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Performance evaluation of effluent treatment plant for automobile industry

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Abstract
The automobile industry's wastewater not only contains high levels of suspended and total solids such as oil, grease, dyestuff, chromium, phosphate in washing products, and coloring, at various stages of manufacturing but also, a significant amount of dissolved organics, resulting in high BOD or COD loads. The study reveals the performance, evaluation and operational aspects of effluent treatment plant and its treatability, rather than the contamination status of the real property. The Results revealed that the treated effluent shows most of the parameters are within permissible limits of Central Pollution Control Board (CPCB), India and based on the site visits, discussion with operation peoples, evaluation of process design, treatment system, existing effluent discharge, results of sample analyzed and found that effluent treatment plant of automobile industry are under performance satisfactory.

Keywords: Effluent treatment plant; Physico-chemical properties; Tractor manufacture.

1. Introduction

Rapid growth of industries has not only enhanced the productivity but also resulted in the production and release of toxic substances in the environment, creating health hazards and affecting normal operations, flora and fauna. These wastes are potential pollutants that produce harmful effects. Wastewaters, which are generated from the automobile industries, are a cause of big problem to the environment [1]. Wastewater from automobile industry consists of high organic and inorganic matter with oil, grease and heavy metals. If partially treated or untreated wastewater is discharged, it causes a great damage the geo-environment [2]. The waste of motor vehicle industries is mainly the result of washing, coloring and various stages of chassis manufacturing which include oil, grease, dyestuff, chromium, phosphate and other pollutants [3]. The liquid wastes discharged from these industries are not voluminous, but are extremely dangerous because of their toxic contents [4]. From these industries and processes, wastewater may contain a variety of hazardous materials such as heavy metals (like chromium, zinc and nickel), organic micro pollutants (like polycyclic aromatic hydrocarbons), solvents, paints and other chemicals [5, 6]. Performance evaluation of existing treatment plants is required to assess the existing effluent quality and/or to meet higher treatment requirements [7]. Abdel [8] studied the upgrading of industrial wastewater treatment units at automobile industry. Wahaab [9] studied the assessment of automobile

industry wastewater treatment units. The main objective of the study is to critically examine the wastewater generation and performance evaluation of effluent treatment plant of the tractor industry.

2. Materials and methods

Performance appraisal is carried out by comparing the concentrations of pollutants at the inlet and outlet of the treatment unit. The grab samples were collected at the inlet and outlet of all the treatment units of automobile industry situated in district Raisen (Madhya Pradesh, India) and analysed as outlined in the standard methods for the examination of water and wastewater [10]. Wastewater generation with respect to production is reviewed and subsequently quantification at each source for wastewater would be made with the help of flow rate of the pumps, operating hours and flow measurement through suitable technology.

3. Results and discussion

The results are presented in three parts. The first part of the study deals with the description of effluent treatment plant and the second part deals with the evaluation of generation of wastewater from the existing industry and the third part deals with the physico-chemical characterisation of wastewater generated from the industry.

3.1 Effluent Treatment Plant

Existing effluent treatment plant was designed for 110 KL capacity based on physico-chemical treatment followed by secondary treatment. There is provision of removal of floating oil through gravity type separation and acid cracking of emulsified oil, which is intimated on contact with effluent water generated from engine assembly or CNC machine in later stages in treatment system (Figure 1). Provision of heavy metals treatment is also provided separately by addition of relevant chemical treatment through coagulation and primary sedimentation along with oil free effluent. Combined treatment of all 5 types of waste streams are carried out in primary treatment followed by secondary treatment (Table 1).

