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Physico-chemical characteristics of wastewater from Paper Industry

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ABSTRACT: This paper presents the physio-chemical characteristics of wastewater from the paper industry which is using waste-paper as a raw material.The wastewater from the paper industry is characterized by colour ,extreme quantities of COD, BOD, pH ,TDS, DO and SS .The wastewater samples were collected from the inlet and outlet of the effluent treatment plant of paper mill. The samples were analyzed and compared with the Indian standards of effluent discharge.The raw wastewater consists pH of 6.8-7.1,Suspended Solids of 1160-1380mg/l,Total Dissolved Solids ranges from 1043-1293mg/l, BOD and COD varies 268 - 387 mg/l and 1110 –1272 mg/l respectively. After treatment pH varies 7.1 -7.3, Suspended Solids 322-505 mg/l, Total dissolved solids ranges from 807-984 mg/l , BOD and COD ranges from 176- 282 mg/l and 799-1002 mg/l, respectively . Result shows that the pH and TDS is in the permissible limits and COD ,BOD,SS does not meet the permissible standards after treatment. The paper mill does not meet the Standards set by Central Pollution Control Board,India

Keywords- Central Pollution Control Board, effluent treatment plant, physicochemical parameters, paper industry ,treated effluent.

1. INTRODUCTION

The paper industry is the largest industry in India [1].Among world it ranks 20th paper producing country. [2] .These industries disturbing the ecological balance of the environment by discharging a wide variety of wastewater. Depending upon the nature of raw material ,the wastewater is generated per metric tonne of paper produced [3] .Then also the consumption of paper is increasing in offices ,institutions schools, colleges , packaging,writing and printing and also for the household. .The paper-making process requires large amount of water for the production processes, hence it is a water-intensive process. This is because, without the physical properties of water, it would not be possible for a consistent structure to be achieved when the constituents of paper are processed in sludge. Consumption of water depends upon the raw material used in industrial processes. The natural raw material are used for the processes are wood, cellulose, vegetables, bagasses , rice husk, fibers and also waste-paper. This creates a high level of wastewater from processing. The dark colour of the wastewater exhibits the toxic effects on the biota and inhibits the photosynthetic activity by reducing the sunlight [4].

The paper mill wastewater characteristically contains colour, very high level of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) ,due to presence of lignin and its derivatives from the raw cellulosic materials , chlorinated compounds, suspended solids (mainly fibres), fatty acids, tannins, resin acids, sulphur and sulphur compounds, etc [5]. Most of these industries discharged their insufficiently treated waste into the rivers or streams, which makes serious problem to aquatic life and flora-fauna. Thus, it is necessary to develop a economical solution on the effluent discharged. The main objective of the paper is to analyze the physico-chemical characteristics of the effluent and the influent of the effluent treatment plant of the paper mill.

The world demand for paper has grown rapidly and was around 5-6% per year. The paper mills have an larger investment and provide employment to 2 lakh people. It is estimated that the capacity of the mills increases from 8.3 million tonnes in 2010 to 14 million tonnes in 2020[6]. In India the total production 70% is from hardwood and bamboo fibre, agro-waste and other 30% is from recycled material. For paper, paperboard and newsprint production, 550 mills in India use wastepaper as a raw material.

2. METHODOLOGY

2.1. Collection of samples

The samples for the analysis was collected from the effluent treatment plant of recycled paper industry of Nagpur.The wastewater samples were collected from the inlet (raw wastewater) and outlet (final treated wastewater) of the effluent treatment plant of the paper

mill for analysis. sampling was done over a period of twice in a month. The samples were collected during August 2011 to April 2011 in fifteen days interval, respectively. The grab samples were collected in the plastic containers which were refrigerated at 4° C prior to further treatment. The samples were analyzed using standard methods of analysis of water and wastewater of APHA [7]. 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 [8].

2.2 Physiochemical analysis of wastewater

The samples collected from the paper industry was brought for the physiochemical analysis in laboratory of Environmental Engineering, Department of Civil Engineering,G.H.Raisoni college of engineering, Nagpur .The pH was measured by pH meter . The colour concentration was determined using COD plus colorimeter (model: La-motte, code-1922/1922-EX-2).BOD was determined titrimetrically, suspended solids was measured by using WHATMAN filter paper.

