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Study on Efficiency of Effluent Treatment Plant

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ABSTRACT

Waste water management is one of the most important problem of world. Industrial establishment resulted into environmental degradation, industrial process discharges variety of waste water pollutants in large quantity. Nowadays emphasis is laid on waste minimization therefore, it is necessary to evaluate monitor and check various environmental parameters weather they are complying with standard given by regulatory authority or not. In this study, waste water was collected from inlet and outlet point of ETP for the determination of pH, TSS, TDS BOD, COD and Oil & Grease using standard procedure. The BOD, COD and suspended solids in treated effluents were reduced significantly, whereas very small reduction was observed in Total dissolved solids in treated effluents in comparison to raw effluents. Most of the parameters of effluent were well within the permissible limits of Central Pollution Control Board, India.

Key Words: Effluent Treatment Plant, Performance evaluation, Monitoring, Parameters.

Introduction

Industrial waste water contains a variety of pollutants, necessitating the use of a specific treatment method called ETP. The goal of an effluent treatment plant is to discharge clean water into the environment while protecting it from the negative effects of the effluent. ETPs are one form of waste water treatment process. Treatment of waste water is performed to remove suspended particles, BOD, COD, Oil &Grease, organic matter, inorganic materials, and other impurities (Nain et al.2015).

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 of from different processes. The treatment of waste water ensures good quality water 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 (Asiwal et al. 2016). 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 physico-chemical treatment and biological treatment followed by tertiary treatment. 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. (Kamdi et al. 2013).

Today due to industrialization the quality of water is degrading continuously. So it is necessary to determine the quality of waste water, which is releasing from the industry and also determine the condition of effluent treatment plant for the treatment to reduce the pollution load from the waste water (Chaurasia et al. 2013). Many manufacturing industries discharging its effluent in large quantity into nearby water body. It may be very harmful to water body as well as for ecology. It may destroy the aquatic ecology. Wastewater monitoring plays an important role to identify the limit of elements and chemicals, which may be injuries to natural aquatic system.

Pollution of inland surface water is a threat to natural ecosystem and lifestyle of people as well. The quality of such effluents can be determined by their physico-chemical and biological analysis (Alam et al. 2017).

Need of ETP

•To clean industry effluent and recycle it for further use.

•To reduce the usage of fresh/potable water in Industries.

•To cut expenditure on water procurement.

•To meet the Standards for emission or discharge of environmental pollutants from various Industries set by the Government and avoid hefty penalties.

•To safe guard environment against pollution and contribute in sustainable development.

