4th International Conference on
Energy, Environment and Sustainable Development 2016 (EESD 2016)

312. Analysis and Treatment of Wash off Water from Vehicular Service Centres in Hyderabad

Shoaib Bhatti[a], Muhammad Ali Memon[a], Imdad Kandhir[a], Zuhaib Siddiqui[b], Sheeraz Memon[a,]*, Gordhan Das Valasai[c]

[a]*Institute of Environmental and Engineering, MUET, Jamshoro, Pakistan*
[b]*Department of Environmental Engineering, NEDUniversity, Karachi, Pakistan*
[c] *Department of Mechanical Engineering, Quaid-e-Awam University of Engineering, Science and Technology, Nawabshah, Pakistan*
*Corresponding Author: *sheerazahmed.memon@faculty.muet.edu.pk*

Abstract

Wash-off vehicle service centres are promptly growing in Pakistan with increase in rate of transportation. This study focuses on the consumption of water that by service stations in Hyderabad city for washing purpose which is taken from two different sources i.e., ground water and water supply. Averagely 25-30 vehicles are being washed in one service station, which includes 15 small, 8 medium, and 2 large vehicles. It is estimated that total 380,880 litres/day of water is being discharged from service stations which exhibits high pollutants level and oil & grease. Wastewater samples were collected from four different service centres. The samples were analyzed for COD, Oil and grease, pH, settable solids, turbidity, EC, TDS. As compared to National Environmental Quality Standards (NEQs) the laboratory results of every station exhibit different contamination level in wash-off water due to on-site local conditions. In this study laboratory scale, Dissolved Air Flotation (DAF) system is designed for wastewater treatment to meet the shortage and scarcity problem through water reuse.

Keywords: *Service station; Contaminants level; Oil & Grease; Dissolved Air Flotation.*

1. Introduction

Service stations contribute a vital role in keeping the vehicles in good condition, hence increasing their life span. Rapid population growth has caused increase in transportation modes and number of vehicles which ultimately resulted in increase of service stations. Continuous vehicle wash is necessary in order to save the life structure of vehicle. Washing measures include removal of dust particles, debris and coarse material by using high pressure cleaning water with the mixture of detergent which results in wash off of physico-chemical compounds present in different forms which vary in size, density and morphology structure [1][2].

The wastewater from service stations may cause groundwater and soil pollution because it directly discharges into sanitary sewers without pre-treatment [3]. Ground water contamination is a big threat to human health which pollutes drinking water and resulting number of deaths in the area where such contaminated water is used. As according to survey by water organization (n.d) 884 million people have deprived of safe water to drink, 3375 million people die with different water diseases. During washing, removal of oil and grease, dust, salt and clay from vehicles may pollute environment and contribute in elevated levels of total dissolved solids, chemical oxygen demand (COD) in effluent water. Also, use of surfactants, diesel, petrol, grease and kerosene oil as cleaning agents, which are discharged in considerable volume during washing and may cause release of hazardous contaminants i.e. hydrocarbon, volatile organic compounds (VOC) and toxic chemicals and metals [4] [5] [6].

The aim of the research work is to characterize wastewater discharge and determine the pollutants level from different automobile service stations with subsequent treatment under the process of Dissolved Air Flotation (DAF) and filtration process techniques to clarify the wastewater for the end user.

2. Methodology

2.1. *Site Selection and Sample Collection*

A study was conducted to collect the baseline data of vehicular service stations across the Hyderabad city, Pakistan as shown in figure 1. The wash off water samples were collected from four different service stations for the analysis and treatment purpose. Sixty litres of sample were collected in polythene container from each service station and analysed at the laboratory of environmental engineering department for physical and chemical parameters such as pH, EC, turbidity, total dissolved solids, oil & grease and chemical oxygen demand.

Fig. 1. Location map of sampling sites

2.2. Water Consumptions for Vehicles Washing

A rough survey was conducted for five different size vehicles during the wash-off period. All vehicles consumed various amount of water in different time due to their size and nature of wash. Data obtained during that survey is shown in table 1.

