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Design of effluent treatment plant for Waste Tyre Pyrolysis Industry, Siltara, Raipur

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Appropriate design techniques, precise construction along with efficient operation as well as maintenance is primarily essential to the plants involving waste water treatment, to produce the residual amount of effluents which satisfies safe disposal standards which are recommended by the legal regulatory authorities. Main objective of this study was to design an efficient waste water treatment plant for Waste Tyre Pyrolysis Industry, Siltara. The design parameters as well as operational aspects involved in an Effluent Treatment Plant (ETP) especially for Waste Tyre Pyrolysis process were also studied. The parameters required in design stage have been looked into and the quantitative as well as qualitative aspects associated with effluent treatment were studied following empirical formula and standard IS codes. The pH reduced from 8.1 to 6.1; TSS: 3582-86 mg/L; TDS: 3558-118 mg/L; COD: 9819-137 mg/L and BOD: 4740-95 mg/L respectively. Finally treated water is being used in industry for other purposes, such as for ash quenching, spraying on coal etc.

Keywords: Effluent Treatment Plant (ETP), Waste Tyre Pyrolysis, design, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD).

Introduction

Narmada industries which was located in Murethi, Siltara, Phase 2, Raipur. It's started business operations in since 2008. Narmada Industries Pvt. Ltd. is manufacturing pyrolysis oil from waste tyres. In Narmada industries installed effluent treatment plant of 10000 litres per day capacity. The treatment is done in four stages such as preliminary, primary, secondary and tertiary treatment.

The treatment of waste tyre pyrolysis industries effluent (waste water) have very different strategies for removing various types of pollutants and particles. In our study, research have been undertaken for wastewater from waste tyre pyrolysis industries. Innovative technologies are developed for treatment of wastewaters from waste tyre pyrolysis industries which is an alarming concern to us. Even though researches shows about studies of waste water pollution but none of them worked on its treatment mainly in ETP systems. Unique feature of our work is recycling, reuse of sludge and water of waste tyre pyrolysis industries.

Materials and methods

Characterization of effluent of Waste Tyre Pyrolysis Industry:

Effluent samples were analysed according to standard methods for characterization of wastewater (APHA, AWWA 2005).

Design of effluent treatment procedure depended on the inlet quality of the effluent. Various principles, empirical formulae from standard references, hand books were applied.

Samples were collected from outlets from each stage in effluent treatment plant. The characteristics such as pH, COD, BOD, TDS, and TSS of waste water samples were determined using APHA standards.

Flow sheet of effluent treatment plant:

Fig. 1 flow sheet of designed of effluent treatment plant for Waste Tyre Pyrolysis Industry.

Preliminary treatment: Effluent from plant is initially passed through bar screens followed by oil and grease trap tank to remove large solids, grit and grease.

