RESEARCH ARTICLE OPEN ACCESS

Performance Evaluation of Effluent Treatment Plant For Thermal Power Plant

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ABSTRACT

The physical and chemical parameters in Thermal Power Pant wastewater were determined. The work of the present study is aimed at determining the physical and chemical parameters of the waste water or the effluent, at inlet and outlet of the effluent treatment plant located at about 20 kms from Nagpur. Thermal Power Plant wastewater were collected for the determination of pH, temperature, phosphate, SS, TDS, COD, and heavy metals using standard procedures. The variation in the parameters at temperature values observed were 31 - 33^{0}C at inlet and 30 - 32^{0}C at outlet. pH values observed were 7.4 - 7.9 at Inlet & 7.1 - 7.5 at Outlet. COD values observed were 40 - 92 at Inlet & 32 - 68 at Outlet. Variation in the heavy metal parameter at Chromium value observed were 0.23 - 0.34 at Inlet and 0.16 - 0.26 at Outlet. Copper value observed were 0.26 - 0.33 at Inlet and 0.15 - 0.32 at Outlet. The average performance efficiency of the plant is calculated for the period of study & observed to be 28.74 % for COD, 27.31 % for TDS, 22.26 % for Chromium, and 19.34 % Copper. The mean concentration of the Cr, Fe are found to be beyond the permissible limits set by Indian standards set for discharge of effluent to the rivers, hence it should be closely monitored.

Key words: Chemical, Physical Parameters, Heavy Metals, Power Plant, wastewater.

I. INTRODUCTION

Industries are major sources of pollution in all environments. Based on the type of industry, various levels of pollutants can be discharged into the environment directly discharged into the river. The industrial waste water is disposed off from different processes; hence we need to analyze it to design the treatment process, most suitable for it. The analysis & characterization of waste water helps us to design appropriate treatment process. (Langer S, Schroedter F, Demmerle C et al., (2000), (Torabian A, Hassani A, Babai F, Boshkoh F et al., (2004).The analysis of waste water ensures good quality water, after treatment for reuse. Effluent Treatment Plant (ETP) that is accurately formulated and environment friendly. Used in various factories, the treatment plant helps in solving the environment pollution problem without exposing the waste material to the environment. Easy to operate and low in maintenance, the range is extensively used in power plants, chemical, food and beverage, oil and petrochemical industries. Effluent treatment plants (ETP) are designed to provide a pollution free working environment and recycle the water for other applications. The industrial effluent treatment plants (ETP) involve different stages of treatment including physio- chemical treatment and biological treatment followed by tertiary treatment. The result indicate quality and quantity of that wastewater in power plant depend on the type of fuel, combustion units capacity, their operation and material used in this structure.
(Torabian A, Hassani A, Babai F, Boshkoh F. et al., (2004). The quality of the discharged effluents will conform to Indian Standards for liquid effluents for thermal power plants as per EPA Notification. The plant will generate effluent and waste during operation phase. The liquid effluents are generated from a number of units during operation of a power plant. Proper treatment of the streams can reduce the amount of discharge of pollutants in wastewater (Al-Zboon K, Al-Ananzeh N et al., (2008). The liquid effluents are generated from a number of units during operation of a power plant. Proper treatment of the streams can reduce the amount of discharge of pollutants in wastewater and also reuse of the treated streams helps in conservation of water.

