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Research Article

ANALYSIS OF EFFLUENTS RELEASED FROM RECYCLED PAPER INDUSTRY

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ABSTRACT

Waste Water and nearby soil samples of recycled paper industry are collected from Northern districts of UP viz. Saharanpur, Muzaffarnagar & Meerut and analyzed for various parameters like pH, TDS, TVS, TSS, TFS, TRC, TS, BOD, COD, Chloride, DO. The inferences were drawn on the basis of analysis. The very high absorbance in the region 200-300nm value suggests that these effluents are not fit to be disposed to the water stream as these effluents will result in increase of organic load in water streams. The present manuscript reports the investigation of the characteristics of effluents released from recycled paper mills of UP state to access the pollution load of recycling paper mills on the environment.

Keywords: Bioaccumulation, COD, TOC, Ozonation, Photochemical processes, Electrochemical processes.

1. INTRODUCTION

Recycled Paper industry is a globally growing industry that consumes a significant amount of resources, raw materials and energy. The characteristics of the wastewaters generated from various processes of the recycled pulp and paper industry depends upon the types of processes and raw materials, process/ technology applied, management practices, internal recirculation of the effluents for recovery and the amount of water being used in a particular process. The majority of pollutants released in pulp and paper industry originate from the pulping and bleaching stages. The high organic content of pulping wastewater, coupled with the presence of chlorine, results in the production of highly toxic organic compounds [1]. Chlorinated phenols, guaiacols, catechols, furans, dioxins, aliphatic hydrocarbons, etc. are of prime concern. Some members of this family are known to be toxic, mutagenic, persistent, and bio-accumulating and are thought to cause numerous harmful disturbances in biological systems, and pose a human risk through long-term exposure via drinking water and through bioaccumulation along with food chain [2, 3].

End-of-pipe treatment of wastewaters can be accomplished by integration of traditional biological treatment processes with chemical. Advanced oxidation applications & chemical oxidation technologies have revealed that the applied processes are effective and promising applications for the treatment of pulp and paper industry wastewaters [4, 5]. Ozonization is efficient in removing COD, TOC, color and increasing the biodegradability of the wastewater in many cases [6, 7]. However, it is an expensive process. Electrochemical methods have proved to be an efficient treatment option for the treatment of pulp and paper industry wastewaters. Combinations of two or more physicochemical processes can be used for the enhancement of removal efficiencies and design of the setup [8]. Currently no relevant data is available on the states/ parameters of the effluents released from recycled paper mills; the most important task seems to be the assessment of the effluents of recycled paper mills so as to design the specific treatment systems for the recycling mills.

The demand for the paper and paperboard by the year 2006-2007 in India was 3.8 million tons/annum and 4.9 million tons per annum at the end of the year 2010. India was also the first country in the world to use bamboo as a basic raw material for making paper. Due to limited forest resources, other raw materials like bagasse, straw, jute, etc. were identified and are now extensively used in the paper products. Waste paper is also being widely used for paper making. At the same time pulp and paper industry is one of the largest and most polluting industries in the world. At present, there are

6666 pulp and paper mills in India, of which 632 units are agro-residue and recycled fibre based units (CPPRI, 2005). Being a fibre deficient country, two-third of the raw material comes from non-wood sources. These include agro-residues like rice straw, wheat straw, sarkanda, bagasse, jute rags as well as waste paper. To access the pollution load of recycling paper mills on the environment, the present manuscript reports the investigation of the characteristics of effluents released from recycled paper mills of UP state.

2. MATERIAL AND METHODS

2.1. Collection of samples

2.1.1. Effluent samples

The effluent samples were collected from the wastewater treatment plants of recycled paper mills of Northern districts of UP viz. Saharanpur, Muzaffarnagar & Meerut. There were seven samples collected from various paper mills of these three districts. The effluent samples were 24-hour composite samples collected in plastic bottles. All the samples were refrigerated at 4°C. Prior to treatment; the samples were warmed to room temperature (24°C to 27°C). For UV Spectrophotometer analysis, the samples were centrifuged and again filtered through 0.45µm glass filters to remove suspended solids. Effluents samples collected from recycled paper mills were analyzed for the required parameters in order to evaluate the pollution load of water streams in which they are thrown. The effluents were characterized by analyzing the physico-chemical characteristics.