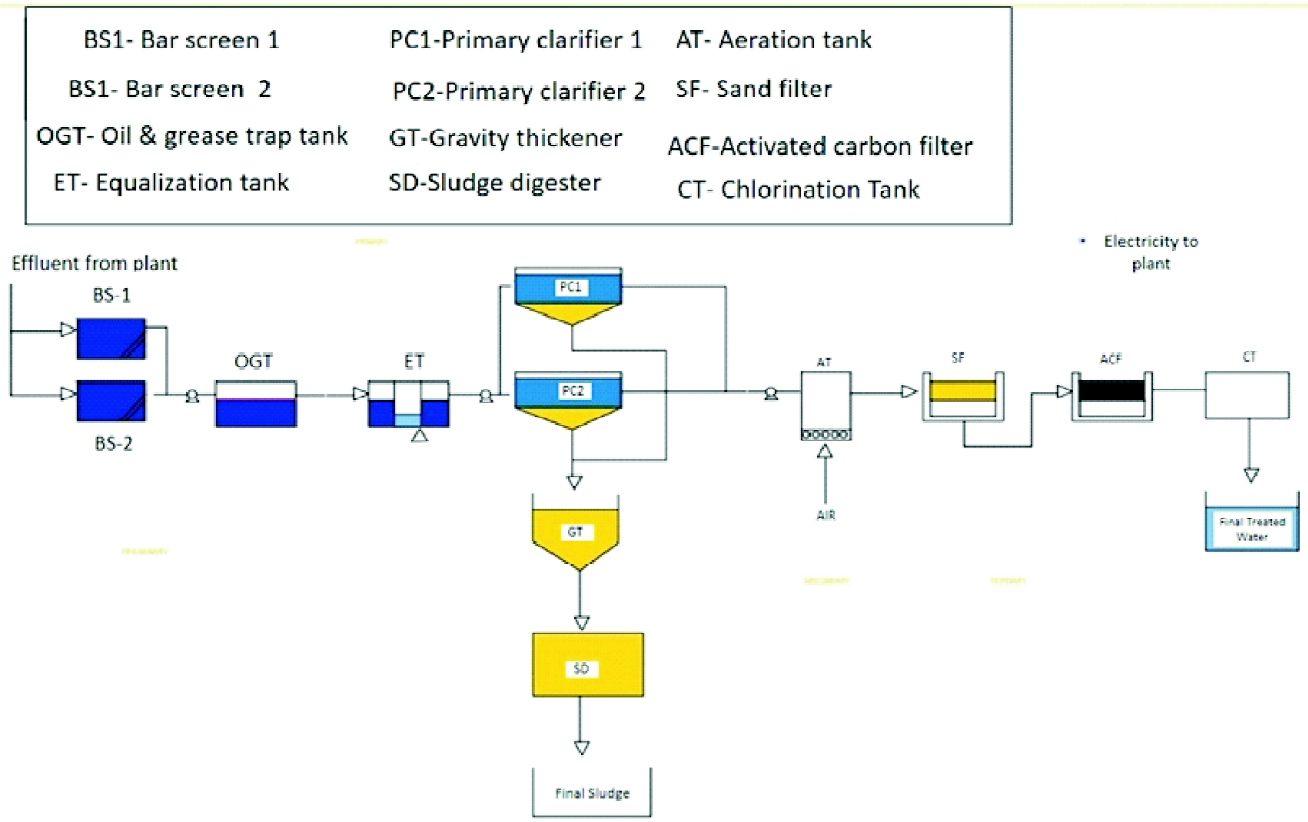

Fig. 1. Flow sheet of effluent treatment plant.

Primary treatment: Effluent from plant after passing through the screen is sent to the oil and grease trap tank where oil is separated from water, which can be used for furnace recharge. Here, the oil and grease tank specially is designed to separate the water. Then, the effluent is sent to equalization tank, fitted with jet aerator for homogenization of effluent. Hydrochloric acid (HCl) is added to neutralize the effluent in equalization tank. Later this effluent is pumped for coagulation process, alum is added as a coagulant. The settled sludge was removed from the bottom of tank while effluent is being passed to the aeration tank.

Secondary treatment: Air is supplied through jet aerator to effluent in aeration tank. The dissolved organic matter is degraded by the action of bacteria in presence of oxygen, resulting in the formation of settleable solids. The bacterial concentration (MLSS) of 3000 mg/L and dissolved oxygen content of 2 mg/L is maintained in aeration tank. The jet aerator is fitted 0.3 metres above the bottom of the tank.

Tertiary treatment system: The effluent from secondary treatment system is pumped to sand filter followed by activated carbon filter. Then the effluent is chlorinated in chlorination tank. Finally the treated water is used for different applications like for ash quenching, for spraying on coal and cooling tower etc. The sludge is stored in poly/HDPE bags and sent through proper manifest to secured land-fill for proper disposal.

Summary of preliminary sizing of equipment is elaborated

Table 1. Bar screen

Depth of chamber (d)	1 m
Total width of opening at the rack (w)	0.5 m
Clear bar spacing (mm)	20
Number of bars	06
Width of bar (mm)	10
Thickness of bar (mm)	30
Width of the chamber (mm)	04
Height of the rack (m)	1
Angle of inclination of the bars to horizontal	60

from Tables 1 to 12.

