



## INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

# A REVIEW: STUDIES ON PREPARATION OF LOW COST ADSORBENT FOR THE WASTE WATER TREATMENT OF PAPER INDUSTRY

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### Abstract

Paper industries produce various types of contaminants and high amount of wastewater depending on the type of processes used in the plant. The generated wastewaters can be potentially polluting and dangerous; it should be treated in wastewater treatment plants before being released to the environment. The main processes in pulp manufacturing and paper making are divided into five major groups including mechanical, chemical, chemo-mechanical, and thermo-mechanical pulping as well as papermaking. The recent research interest in low-cost alternatives for industrial waste and wastewater treatment is reviewed. An examination of the selection criteria and activation methods for the preparation of adsorbent is followed by a critical assessment of low-cost adsorbents prepared from fired clay. Emphasis is given to in-situ reuse applications where stated in the literature and rudimentary economic analyses provided, where available, for comparative operations with adsorbent. Adsorption, aeration, flocculation is the best process of water treatment because of its significant advantages. Fired clays and their minerals, both in its natural and modified forms it can effectively remove various heavy metals from aqueous solution. The main processes in pulp manufacturing and paper making are divided into five major groups including mechanical, chemical, chemo-mechanical, and thermo-mechanical pulping as well as papermaking, each producing a high volume of wastewater with special characteristics. Clays and their minerals are cheap material used as an adsorbent for removing toxic heavy metals.

**Keywords:** Adsorption, Wastewater treatment, Contaminants removal etc.

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## 1. INTRODUCTION

The wastewater produced by industrial operations has a significant impact on the environment. Pulp-and-paper industry is a large consumer of fresh water and an important source of wastewater, generated during various stages of pulping and papermaking activities. Environmental pollutants and their toxicity cause a major problem worldwide. A pollutant poses severe health and scientific challenges. Water pollution is one of the biggest environmental issue causing serious problems to living beings. The removal of various toxic substances from water and wastewater has been a core interest of many scientists and researchers around the globe over the past decades. Dyeing, battery, printing, mining, metallurgical engineering, electroplating, pigment, PVC stabilizers, nuclear power operations, electric appliances manufacturing, semiconductor, cosmetics, and so on belong to industries that generate various types of pollutants in wastewater effluent [1]. There are many types of pulps depending on the type of process like chemical pulp, mechanical pulp (improve the opacity and

the volume of paper), nitric acid pulp, alkaline pulp and sulfite pulping, etc. In general, pulps are used for paper and board production. The pulp and paper industry processes huge quantities of biomass every year. But the operation of pulping and papering cause some contaminates like organic and nutrient loadings, solids deposition, and colour complicate efforts to define chemical toxicants by causing environmental impacts at community and population levels.

### 1.1 Wastewater Production in the Paper & Pulp Processes

During the process some materials are added like kaolin, CaCO<sub>3</sub>, talc and/or TiO<sub>2</sub>, bleach to give the paper whiter colour and other chemicals like organic fillers (starch, latex), colours and aluminium sulfate are used to make paper or simplify the process. Pulp is also washed by water containing some additions like sodium silicates, sodium carbonate, fatty acids or non ion detergents, so the wastewater produced will also

contain peroxides, oxygen and ozone or chlorine or chlorine dioxide sometimes and all above.

## 2. WASTEWATER TREATMENT

The growing concerns about the use of fresh water, increased economic considerations and stringent environmental regulations have highlighted the importance of water use and efficient wastewater treatment in the pulp-and-paper industry. The recycling and reuse of the generated wastewater after its proper treatment is the key to reduce fresh water use. This process minimizes discharges to the environment while advancing environmental conservation by reducing fresh water consumption. Effluent from the paper industry is generally high concentration of suspended solids and BOD. Plants that bleach wood pulp for paper making may generate chloroform, dioxins, phenols and chemical oxygen demand (COD)[3]. Paper mills using imported pulp may only require simple primary treatment, such as sedimentation and air purge. Increased BOD or COD loadings, as well as organic pollutants, may require biological treatment such as activated sludge or anaerobic sludge blanket reactors. For mills with high inorganic contents like salt, tertiary treatments may required general treatments like ultra-filtration or reverse osmosis or treatments to remove contaminants