3. RESULTS AND DISCUSSION

The paper mill produces variety of writing and printing paper using waste-paper as raw material. The average production of paper in the mill is around 50,000 tonne per year to produce huge different varieties of paper. The wastewater generated from the paper mill consists of white water from stock preparation, paper machine and from the bleach section etc .The wastewater for analysis is collected from the inlet ,which is more polluted and from the outlet, that after treatment from the ETP. The results of monthly analysis of pH, colour, COD,BOD,TDS, SS are analyzed after treatment and compared with the standard values(table.1)

3.1 pH

The hydrogen-ion concentration is an important quality parameter of wastewater. Fig.1shows that the pH of the influent (raw wastewater) was measured to be 6.8 compared to 7.1 with treated effluent. Low value of pH is due to the metabolism of fungus and also metabolic production of acids by indigenous micro flora.[6] [7]

3.2 COLOUR

The colour of the wastewater typically depends upon the different industrial processes. The measurement and removal of colour is essential part as it is unfit for recycling without proper treatment. Fig.2 shows the variation of colour at the inlet and at the outlet of the ETP.

3.3 SUSPENDED SOLIDS

Fig.3 shows the concentration of suspended solids measured from inlet of ETP ranges from 1160-1380mg/l after treatment the concentration of suspended solids measured from effluent ranges from 322-505 mg/l respectively. suspended solids from the effluent reduces slightly due to the presence of fibres in the wastewater.

3.4 TOTAL DISSOLVED SOLIDS

The total dissolved solids concentration varied from inlet 1043-1293mg/l whereas from treated effluent varied from 807-984 mg/l respectively.Fig.4 shows the variation of total dissolved solids from the inlet and outlet of ETP.The values shows TDS are in permissible limit as compared with Indian standards.

3.5 BOD and COD

The BOD and COD levels of influent wastewater varied from 268-387 mg/l and 1110 –1272 mg/l respectively. Whereas the BOD and COD levels of effluent varied from 176 - 282 mg/l and 799-1002 mg/l respectively.Fig.5&6 shows the levels of BOD and COD is reduced to certain extent due to biological treatment process for which the effluent is treated which consists of equalization, primary clariflocculator , aeration tank and the secondary clariflocculator. Biological treatment process results in oxidation of organic matter, which provides energy for microbial metabolic process. [8] The slight reduction in BOD and COD values shows that the removal percentage is 40-50%and 30-40% .

The pH and TDS of the wastewater from effluent is within the Indian standard limits. And also within the permissible limit set by Central Pollution Control Board, India to discharge for irrigation . Whereas the other parameters viz, SS, COD, BOD are not within the limits of Indian standard.

4. CONCLUSION

The paper mill is growing fast and produces different varieties of paper. The physico-chemical characteristics of effluent from this mill revealed that the effluent is light brown in colour, pH shows alkaline nature of the effluent, SS, BOD, COD are the parameters from the treated effluent is high in concentrations compared to Indian standards.

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List of tables and figures

Table.1 .Comparison of treated effluent with standard values

Parameters	Unit	Average values	Onland for irrigation IS-3307(1974)
pH	-	6.9	5.5–9.0
COLOUR	Hazen unit	Light brown	-
SS	mg/l	443	200
TDS	mg/l	910	2100
DO	mg/l	-	-
BOD	mg/l	202	100
COD	mg/l	892	250