Water is essential for all socio-economic development and for maintaining healthy ecosystems. As population increases and development calls for increased allocations of groundwater and surface water for the domestic, agriculture and industrial sectors, the pressure on water resources intensifies, leading to tensions, conflicts among users, and excessive pressure on the environment. The major uses of water are for irrigation (30%), thermal power plants (50%), and while other uses are domestic (7%) and industrial consumption. The importance of reuse and recycling of treated industrial effluents has been realized on account of two distinct advantages: reduction of pollution in the receiving water bodies and reduction in the requirement of fresh water for various uses. Power plants generate electrical energy from thermal energy (heat). Since heat is generated by burning fossil fuels like coal, petroleum, or natural gas, these power plants are also collectively referred to as the fossil fueled power plants. Coal power plants were the earliest of the fossil power plants to have been built. Even today, coal is the most common fuel that is used by thermal power stations. Reuse and recycling of liquid effluents to the extent possible has been considered. Cooling tower blow down will be used for ash handling. Ash water from ash pond will be recycled back to the system after proper treatment. All other service water will be treated and collected in a common mixing basin (CMB). As much of treated wastewater will be reused in the plant for cleaning, gardening and dust suppression. Excess will be discharged through a single point. The quality of the discharged effluents will conform to Indian Standards for liquid effluents for thermal power plants as per EPA Notification. The area under study is a coal based thermal power station with the installed capacity of 210*4 MW, located about 20-25 kms from city. It requires about 14000MT of Coal Per Day which is brought in by Rail. The ETP reduces the water load of the plant, reduces wastage, helps protecting the environment and improves the water productivity of the plant. Among the liquid effluents generated in the plant, the major quantities come from cooling tower blow down. Major pollutants in CTBD can be suspended solids and others like chlorine, zinc, chromium and phosphate. Boiler blow down is done to control dissolved solids in boiler water. ETP consist of oil scrapper, plate settling, aeration chamber, chemical mixing, to separate oil and suspended solids. The area under study is a coal based thermal power station with the installed capacity of 210*4 MW, located about 20-25 kms from city. It requires about 14000MT of Coal per Day which is brought in by Rail. Some quantity of coal is also received by the rope way. The water requirement for various activities in the power station is 91000 M^3 per day, of this 65000 M^3 per day is fresh requirement the average daily recovery from Ash Bund is 14000 M^3 and the average daily recovery from the Effluent Treatment Plant is 12000 M^3. The area under study is a coal based thermal power station with the installed capacity of 210*4 MW, located about 20-25 kms from city. It requires about 14000MT of Coal per Day which is brought in by Rail. Some quantity of coal is also received by the rope way. The water requirement for various activities in the power station is 91000 M^3 per day, of this 65000 M^3 per day is fresh requirement the average daily recovery from Ash Bund is 14000 M^3 and the average daily recovery from the Effluent Treatment Plant is 12000 M^3. It has functional Electrostatic Precipitator to extract the Fly Ash from the Flue Gas. To reduce the effect of flue gases being released in the atmosphere Massive Tree Plantations for sustained development has been done. The liquid effluents are generated from a number of units during operation of a power plant. Proper treatment of the streams can reduce the amount of discharge of pollutants in wastewater and also reuse of the treated streams helps in conservation of water. Among the liquid effluents generated in the plant, the major quantities come from cooling tower blow down. Major pollutants in CTBD can be suspended solids and others like chlorine, zinc, chromium and phosphate. Boiler blow down is done to control dissolved solids in boiler water. ETP consist of oil scrapper, plate settling, aeration chamber, chemical mixing, to separate oil and suspended solids. Blow down is done to control dissolved solids in boiler water. This stream mainly contains some dissolved salts, though the amount is generally low. This stream may contain phosphates or other chemicals used for prevention of scale formation and corrosion. Quality of blow down varies with boiler size, maintenance, quality of makeup water etc. and ranges between 0.1 – 1 % of steam flow. This consists waste water from different plant uses including washings, leakages, etc. This stream mainly contains suspended solids and at times oil & grease. This effluent will be passed through an oil separator unit for removal of particulates and oil. The effluent will be led to the coal particles settling tank to settle the coal particles. Major water treatment waste is generated from raw water treatment as sludge from the clariflocculators. Ash pond effluent will be collected at one end of the pond and most of the ash will be deposited in the pond. The overflow will be pumped back to an ETP consisting to remove the remaining particulates from the recycled ash water. This water will be sent back for ash handling again. Sludge from the system will be sent back to ash pond.