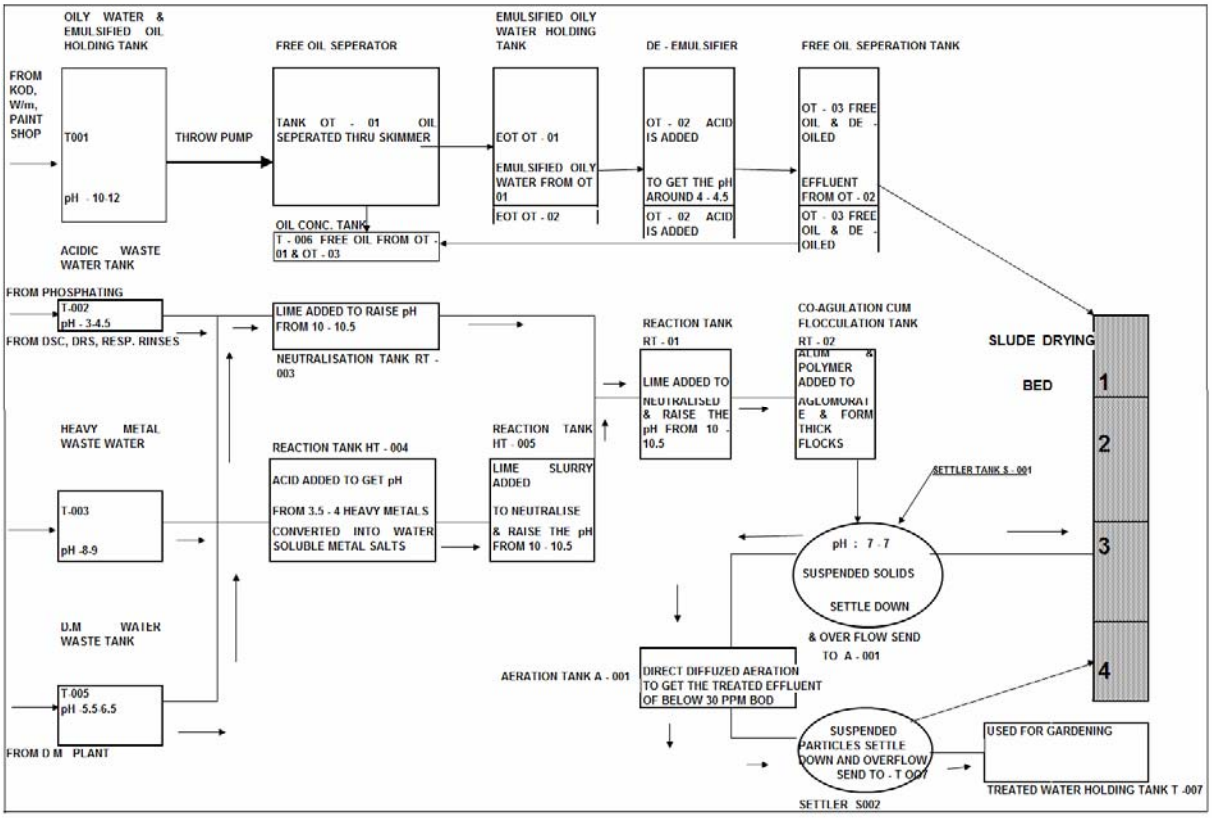

Figure 1. Flow diagram of effluent treatment plant

Table 1. Details of existing effluent treatment plant

S.N.	ETP Unit	Dimension	Holding Capacity
1	Oily & mulsified Waste Water Collection Tank (T-001)	3 mt x 3 mt x 16.70 mt	150 Cu. Mt.
2	Oily Emulsifier Tank (OT01)	3.5 mt x 1.5 mt x 3.0 mt	15.75 Cu. Mt.
3	Demulsified Oil Separator Tank (OT-03)	1.5 mt x 1.5 mt x 3.0 mt	7 Cu. Mt.
4	Acidic Waste Water Collection Tank (T-002)	3 mt x 3 mt x 5.5 mt	50 Cu. Mt.
5	Heavy Metal Waste Water Collection Tank (T-003)	3 mt x 1.5 mt x 2.25 mt	10 Cu. Mt.
6	Machine Wash Wastewater Collection Tank (T-004)	3 mt x 1.5 mt x 2.25 mt	10 Cu. Mt.
7	DM Waste Water Collection Tank (T-005)	3 mt x 3 mt x 3.30 mt.	30 Cu. Mt.
8	Oil Separator Tank (Acid Cracking)	1.5 mt x 4 mt x 5.0 mt	30 Cu. Mt.
9	Neutralization Tank (Flash Mixing)	1 mt x 1.5 mt x 1.0 mt	1.5 Cu. Mt.
10	Lime Solution Preparation Tank	1 mt x 1.5 mt x.1 mt	1.5 Cu. Mt.
11	Flocculation Tank (RT-02)	1 mt x 2.5 mt x 4.8 mt	12 Cu. Mt.
12	Primary Settler	5 mt Dia x 4 mt	80 Cu. Mt.
13	Secondary Settler	5 mt Dia x 3.5 mt	70 Cu. Mt.
14	Sludge Drying Beds (4 nos)	2 mt x 2mt	16 M^2
15	Treated Water Collection Tank	3 mt x 3 mt x 5.5 mt	50 Cu. Mt.