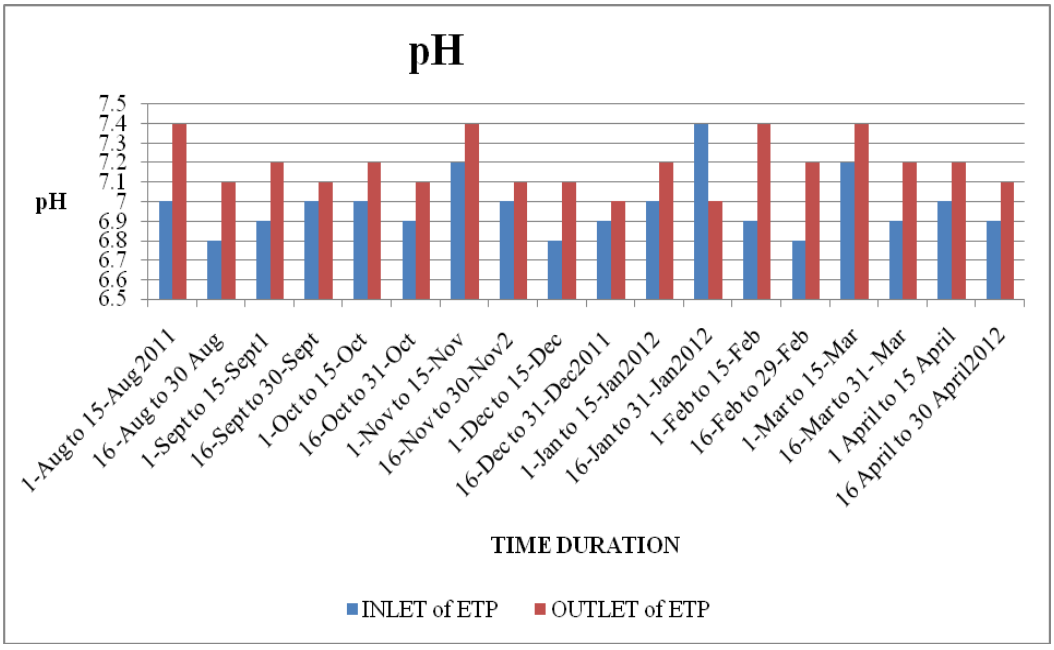

Fig. 1: Graph 1. showing results of pH from inlet and outlet.