2.1.2. Soil Samples

Organic and inorganic components of effluents enter into the soil and underground water and thus affecting the land and water streams. In order to assess the impact of wastes on the environment, the study has also been carried out for the analysis of the soil profile near the recycled paper mills. Various samples were collected at variable distances (1, 2 and 5 km) area from the recycled paper mills.

Instruments used: These include UV Spectrophotometer (HACH: DR4000U), Water and Soil Analyzer kit (Model: GMK-731), COD Analyzer kit (Thermo Orion COD-125Meter), Centrifuge, Ultraviolet Lamp Unit, BOD5 days Incubator (HASH BOD Trak Incubator), Hot oven and Electric Furnace.

3. RESULTS AND DISCUSSION

3.1. Analysis of Effluent Samples

The effluents generated by mills contain high concentration of chemicals in the receiving water bodies which results in reduced penetration of light, thereby affect habitat. The high concentration of organic matter in the effluents contributes to the Biochemical Oxygen demand (BOD) and depletion of dissolved oxygen in the receiving ecosystems. The organic compounds may be persistent, bio accumulative and toxic pollutants thereby removal of the effluents is desirable. Paper and pulp mill effluents are major contributor to absorbable organic halides (AOX) loads in the receiving ecosystems. Table 1 reflects that the treated effluent discharge of recycled paper mills contains high TDS (Total Dissolved Solids) and TSS (Total Suspended Solids). The high COD value reflects the presence of organic and inorganic matter which may be persistent and not degraded by the treatment process established at the industries. The physicochemical characteristics of effluents are shown in Table 1.

3.2. Analysis of Soil Samples

In order to assess the impact of wastes on the soil, the study has also been carried out for analysis of the soil profile near the recycled paper mill. Various soil samples were collected at variable distances (1, 2 and 5 km) area from the recycled paper mills. The soil has high COD values which indicate the input of non biodegradable components in the soil, which decrease with increase in distance. The high COD value decreases the fertility of the soil and causes soil pollution and also has detrimental effect in the environment after long period. The pH of the soil decreases very near to the site i.e., 1km from paper mill, which indicates that the effluents are acidic in nature and hence affect the fertility of soil. pH varies from 6.72 to 8.14 with variation of distance from 1km to 5km, which is shown in the table 2.

Decrease in pH near the mills was due to the acidic nature of effluents, which affect the pH of the soil. The DO in soil increases with increase in distance which show that the effluents contains chemical load which affect the DO value of the soil and hence decreases the fertility of the soil and also affect the production and cause soil pollution.

The DO value varies from 2.0ppm to 4.1ppm as the distance varies from 1km to 5km, which is shown in Table 2. The TDS value in soil decreases with increase in distance, which indicates that effluents contains big load of organic and inorganic components and non biodegradable components in the soil. The high TDS value of soil affects the fertility of the soil and cause soil pollution. The TDS values vary from 0.304 ppm to 0.136ppm with the distance varying from 1km to 5km, which is shown in Table 2.

Table 1: Physicochemical Characteristics of Effluents from Recycled Paper Mills

S No.	Parameters	S-1	S-2	S-3	S-4	S-5	S-6	S-7	Indian Standard (BIS)
1	pH	6.79	7.05	7.37	6.94	7.25	7.38	7.62	5-9
2	TDS	2300	2800	2700	3800	3100	3260	1760	2100
3	TVS	1000	1500	400	1200	900	600	1000	-
4	TSS	700	1500	1200	1400	1000	940	820	100
5	TFS	3000	2800	3700	4000	3200	3600	2000	-
6	TRC	3	4	3.5	5.8	6.2	5.3	4.6	1.00
7	TS	4000	4300	4100	5200	4100	4200	3000	-
8	BOD5 Day	192	188	126	152	132	168	124	30
9	COD	1168	1120	518	1270	881	1276	961	150
10	Chloride	505	448	349	647	363	508	576	600
11	DO	0.4	0.6	1.5	0.6	0.7	0.9	2.0	5