Pollution load is very less in coming effluent in terms of BOD & COD, except machine shop waste water, which is also very small quantity-wise. Where effluent from DM Water backwash is also helps to dilute the high polluting stream, which contains high TDS only. There is no provision of sludge recirculation in aeration tank to maintain MLSS & FM ratio to treat the effluent for biological treatment, which was planned in the original treatment scheme by TCE at initial project stages. In fact, oxidation of effluent is done in existing aeration tank in absence of sludge recirculation arrangement. However BOD level is very less at inlet of aeration tank, which gives advantage to take more hydraulic load in existing aeration tank with minor modifications in sludge recirculation arrangement. There is also no provision for chlorination of effluent & tertiary treatment, which was planned in original treatment scheme proposed by TCE at initial project stages.

3.2 Waste water generation

Based on actual water consumed in 3 shift operations of tractor industry and analyzed in comparison to effluent generated v/s tractor manufactured, it has been observed that highest effluent discharge per day was 76 KL. Maximum number of rolled out tractors was observed to be 232 nos per day. Average effluent generation per tractor manufactured was 0.58 KL. The monthly discharge of waste water from the industry is given in Table 2. The Wastewater source and pollutants is given in Table 3.

3.3 Physicochemical characterisation of wastewater

The physico-chemical properties of wastewater parameters like pH, TDS, TSS, BOD, COD, Oil & Grease, Ni, Zn, PO_4 were analysed and tabulated (Table 4) based on processes & raw materials used in paint shop & other sources of effluent generated which was identified for sample collection in order to understand the characteristics of individual wastewater stream so as to classify high polluting, semi polluting & non-polluting streams to be segregated at source to reduce pollution load & cost of treatment chemicals.

The results of treated effluent shows that all parameters are well within limits of prescribed standards, it is important to highlight that this sample was collected during full-fledged operational phase by treating effluent receiving during the three shift operations. Maximum ETP Treatment Capacity can be Up-graded with utilization existing resources 250 KL/ Day. Average Waste water discharge can be managed 10 KL/ Hour, during Full-fledged three shift operations with suggested up-gradation of existing ETP. Peak discharge of wastewater can be managed up to 25 KL/ Day during full-fledged three shift operations with suggested up-gradation of existing ETP. Excising civil tanks of ETP are sufficient for

treatment with respect to residence time volume wise and pollution load exists for expanded effluent load up to 250 KL per day except aeration tank.

Table 2. Data effluent Discharge & Tractor manufactured in month January 2013

Month January 2013	Tractor Manufactured & Rolled out per day (Shift wise)				Total Process Effluent Generated	Effluent Generated per Tractor Manufactured
	Shift A	Shift B	Shift C	Total	In KL per DAY	
1 Jan				00	0	00
2 Jan	16	58		74	43	0.58
3 Jan	62	84	57	203	45	0.22
4 Jan	75	75	58	208	76	0.36
5 Jan	71	88	73	232	68	0.29
6 Jan			63	63	27	0.42
7 Jan	68	74		142	45	0.31
8 Jan	81	78	62	221	60	0.27
9 Jan	80	82	63	225	65	0.28
10 Jan	69	82	71	222	62	0.27
11 Jan	78	85	64	227	60	0.26
12 Jan	61	75	70	206	60	0.29
13 Jan			77	77	28	0.36
14 Jan				00	0	00
15 Jan	47	85		132	42	0.31
16 Jan	67	70	51	188	52	0.27
17 Jan	75	80	61	216	65	0.30

Table 3. Wastewater source and pollutants

S.N.	Wastewater Stream	Source of Generation	Present effluent Discharge kl/day (One Shift ops)	Expected max effluent discharge kl/day (Proposed-three shift ops)	Major Pollutants
1	Oily & Emulsified Waste Stream	Chassis Line	22 KL/ day	64 KL/ Day	Emulsified & Floating Oil
2	Acidic Waste Stream	Paint Shop-Pre-treatment Metal Surface	32 KL/ Day	95 KL/ Day	Acidic Stream
3	Heavy Metal Waste Stream	Paint Shop-Pre-treatment Metal Surface	3 KL/ day	8 KL/ Day	Heavy Metals like Zn, Ni, PO4
4	Machine Shop waste Stream	Transmission Line	3 KL/ Week	9 KL/ Week	High BOD
5	DM Waste Stream	Utility-DM Plant	12 KL Day	35 KL/ day	High TDS

The population growth trends and industrialization has led to demand of tractors increasing with each day. Agriculture is the backbone of Indian economy and tractors are being used by farmers to enhance the bumper production of grain. The green revolution is the major stone milled in the Indian history. The graphical representation shows the increasing demand of human beings (Figures 2-5).