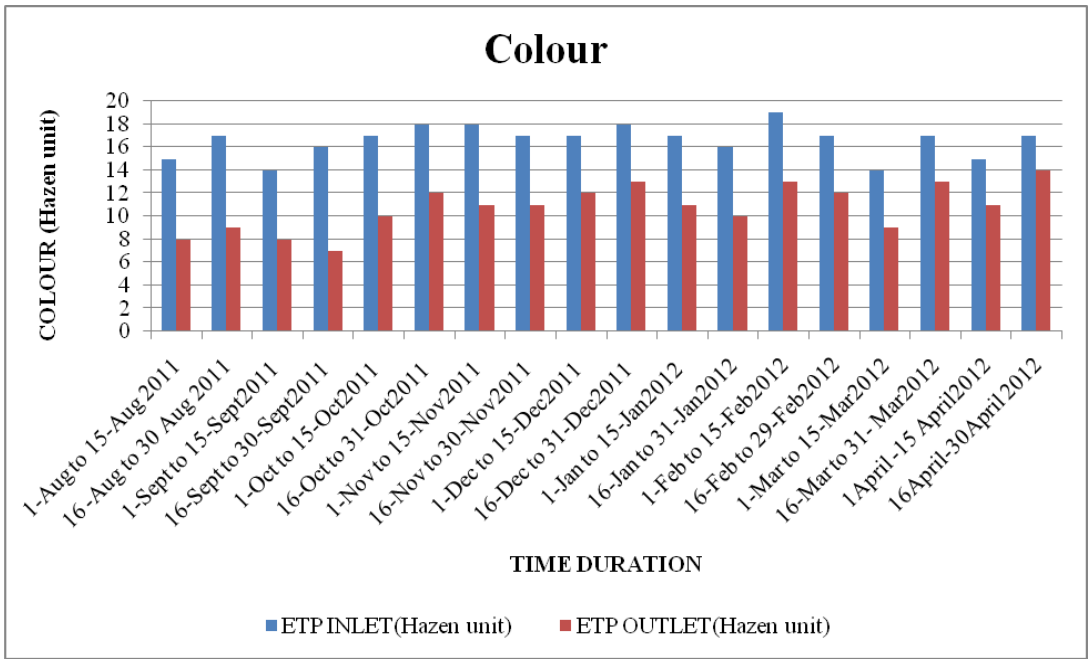

Fig. 2: Graph 2 showing results of colour from inlet and outlet

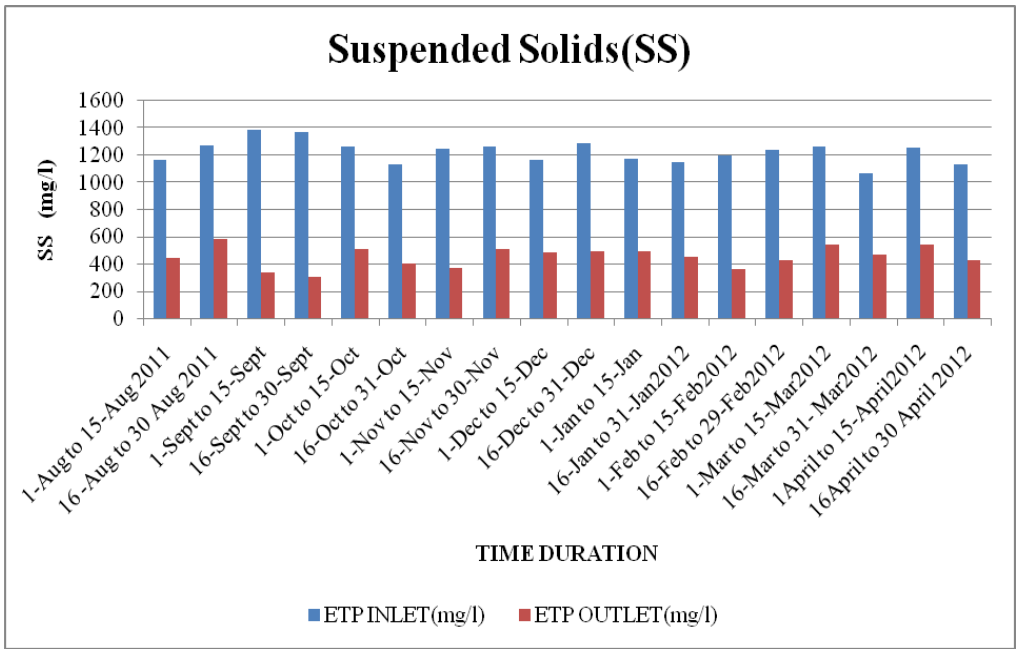

Fig. 3: Graph 3 showing results of suspended solids from inlet and outlet

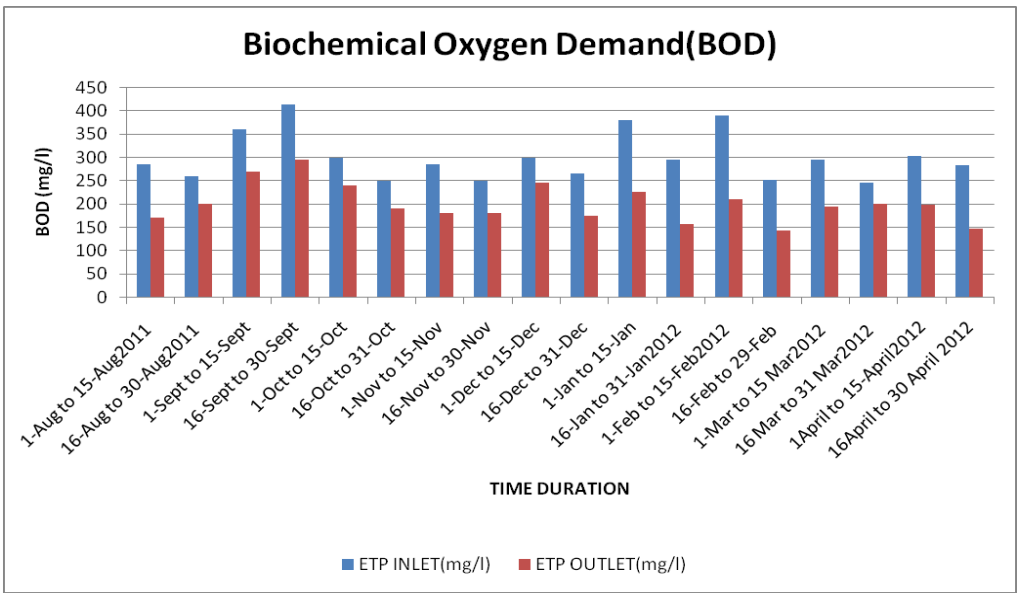