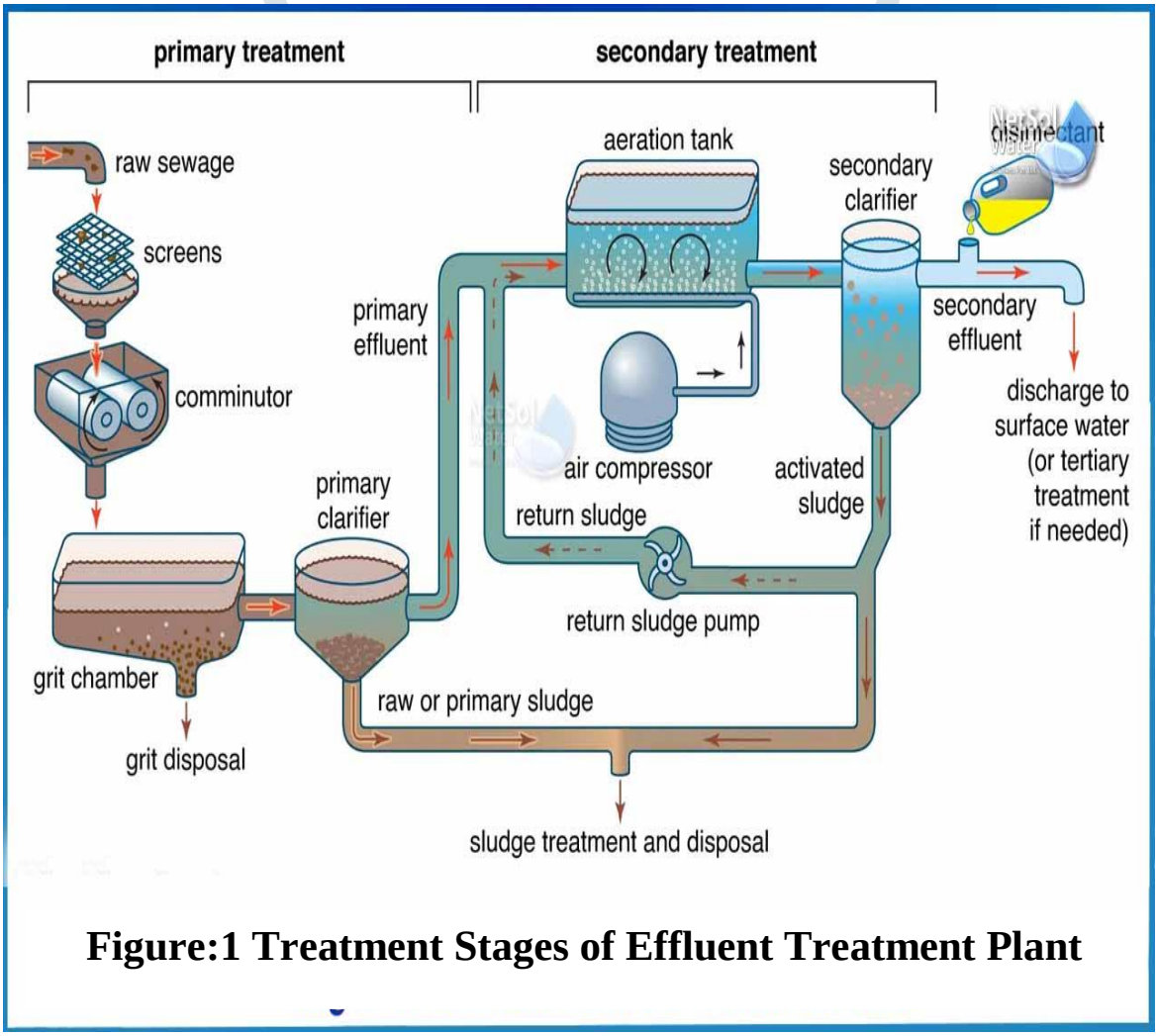

Figure:1 Treatment Stages of Effluent Treatment Plant

Source:-www.neoakruthi.com

The main aim of study was:

1. To assess the physical and chemical properties of waste water samples collected from inlet and outlet point of Effluent Treatment Plants.
2. To determine the removal percentage of various parameters studied.
3. To compare the treated effluent quality with discharge standard given by CPCB.

Material & Method

The samples were collected from inlet & outlet point of ETP. The volume of the sample collected in a day was 5 liters at each point. Samples were collected in clean plastic container. After collection, the container was tightly closed, marked and labeled. The samples were brought to the laboratory for the chemical analysis. The waste water samples were analyzed for physical and chemical parameters. The physical & chemical parameter includes pH, TSS, TDS, BOD, COD and Oil & Grease. All the parameters were analyzed as per standard methods APHA AWWA WPCF 2005.

Results and discussion

The samples were collected from Inlet & outlet point of ETP. Five-liter sample was collected in clean plastic container from each point in weekly interval. After collection, the container was tightly closed, marked and labeled. The samples were brought to the laboratory for the chemical analysis. The waste water sample was analyzed for physical and chemical parameters and the results obtained are discussed below: -

pH

pH is a crucial factor in determining the quality of the water. Bitter tests result from high pH. Chlorine efficacy is decreased by coated water pipes and appliances. The mucous membrane of the cells is affected if the pH is discovered to higher above the acceptable range (6.5-8.5) (Brahmbhatt and Pandya 2015). The pH of inlet sample was measured in ranged from 6.88 - 6.99 with an average 6.94, while the pH of the outlet sample was observed in ranged from 7.12 - 7.92 with an average of 7.62 (Table.1). The data indicate that the pH of outlet sample of ETP was found in acceptable range of 6.5 – 8.5 (Table-8).

Table: - 1 pH of inlet and outlet sample

Observations	Inlet	Outlet
Observation 1	6.88	7.12
Observation 2	6.94	7.82
Observation 3	6.99	7.92
Average	**6.94**	**7.62**
± S.D.	**0.06**	**0.44**

Total Suspended Solids (TSS)

The amount of suspended materials that is present in water is referred as suspended solid component of effluent. Silt clay, tiny organic and inorganic particles and suspended solids are considered a form of pollution since they are insoluble and can lead to a number of issues (Sahithya and Chandana Lakshmi 2016). The TSS of Inlet sample was observed between 242 – 340 mg/l, with an average of 282 mg/l being recorded. Whereas the TSS of Outlet sample was between 22 - 32mg/l, with an average of 27.33 mg/l (Table 2). The percentage removal of TSS was found 90.30 % (Fig.2). The permissible limit of TSS is 30mg/l (Table 8). In this study, TSS has found in the permissible limit which is indicating that ETP is removing TSS effectively.