Table 1. Data for water consumption

S. No.	Type of vehicles	Time external body dust removal	Time for inside dust removal	Time for final wash	Time require to fill 1.5 Liter bottle	Total water consumption (liter)
1	Truck	30 min	30 min	35 min	6 Sec	1425
2	Mini-Truck	25 min	25 min	20 min	6 sec	1050
3	Car	7 min	5 min	6 min	6 sec	270
4	Rickshaw	4 min	4 min	5 min	6 sec	195
5	Bike	3 min	-	3 min	6 sec	90

2.3. Experimental Work

2.3.1.Dissolved air flotation treatment design

Dissolved air flotation (DAF) is a treatment process in which wastewater is clarified by the separation of oil and grease, total dissolved solid and other insoluble impurities [7]. DAF is made of iron and designed for a shallow tank as shown in figure 2, in which top bridge rotates the tank rim in every three minutes. Its working principle is based on air flotation technique where removal of suspended particles, oil and solids occur. In this process, pressurized water is saturated with dissolved air and discharged in flotation vessels. Wastewater treatment is activated with the presence of air which results bubble formation. When air bubble is injected in flotation tank then the removal process starts. The small bubbles adhere to oil, grease and suspended particles and results in floating on the surface of water where it can be removed easily by skimming device. High pressure is required to remove the oil layer from wastewater. When air is dissolved in wastewater with high pressure, the removal of oil layer is obtained in floating tank. Under this process skimming tank is used where floatation material such as oil, fat and grease remains on the surface of wastewater. After the treatment of wastewater, the clear effluent should be collected in

separate tank.

Fig. 2. Dissolved Air Flotation Unit

2.3.2.Filtration method

In this study, comparison of Filtration processes used for the turbidity removal is conducted using alum dose and wood fibre techniques as shown in figure 3. In alum dose process, six different results were obtained in the laboratory for each service station using 1.5 to 6.5 ml alum per 500 ml contaminated sample. While model's capacity is 60 liters and alum dosing for model is 300 ml/60 lit, 180 ml/60 lit, 420 ml/60 lit and 300 ml/60 lit respectively for all four stations [9] [10]. The optimum results in which maximum turbidity removed was found in wood fibre technique and therefore it was selected for further treatment after DAF process. In case of wood fibre, the length and diameter of column were 11.4 inches, 2.5 inches respectively. The length of wool fibre was 4.5 inches, for 60 liters of polluted water.

Fig. 3. Filtration techniques (a) jar test (b) wood fibre

3. Results and Discussion

Results of all samples collected from different locations were analyzed for water quality parameters such as pH, TDS, EC, turbidity, Oil and Grease, COD and settable solids and are brought under discussion. Initially raw water from all selected service stations and then treated water was analyzed as presented in table 2. The turbidity (NTU) of the raw and treated samples are ranging from 82.4 to 493 NTU and 8.87 to 19.3 NTU respectively. Similarly ranges for oil and grease were from 11 to 49 ppm and 0.2 to 1.95 ppm which shows maximum removal in this process as compared to all other parameters.

Table 2. Water quality data before and after reatment

S. No	Parameters	Masha Allah service station		Indus service station		Al-noor service station		Site area service station	
		Raw water	Treated water	Raw water	Treated water	Raw water	Treated water	Raw water	Treated water
1	TDS (g/L)	1.79	1.8	0.21	0.35	1.01	1.02	0.85	0.87
2	EC (mS/cm)	3.59	3.6	0.43	0.57	2.02	2.03	1.7	1.72
3	Turbidity (NTU)	82.4	8.87	493	15.26	180	14.5	322	19.3

4	Oil and Grease (ppm)	49	1.8	17.6	1.85	16	0.2	11	1.95
5	COD (mg/l)	2.18	2.15	4.08	2.67	4.75	3.41	3.01	1.87

Pollutant removal efficiency is shown in figure 4. It was observed that Turbidity and Oil & grease were removed more than 90% for all service stations, whereas, COD, EC and TDS were not showing significant results for the removal and treatment.