Fig. 4: Graph 4 showing results of Total Dissolved Solids from inlet and outlet

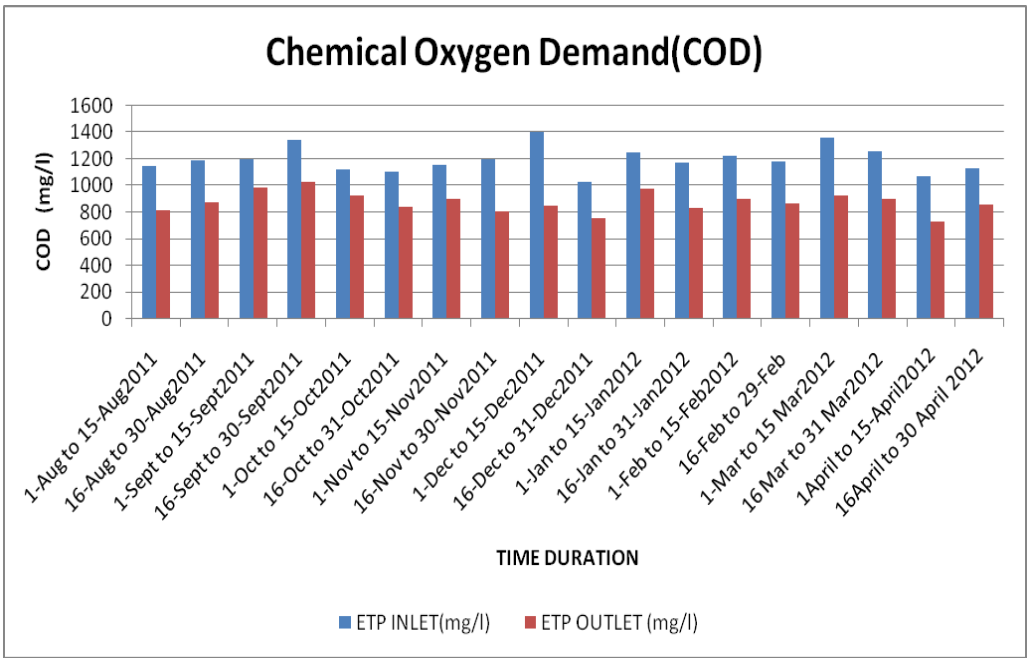

Fig. 5: Graph 5 showing results of Biochemical Oxygen Demand from inlet and outlet

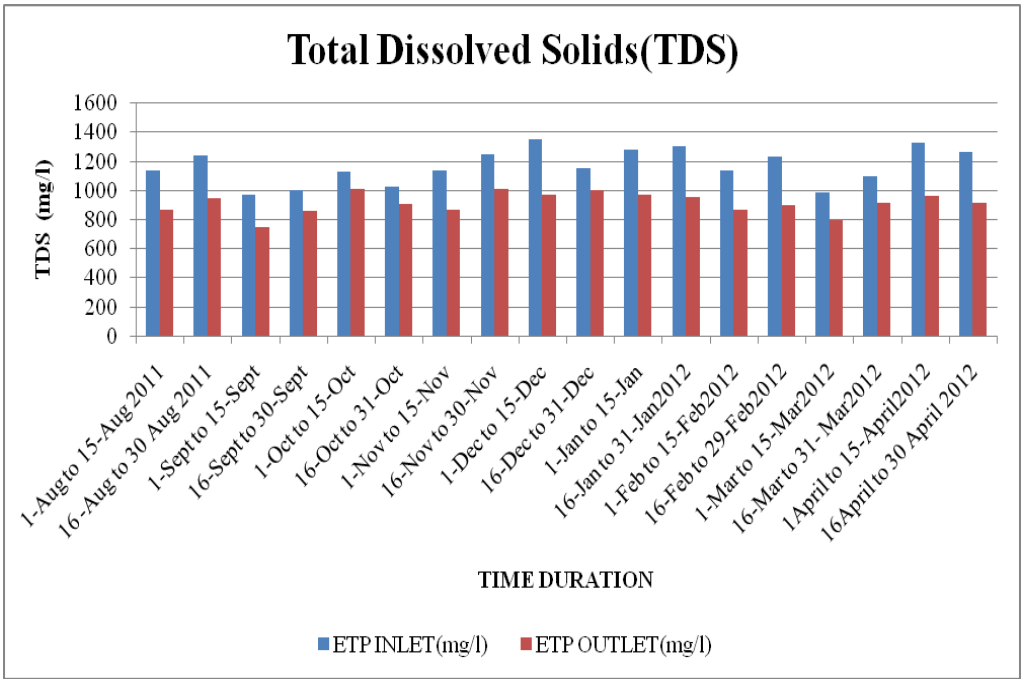

Fig.6: Graph 6 showing results of Chemical Oxygen Demand from inlet and outlet