Table: - 2 TSS (mg/l) of Inlet and Outlet sample

Observations	Inlet	Outlet	% Removal
Observation 1	242	22	90.90
Observation 2	340	28	91.76
Observation 3	264	32	87.88
Average	**282**	**27.33**	**90.30**
± S.D.	**51.42**	**5.03**	

Total Dissolved Solids (TDS)

The weight of residue that remains after a water sample has been evaporated to dryness is used to express the amount of TDS (Total Dissolved Solids). TDS levels in water under 500 mg/l are considered to have acceptable palatability (Mehta et al. 2021). The TDS of Inlet sample was measured in ranged between 638 – 760 mg/l with an average of 708.67 mg/l. while the TDS of Outlet sample was observed in ranged between 602 - 734 mg/l with an average of 682.67 mg/l (Table 3). The percentage removal of TDS was observed 3.67% (Fig.2). The permissible limit of TDS is 100 mg/l (Table 8). In this study, TDS in outlet sample has found higher than the permissible limit which is indicating that ETP is not removing TDS effectively.

Table: - 3 TDS (mg/l) of Inlet and Outlet sample

Observations	Inlet	Outlet	% Removal
Observation 1	760	734	3.42
Observation 2	638	602	5.64
Observation 3	728	712	2.19
Average	**708.67**	**682.67**	**3.67**
± S.D.	**63.26**	**70.72**	

Biological Oxygen Demand (BOD)

The BOD rises as organic matter in water breaks down. It is a gauge of how clean the water is. Less than 1.0-2.0 mg/l can be regarded as clean, 3.0 mg/l as fairly clean, 5.0 mg/l as doubtful clean and 10.0 mg/l as poor (Uddin et al. 2018). The BOD of Inlet sample was found in ranged 147 – 208 mg/l with an average 181.33 mg/l while the BOD of Outlet sample was measured in ranged 19 – 32 mg/l with an average 25.67 mg/l (Table 4). The percentage removal of BOD was observed 85.84% (Fig.2). The acceptable limit of BOD is 30 mg/l (Table 8). In this study, BOD was found in permissible limit which is showing that ETP is effectively removing BOD.

Table: - 4 BOD (mg/l) of Inlet and Outlet sample

Observations	Inlet	Outlet	% Removal
Observation 1	147	19	87.07
Observation 2	189	26	86.24
Observation 3	208	32	82.35
Average	**181.33**	**25.67**	**85.84**
± S.D.	**31.21**	**6.51**	

Chemical Oxygen Demand (COD)

Chemical Oxygen Demand is the amount of oxygen needed to break down organic waste, both bio-degradable and non-bio-degradable. The availability of organic material in water is determined by the COD, making it useful as a key indication of organic pollution (Desai and Kore 2011). The COD of Inlet sample was observed in range of 664 – 842 mg/l with an average of 751.33 mg/l whereas Outlet sample was measured in range of 78 – 128 mg/l with an average of 105.33 mg/l (Table 5). The percentage removal of COD was observed 85.97% (Fig.2). The permissible limit of COD is 250 mg/l (Table 8) and in this study COD was observed under the acceptable limit which is showing that ETP is performing well.

Table: - 5 COD(mg/l) of Inlet and Outlet Sample

Observations	Inlet	Outlet	% Removal
Observation 1	664	78	88.74
Observation 2	748	110	85.29
Observation 3	842	128	84.79
Average	**751.33**	**105.33**	**85.97**
± S.D.	**89.05**	**25.32**	

Oil and Grease(O&G)

Oil and Grease in water can cause surface films and shoreline deposits, leading to environmental degradation and can induce human health risks when discharged in surface or ground water (Mishra et al. 2009). The Oil & Grease of Inlet sample was observed in ranged 9.4 - 12.4 mg/l with an average of 10.93 mg/l while Outlet sample was measured in ranged 2.8 - 4.8 mg/l with an average of 3.67 mg/l (Table 6). The percentage removal of Oil & Grease was observed 66.42% (Fig.2). The permissible limit of Oil & Grease is 10 mg/l (Table 8). During this study, Oil & Grease was measured under permissible limit which is indicating that ETP is performing well.