II. METHODOLOGY

The physical and chemical parameters in Thermal Power Pant wastewater were determined. Thermal Power Plant wastewater were collected for the determination of pH, temperature, phosphate, suspended solid (SS), total dissolved solid (TDS), chemical oxygen demand (COD), and heavy metals using standard procedures. The physical parameters (Temperature, pH, C.O.D, S.S, and TDS) and chemical parameters (PO4 ,Zn, Cu, Cr, Fe) are within the limits. The mean concentration of 100mg/l for S.S, 250 mg/l for C.O.D & 2000 mg/l for T.D.S.& 1.0 mg/l Cu,5.0 mg/l PO4, 1.0 mg/l Fe & Zn,0.2 mg/l Cr for the discharged of wastewater into river, As much of treated wastewater will be reused in the plant for cleaning, gardening and dust suppression. ETP wastewater samples were collected during the period of the study that lasted from August 2011 to Apr 2012. (Joseph C. Akan, Ph. et al., 2006) All samples were analyzed in G.H.Raisoni College/Environmental Engineering laboratory. The procedures of the Water and Wastewater Standards Methods were used for the analysis of the samples [IS 3025-1984].Table 2.1 Present the analysis of ETP parameter for thermal power plant.

Table 2.1 Parameter used for the analysis of ETP for Thermal Power Plant [IS 3025-1984].

Parameter	Concentration
Temperature	33°C
pH	6.5-8.5
C.O.D	250 mg/l
Total Dissolved Solid	2000 mg/l
Suspended Solid	100 mg/l
Phosphate	5.0 mg/l
Chromium	0.2 mg/l
Copper	0.2 mg/l
Iron	1.0 mg/l
Zinc	1.0 mg/l

2.2 Determination of Physical &Chemical Properties

Temperature & pH were determined using a pH meter; while the levels of total dissolved solid (TDS) were determined by using conductivity meter at the point of sample collections. Chemical Oxygen Demand (COD) was determined using closed reflux method.

$$\text{COD mg/l} = \frac{(A-B)\, N \times 8000}{V}$$

Where,
A= Volume in ml. Ferrous ammonium sulphate for blank
B= Volume in ml. Ferrous ammonium sulphate for Sample
V= Volume of Sample
N=Normality of ferrous ammonium sulphate
Suspended Solid (SS), 100ml of the wastewater samples were filtered through a pre weighed filtered paper. The filtered papers were dried at 103-105°C. TDS & SS was determined by using the following Formula;

$$\text{TDS (mg/l)} = \frac{\text{mg of residue X 1000}}{\text{Ml sample}}$$

2.3 Determination of Heavy Metals in Wastewater Samples

Wastewater samples were taken from thermal power plant in August 2011.The wastewater originating from different dissolved heavy metals particularly PO4, Cu, Fe, Zn and Cr. Release of heavy metals from this wastewater into the environment will have potentially negative impacts on soil, groundwater and surface water quality as well as human health. . (Saeedi M, et al., 2006)