Based on site visits, discussion with operation peoples, evaluation of process design, treatment system, existing effluent discharge, expanded wastewater quantum after production capacity enhancement and results of sample analyzed stream wise generated from different processes are operational data shows that average effluent discharges variation with respect to one shift, two shift and three shift operations

were recorded 30 KLD, 48 KLD & 76 KLD subsequently. Highest effluent discharge from processes was observed 76 KL per day during 3 shift operations, it shows that existing effluent treatment system would be capable to treat expanded effluent load with some suggested technological up-gradation.

Table 4. Physicochemical characterisation of different stages of wastewater

S.N.	Name of Parameter	Standard limits	1	2	3	4	5	6	7
1.	P^H	5.5 to 9.0	8.28	8.90	8.37	9.02	7.42	9.71	8.76
2.	Total Dissolved Solids	-	2042	945	896	1666	4190	1226	1363
3.	Total Suspended Solids	<100	150	388	22	440	310	388	200
4.	Biological oxygen Demand	<30	150	11.2	8.2	9.7	56.2	8.8	3.4
5.	Chemical Oxygen Demand	<250	1200	88	40	60	448	60	8
6.	Oil &Grease	<10	3.18	2.4	3.8	3.5	4.5	2.5	2.3
7.	Ni	<3.0	BDL	52.8	BDL	BDL	BDL	2.38	3.415
8.	Zn	<5	3.31	88.6	0.135	2.23	2.345	2.11	3.645
9.	PO_4	<5	3.0	2.8	0.8	4.2	3.4	3.1	3.7
10.	SO_4	-	1800	930	780	1100	8000	1180	1210

Name of sample: (1) Oily & Emulsified wastewater, (2) Acidic waste water, (3) Heavy Metals Containing Wastewater, (4) Machine Wash wastewater, (5) Dm Plant Bach wash wastewater, (6) Primary Settler-I outlet, (7) Treated Effluent.