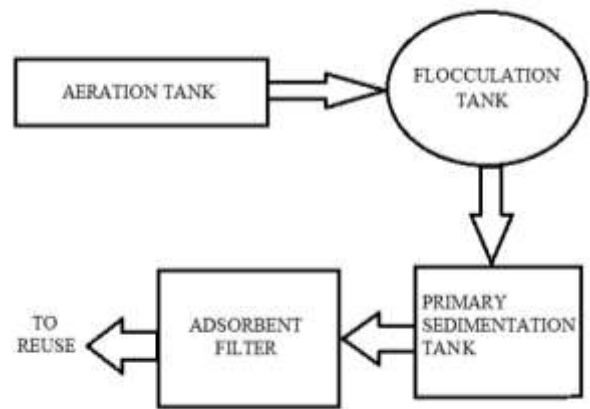
**Table No. 1:** Characteristics of waste waters generated in various paper and pulp processes [2]

Processes	Parameter					
	pH	COD	BOD	SS	TS	Colour
TMP White-water	4.6	2713	1541	127	--	--
TMP	4.2	5600	2800	810	--	--
CTMP	6.2	7300	2500	500	--	--
Kraft mill	8.2	4112	--	362 0	826 0	4667.5
Bleach Kraft mill	10.1	1124- 1738	128-184	37- 74	--	--
Sulfite mill	2.5	4000- 8000	2000- 4000	--	--	--
Pulping	10	--	360	256	181 0	--
Bleaching	2.5	--	140	216	228 5	40
Bleached pulp mill	7.5	2572	1566	113 3	--	4033
Wood preparation	--	--	250	600	116 0	--
Paper making	7.8	953	561	760	184 4	Black
Newsprint mill	--	3500	--	250	375 0	1000
Chip wash	--	20000	12000	609 5	--	--
Digester house	11.6	38588	13088	233 19	515 83	16.6

### (1) Physicochemical treatment:-

Physicochemical processes are used to remove suspended solids, colloidal particles, toxic compounds, floating

matters, and colors from wastewaters. These processes include sedimentation, ultra-filtration [4], coagulation, flocculation [5]. Physicochemical processes are commonly used in the preliminary, primary, or tertiary stages of wastewater treatment [6]. The concentration of contaminants present in wastewaters and their desired removal efficiencies are important factors in choosing the type of physicochemical treatment process. The presence of lignin and its derivatives contribute to strong colour in most pulp-and-paper wastewaters [8]. These wastewaters also contain high concentrations of suspended solids. Therefore, the use of a primary treatment, commonly sedimentation [7], is essential for the treatment process. The possibility of removing 80% of suspended matters from wastewater by sedimentation [4] used sedimentation combined with adsorption and ultra-filtration for the treatment of Kraft black liquor and achieved 60% and 87% total solid removal.



**Fig-1:** Wastewater Treatment Method

### (2) Biological treatment

Most waste water treatment plants use aerobic and/or anaerobic biological processes to remove organic contaminants in wastewaters. Aerobic processes are preferably used in most pulp-and-paper mills because of their ease of operation as well as the relatively low capital and operating costs [7]. Among aerobic technologies, activated sludge (AS) and aerated lagoons are commonly used in the pulp and- paper industry [9]. Although the use of anaerobic processes in the pulp-and-paper industry is not common, a number of mills have employed different anaerobic technologies because of lower sludge production, renewable energy production (biogas), smaller area requirements. Aerobic and anaerobic processes have certain disadvantages including the high sludge production of aerobic processes and sensitivity of anaerobic bacteria to toxic materials.

## 3. DISCUSSION

From the above comparison of different process of waste water treatment of paper industry commonly carried by aerobic treatment. The treatment of the wastewater in paper industry used to remove contaminants. In this review, different wastewater treatment processes in the Paper Industry were investigated and compared with respect to the extent of GHG emission and contaminant removal efficiencies.

The following conclusions result from this study:

- i. Both aerobic and anaerobic biological processes are appropriate for the treatment of pulp-and-paper wastewaters.
- ii. Physical treatment is also can be used for waste water treatment of paper industry.
- iii. Although COD removal efficiencies in both treatment methods can be satisfactory, anaerobic treatment is generally more successful in the removal.

### ACKNOWLEDGEMENT

Author is gratefully acknowledged the support and encouragement and motivation from Project guide “Prof. Nitin chawahan” sir. I would also like to extend my gratitude to the Principle “Dr. R. S. Tatwawadi” sir, HOD of Chemical engineering department “Prof.A. P. Pardey” sir, Jawaharlal Darda Institute of Engineering and Technology, Maharashtra, India.

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