3.0 RESULTS & DISCUSSIONS

1) pH

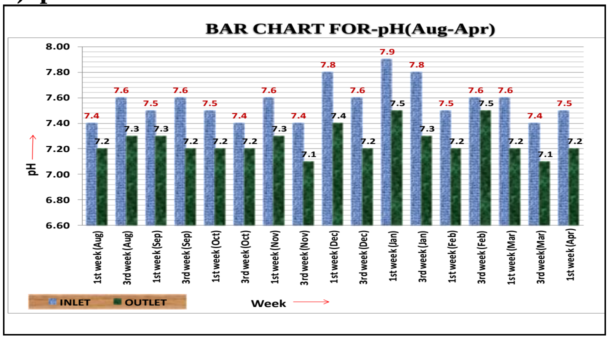

Fig.1 Shows Variation in pH from Inlet and Outlet of ETP

2) CHEMICAL OXYGEN DEMAND

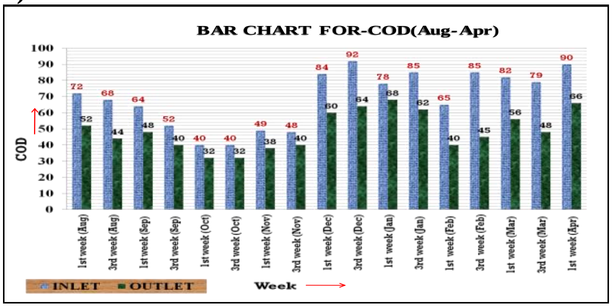

Fig.2 Shows Variation in COD from Inlet and Outle

3) TOTAL DISSOLVED SOLID

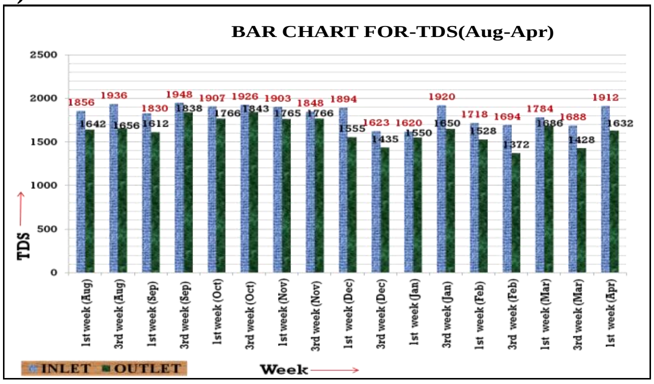

Fig.3 Shows Variation in TDS from Inlet and Outlet of ETP

4) SUSPENDED SOLID

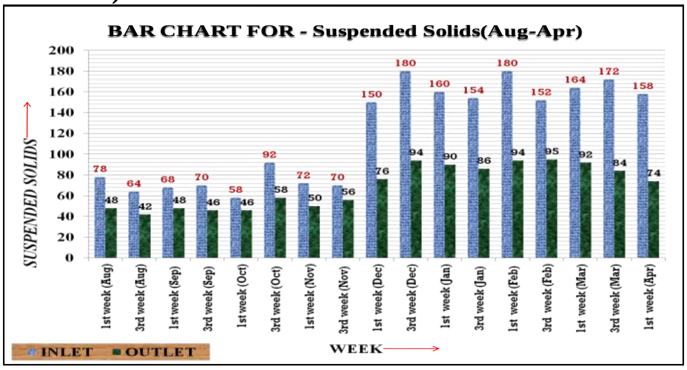

Fig.4 Shows Variation in Suspended Solid from Inlet and Outlet of ETP

5) CHROMIUM

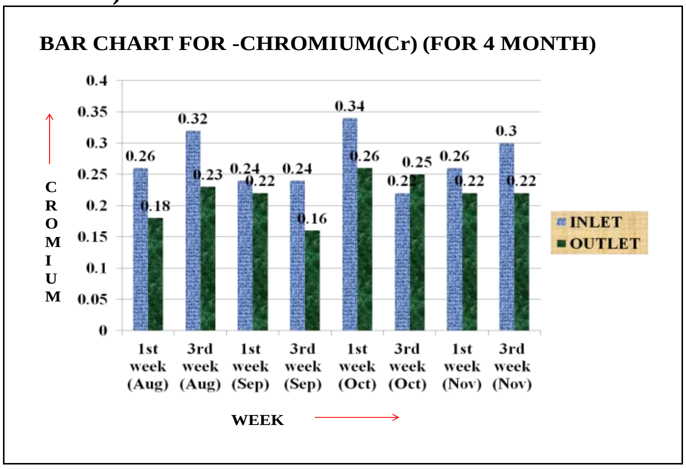

Fig.5 Shows Variation in Chromium from Inlet and Outlet of ETP

6) COPPER

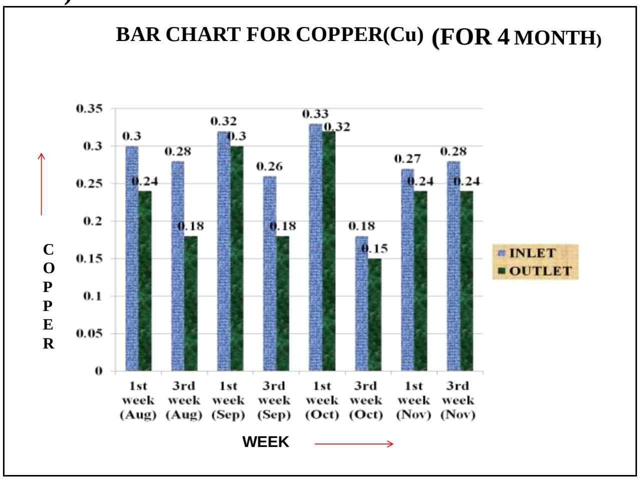

Fig.6 Shows Variation in Copper from Inlet and Outlet of ETP

6) IRON

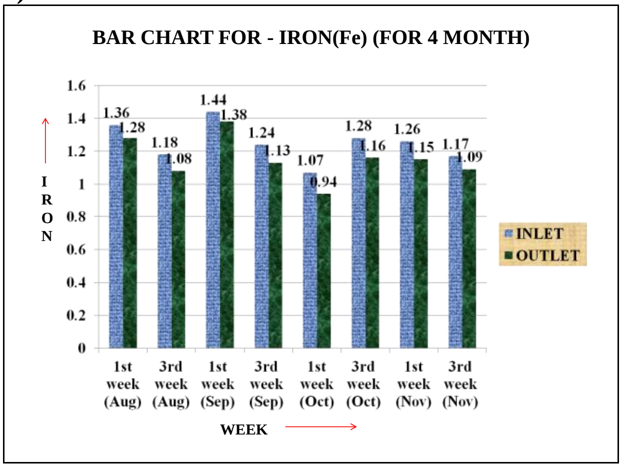

Fig.6 Shows Variation in Iron from Inlet and Outlet of ETP

7) ZINC

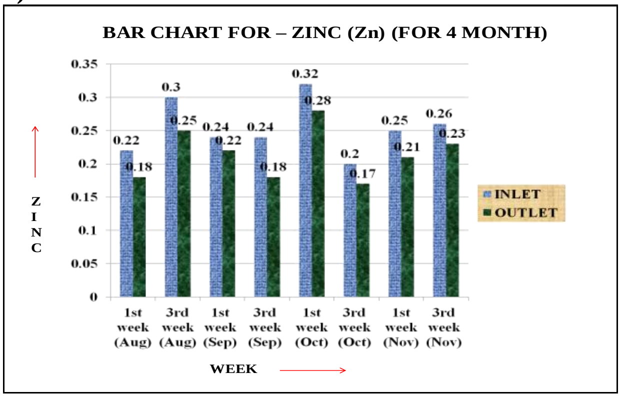

Fig.7 Shows Variation in Zinc from Inlet and Outlet of ETP

The pH of the Power Plant wastewater sample is basic with pH values inlet ranging varies from 7.9 to 7.4 and from 7.5 to 7.1 at outlet of the ETP. pH is the measure of acidity and alkalinity of water. However, the IS Permissible limits of pH 6.5-8.5 for the discharged of wastewater from all industries into river. The level of temperature in the Power Plant wastewater basic values inlet ranging varies from 31-33 