Table: - 6 Oil & Grease(mg/l) of Inlet and Outlet sample

Observations	Inlet	Outlet	% Removal
Observation 1	11	2.8	74.54
Observation 2	9.4	3.4	63.17
Observation 3	12.4	4.8	61.71
Average	**10.93**	**3.67**	**66.42**
± S.D.	**1.50**	**1.03**	

Table: - 7 Average and % removal of various parameters

Parameters	Inlet mg/l	Outlet mg/l	% Removal
pH	6.94	7.62	–
TSS	282	27.34	90.30
TDS	708.67	682.67	3.67
BOD	751.34	105.34	85.97
COD	181.34	25.67	85.84
Oil & Grease	10.93	3.67	66.42

Fig. 2 % Removal of Various Parameters

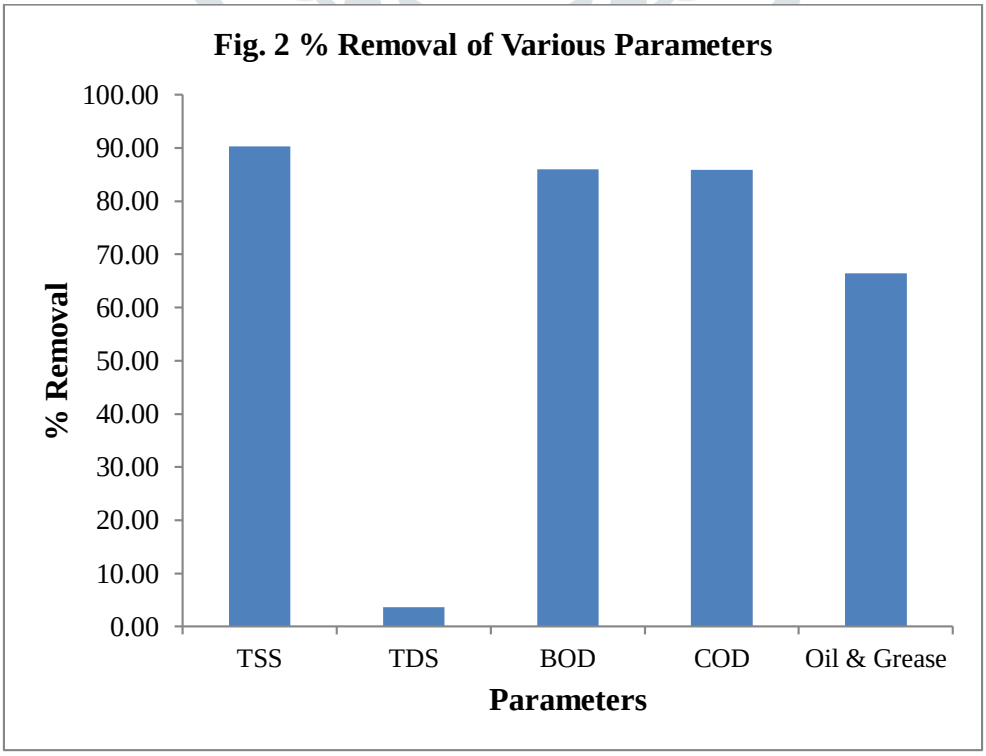

Table: -8 Typical Effluent Discharge Limits

S. No.	Parameters	Limit
1.	pH	6.5 – 8.5
2.	TSS	30 mg/l
3.	TDS	100 mg/l
4.	Biological Oxygen Demand	30 mg/l
5.	Chemical Oxygen Demand	250 mg/l
6.	Oil & Grease	10 mg/l

Source: Central Pollution Control Board

Conclusion

From the study it can be concluded that priority for the improvement in ETP performance is to bring down TDS. In order to achieve this additional facility for removal of TDS in primary treatment section and optimized dosing of chemical is required.

The overall percentage removal of TSS, TDS, BOD, COD and Oil & Grease in the effluent treatment plant during the study period was found in the range of 90.30, 3.67, 85.97, 85.84 and 66.42 respectively`

Recommendation

1. Proper loading to the existing treatment plant capacity.
2. Regular monitoring of pH, solids, BOD, COD and Oil & Grease.
3. Skilled manpower for operation and maintenance of effluent treatment plant.
4. The treated effluent can be used for green belt development.
5. Strong environmental regulations should be enacted and enforced specially in industry.
6. Momentum should be increased in developing nation that recycling loop from the point of generation to point of treatment and reuse must be shortened.

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