Results and discussion

The pH of the waste water sample was reduced from 8.1 to 6.1, COD was reduced from 9819–137 mg/L, and BOD was reduced from 4740–95 mg /L. The total suspended solids (TSS) of the sample was reduced from 3582–86.3 mg/L, TDS was reduced from 3558–118 mg/L. So, all characteristics of treated water are within the permissible limits (Table 13).

Table 2. The oil and grease trap tank

Vertical velocity (cm/h)	6.5
Horizontal flow velocity (cm/h)	64.7
Minimum vertical cross sectional area (m^2)	0.54
Number of channels	01
Width of channel (m)	0.85
Depth of channel (m)	0.50

Table 3. Equalization tank

Number of equalization tank	01
Flow rate per tank Q (litre/h)	200
Retention time (h)	4
Area (m^2)	2
Volume (m^3)	2
Length (m)	2
Breadth (m)	1
Free board (m)	0.3
Inlet velocity (m/h)	2

Table 4. Primary clarifier

Number of tank	02 clarifiers in parallel
Flow rate per tank Q (litre/h)	200
Retention time (h)	02
Area (m^2)	1.2
Volume (m^3)	3
Breadth (m)	1
Height (m)	2.5

Table 5. Aeration tank

Number of tank	01
Flow rate per tank Q (litre/h)	206
Retention time (h)	02
Area (m^2)	2.0
Volume (m^3)	3.0
Breadth (m)	1
Height (m)	1.5

Table 6. Sand filter

Number of sand filter	01
Flow rate through sand filter Q (m^3/h)	205
Area (m^2)	2
Breadth (m)	01
Length (m)	02
Volume (m^3)	2

Table 7. Activated carbon filter

Number of sand filter	01
Flow rate through sand filter Q (m^3/h)	205
Area (m^2)	2
Breadth (m)	01
Length (m)	02
Volume (m^3)	02
Filtration duration (h)	08

Table 8. Chlorination tank

Number of tank	01
Flow rate of NAOCL/channel Q (litre/s)	0.05
Volume of tank (m^3)	02.5
Depth (m)	01
Breadth (m)	01
Cross sectional area (m^2)	02.5
Length (m)	02.5

Table 9. Effluent transfer pump

Number of pumps	03s
Flow rate (m^3/h)	1
Head of the pump (m)	25

Table 10. Lime alum PAC dosing pump

Number of pumps	01
Flow rate (litre/h)	6

Table 11. Jet aerator

Number of aerators	02
Flow rate (m^3/h)	10
Capacity (kw)	0.76

Table 12. Filter feed pump

Number of pumps	02
Flow rate (m^3/h)	1
Head of the pump (m)	30

Table 13

Stream	Effluent to bar screens	Barscreens to oil and grease trap tank	oil water separator to Eq. tank	Eq. tank to primary calrifiers	Primary calrifiers to aeration tank	Aeration tank to sand filter	Sand filter to activated carbon filter	Activated carbon filter to disinfection unit
pH	8.09	8.09	6.89	6.8	6.75	6.45	6.45	6.1
COD (mg/L)	9819	9819	9819	10600	4128	420	137	137
BOD (mg/L))	4740	4740	2170	3460	2569	298	95	95
TSS (mg/L)	3582	3582	4726	969	870	250	133	86
TDS (mg/L)	3558	3558	5600	3200	1170	320	175	118

Conclusion

Water pollution is controlled by establishing a wastewater treatment plant. Good pollutant removal efficiency depends on proper design, maintenance and operation of plant. Present study reveals that it is very necessary to have an effluent treatment plant for Waste Tyre Pyrolysis Industry. All treatment units were designed such that the effluent characteristics complies with national standards. Finally treated water is being used in industry for other purposes, such as for ash quenching, spraying on coal etc.

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