Except pH all parameters are in parts per million (ppm)

Table 2: Parameters of Soil Samples at Different Distances

S No.	Parameters	Soil (1km)	Soil (2km)	Soil (5km)
1	Temperature (°C)	14.6	14.6	14.6
2	pH	6.72	8.02	8.14
3	ORP(mV)	670	530	630
4	DO(ppm)	2.0	3.4	4.1
5	Conductivity (mS)	0.602	0.286	0.268
6	TDS(ppt)	0.304	0.142	0.136
7	Salinity(ppt)	000.3	000.2	000.2
8	COD(ppm)	133	113	90

3.3. UV-VIS Spectra of the effluents

The –Vis spectra of the effluent samples of recycled paper mills were recorded and are given in figure 1. The UV-Vis spectra of the effluents show absorbance around 210nm, which indicated the presence of the aliphatic compounds with different functionalities as well as aromatic constituents. The most probable compounds present in the effluents stream may be phenol and its derivatives, liquor chlorophenols, chlorocatechols, etc. The maximum absorbance values (λmax) for all the samples have been recorded in Table 3. The very high absorbance in the region 200-300nm value suggests that these effluents are not fit to be disposed to the water stream as these effluents will result in increase of organic load in water streams. The UV-Vis spectra show the absence of any colored constituents present in the effluents.

Sample No.	Peak Value (λmax)	
	Wavelength	Absorbance
1	211	2.893
2	207	2.915
3	205	2.717
4	216	3.150
5	208	2.898
6	212	2.867
7	206	2.982

Table 3: λmax for the effluents

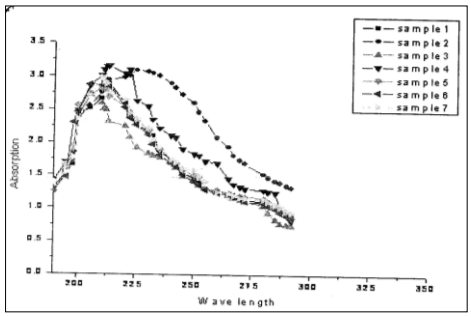

Fig. 1 Absorption Spectra of Effluents of Paper Mills

4. CONCLUSION

Treated industrial effluents released from recycled paper mills have high COD (1270 ppm) and BOD (192ppm) contents. The UV-Vis spectra show the presence of organic compounds i.e, probably the chloro/ methoxy derivatives of phenol. The soil samples from various distances from paper mills are collected and analyzed, which showed that COD and TDS of effluents reduced with distance and pH and DO increased with increase in distance as we move away from paper mills. The present study suggests incapability of wastewater treatment plant to effectively remove many pollutants and it is not safe to dispose effluentsin water strems or nearby fields.

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6. REFERENCES

1. Miller RM, Singer GM, Rosen JD, Bartha R. *Environmental Science and Technology,* 1988; **22(10):** 1215-1219.
2. Legrini O, Oliveros E, Braun AM. *Chemistry Review,* 1993; **37:** 671-698.
3. Carey JH. "An Introduction to AOPs for Destruction of Organics in wastewater. In: *Proceedings of the Symposium on*

Oxidation Processes Treat. Contam. Water air, Wastewater Technol. Cent. Adv., Paper No.1, Burlington: Ontario; 1990.
4. Beltrán F, González M, Alvarez P. *Ingenieria Quimica,* 1997; **331:** 161-168.
5. Galze WH, Kang JW, Chapin DH. *Ozone Science and Engineering,* 1987; **17:** 335-352.
6. Li L, Peishi C, Earnest F. *AIChE J,* 1991; **37:** 1687-1697.
7. Andreozzi R, Caprio V, Insola A, Martota R. *Catalysis Today,* 1999; **53:** 51-59.
8. Benitez FJ, Beltran-Heredia J, Gonzalez T, Real F. *Industrial Engineering Chemistry and Research,* 1995; **34:** 4099-4105
9. Dass B, Suda D, Sharma S. *Journal of Industrial Pollution Control,* 2011; **27(2):** 185-189.
10. Hoigne J, Bader H. *Water Research,* 1983; **17:** 173-183.