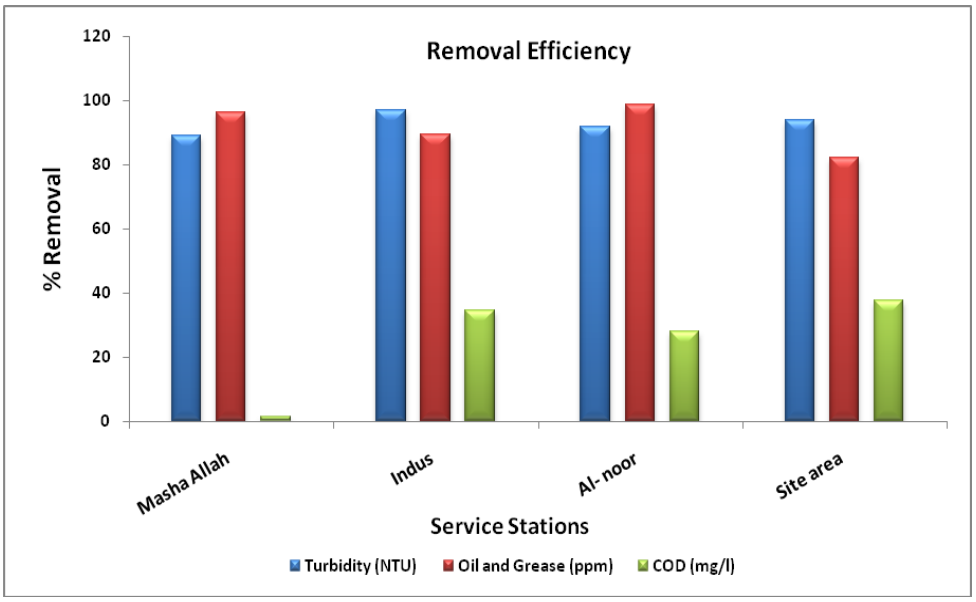

Fig. 4. Pollutants removal efficiency in all service stations

4. Conclusion

This study focus on the consumption of water that is being used by Hyderabad service stations for washing purpose which is taken from two different sources i.e., ground water and water supply. It is estimated that total 380,880 liters/day of water is being discharged from service stations which exhibits high pollutants level and oil & grease. As compare to National Environmental Quality Standards (NEQs) the laboratory results of every station have its own value of contamination in wash-off water which varies with the local conditions. It is suggested to install and fix on-site treatment facilities so that the treated water can be reused for multiple applications.

References

[1]. Chaudhari, L.B., Murthy, Z.V.P., 2010. "Treatment of landfill leachates by nanofiltration" Journal of Environmental Management, 91 (5), pp 1209-1217.
[2]. Wei, B., and L. Yang (2010), "A review of heavy metal contaminations in urban soils, urban road dusts and agricultural soils from China" Microchemical Journal, 94 (2), pp. 99-107.
[3]. Sealey, B.J., Phillips, P.S., Hill, G.J., (2001), "Waste management issues for the UK ready-mixed concrete industry" Resources, Conservation and Recycling, 32 (3-4), pp. 321-331.
[4]. Dhar, D.B and D.P, Tripathy, 2002. "Environmental Pollution Research", A.P.H Publishing Cooperation, New Delhi, India.
[5]. Browning, R. and Shafer, H. (2002), "Outreach Research—Survey and Focus Groups Dyers and Used Oil Disposal Initial Results and Recommendations" California, US.
[6]. Edgar, E. (2009), "An unusual obituary: The Integrated Waste Management Board" Capitol Weekly (Sacramento, CA), US.
[7]. James K. Edzwald, (February 1995). "Principles and applications of dissolved air flotation". Published in water Science & Technology.
[8]. American Water Works Association, Operational Control of Coagulation and Filtration Processes (M37). 1992
[9]. American Water Works Association, Simplified Procedures for Water Examination (AWWA M12). 1977.
[10]. Kim Luu, June 2000 Study of Coagulation and Settling Processes for Implementation in Nepal.