Total	Dissolved	Total	Dessolved	
Floatation	10	40	25	140	55	100
Washing	90	50	30	190	65	130

water and power requirement, high yield, easier effluent treatment and low pollution load. In our conditions, we should confine ourselves to this process only to the extent possible. Even if de-inking cannot be avoided, floatation method is preferable over washing for several of the reasons stated above.

The overall favourable impact on the environmental pollution will depend upon the extent manufacture of virgin pulp is replaced by waste paper pulp, the quality of waste paper and the products, the extent of internal controls and finally the process adopted for treatment of waste paper.

ACKNOWLEDGEMENT

The author is grateful to the management of M/s Straw Production Ltd for their permission to present this paper. Thanks are also due to Mr. S. K. Misra, Supdt. (Quality Control & Water Services) for his assistance in preparing this paper.

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