and from 32-30 at outlet of the ETP. IS Permissible limits of temperature is 31-33°C. While that of COD ranged from 250 mg/l. The COD removal efficiency of the plant is consistent and is ranges from 20% to 40%. The concentration of TDS in the Power Plant wastewater sample ranged from 2000 mg/l and level of SS ranged from 100 mg/l. The concentration of heavy metals in Thermal power plant wastewater sample is as presented in table 2.1. The levels of PO4 ranged from 0.40-0.60 mg/l in Inlet & 0.38-0.52 mg/l in Outlet; IS Permissible limits PO4 of 5.0 mg/l. Level of Cr is 0.22-0.34 mg/l in Inlet & 0.18-0.26 mg/l in Outlet. Level of Cu is 0.18-0.33 mg/l in Inlet & 0.15-0.32 mg/l in Outlet. Range of Cr, Cu, Fe was found to have the highest concentration in the Power Plant wastewater was higher than the Indian standard for the discharge of wastewater into river.

III. CONCLUSION

The pH, COD removal efficiency was observed to be 8%, 55% respectively. & Heavy metals PO_4, Cr removal efficiency was observed to be 37%, 41% respectively. The waste water flow from the processing unit is highly fluctuating. The treated water at ETP is used for various purposes such as gardening, cleaning, fly ash and bottom ash removal. This reduces the specific water consumption of the plant and thus reduces the generation cost as well.

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