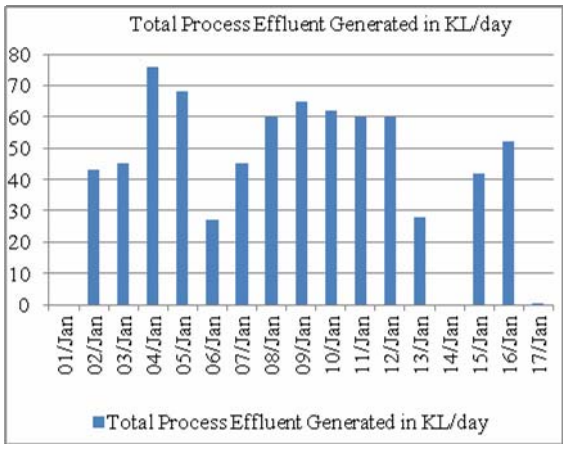

Figure 2. Show the process effluent generated in kl/day

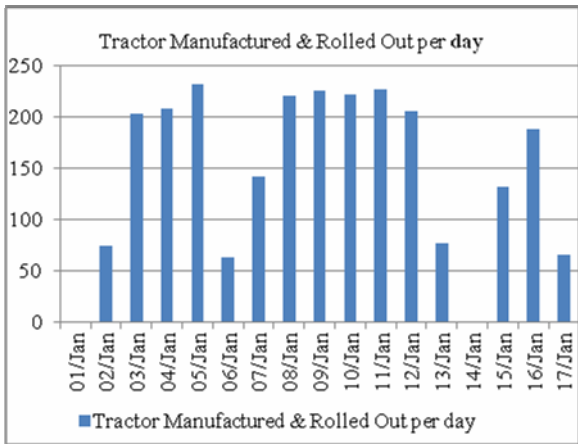

Figure 3. Show the tractor manufactured & rolled out per day

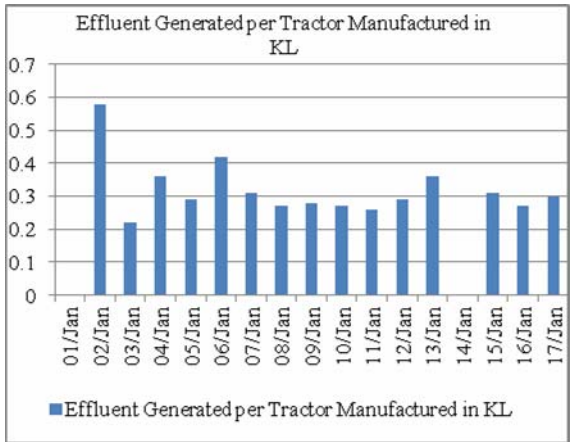

Figure 4. Show the effluent generation in manufacturing of per tractor

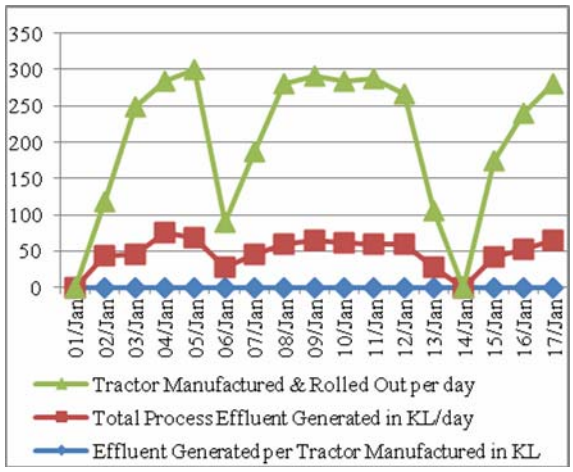

Figure 5. Show the interrelation ship between all processes

4. Conclusion

It is observed that the expanded flow will be 145 KL per day after full-fledged operations in three shifts by achieving production of up to 250 tractors per day. In this scenario, ETP can be upgraded for 150 KL per day. Results of existing ETP are well within limits with respect to the standards limits laid down by CPCB. Since the pollution load is very less from incoming effluent from processes, it means existing system can be modified for expanded hydraulic load with the provision of tertiary treatment. However, existing ETP can be modified for accommodation of a maximum of 250 KL per day with full utilization of existing unit and suggested modifications with technological upgrade of treatment equipment.

References

[1] Bandela N.N., and Puniya P.N. treatment of paint content in effluents of automobile industries. Journal of Environmental Research and Development, 2008, 2(3), 426-431.

[2] Asano T. Water from (Waste) Water - the Dependable Water Resource, Water Science and Technology, 2002, 45(8): 24-33.

[3] M irbagheri S. A., Salehi Moayed M. optimization of motor vehicle industries wastewater treatment methods with the aim of heavy metals removal and water reuse in pilot scale, Iran. J. Environ. Health Sci. Eng., 2006, Vol. 3, No. 4, pp. 289-295.

[4] El-Gohary F., Abdel Wahaab R., Nasr F., and Ali H. I. Development industrial wastewater management programme (case study). In Proc. 2nd Specialized Conference on Pretreatment of Industrial Wastewaters, October 16-18, 1996, Athens, Greece, pp. 148-155.

[5] El-Gohary F., Abou El-ela, S. I., and Ali H. I. Wastewater management in the automobile industry. Wat. Sci. Tech. 1989, 21, 225-233.

[6] Van Baardwijk F. A. M. and Pols H. B. Water pollution prevention in the Netherlands. In Proc. Intern. Conference on Pollution Prevention: Clean Technologies and Clean Products. June 10-13, Washington, 1990.
[7] Sastry C.A., Hashim M. A. and Agamuthu P. Waste Treatment Plants, Narosa Publishing House, New Delhi, 1995.
[8] Abdel W.R. Upgrading of industrial wastewater treatment units at automobile industry. Biomed. Environ. Sci. 2000, 13 (3), 219-24.
[9] Wahaab R. A. Assessment of automobile industry wastewater treatment units. Bull. Environ. Contam. Toxicol. 2011, 66 (6), 770-6.
[10] APHA, AWWA, WPCF. Standard Methods for the Examination of Water and Wastewater, American Public Health Association, Washington, D.C, New York, USA. 20th edition. 1998.

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