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ENVIRONMENTAL POLLUTION FROM AUTOMOBILE VEHICLE SERVICE STATIONS

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ABSTRACT

Automobile vehicle service stations are rapidly increasing in Pakistan with rise in growth of transportation. On average 20 to 30vehicles are washed daily at every car wash facility and each vehicle takes an average of 151.4 to 227.4 liter of water depending on size of the vehicle. To evaluate the water pollution caused by service stations waste water samples were collected from different service stations of Lahore. The samples were analyzed for BOD, COD, Oil and grease, pH, Alkalinity, Sulphates, Phosphates, Iron, Chlorides, suspended solids, settable solids, Chromium and Nickel. Laboratory analysis of the samples show that BOD is 5 times greater than National Environmental Quality Standards (NEQs), COD 7 times, Oil and grease 107 times, Iron 2 times and settable solids are 2 times greater than NEQs. These pollutants cause DO depletion, impairment in photosynthesis, fatality to aquatic life, toxicity to water resources, and human life. The study was conducted to address the environmental conditions prevalent at the service stations of Lahore, Pakistan to point out the present practices adopted by the workers and the potential impacts of these haphazard practices on lives of the workers, and the environment.

Keywords: *Environment, Pollution, BOD, COD, Dissolved Solids, Suspended Solids.*

INTRODUCTION

Service stations play very important role for keeping vehicle in the best of their conditions. As a result of increasing number of vehicles, there is an increase in number of automobile service stations. Effluents from these service stations may cause air, water and soil pollution. For every vehicle wash, petrol, kerosene oil, diesel is used as cleaning media along surfactants. After washing petrol, oil, diesel, greases, clay, salt, and cow dung all pollute the environment and contribute to biological oxygen demand (BOD), chemical oxygen demand (COD) and suspended solids in

effluent waters. Fumes from petrol, diesel, solvents or greasers are very dangerous. In sewers they reach in considerable volume from street and service stations. For the most part they float on the wastewater, although a portion is carried into the sludge on settling solids. Sludge from the carwash activity can clog sewer and municipal sewers if it is not separated from wastewater stream from services station and dispose of properly. Release of hazardous contaminants i.e. hydrocarbons, hazardous air pollutants (HAP) and volatile organic compounds (VOCs) from the underground storage tanks, vent pipes, during decantation and petrol filling, contribute the air pollution at service stations (Tripathy & Dhar, 2002; Browning & Shafer, 2002; Edgar, 2009).

The automobile vehicles are needed to be washed frequently to remove dust and preserve the aesthetic appeal and lastly but not the least, to increase their life span. A washing event may include, removal of coarse material, debris and dust using high pressure cleaning water and detergent mixture. The detergent is applied to the surface that is followed by high pressure water cleaning. The cleaning may result in removal of compounds present in different physical-chemical forms that vary in size (nominal molecular mass), valance electrons and charge, oxidation state, density, morphology and structure (Wei & Yang, 2010; Ahmad, 2010; Chaudhari & Murthy, 2010).

In this connection, it is imperative to conduct a study to address the environmental conditions prevalent at the service stations of Lahore to point out the present practices adopted by the workers and the potential impacts of these haphazard practices on lives of the workers, and the environment. The objectives of the study are to determine the types and the levels of pollutants that may be present in waste water of service station and study practices being adopted to avoid these impacts at service station in Lahore. It is also important to address the possible hazards that can be caused by these pollutants and suggest the possible remedies and treatment options for such waste water and select the best possible option (Ahmaruzzaman, 2011; Prieto, Barrado, Vega & Deban, 2001).

Service station can pollute air, surface water, ground water and soil. Literature survey was carried out as the first step to identify various environmental impacts of service stations (Sealey, Phillips & Hill, 2001). However, emphasis of the studies were on surface water pollution, which

has been addressed in the literature and site survey, laboratory analysis of samples of service station wastewater and finally remedial actions are suggested.

METHODOLOGY

Many petrol pumps and service stations were surveyed to examine current practices and to collect samples for the analysis. There are four major petrol pump companies operating in Lahore city; Shell, Caltex, Pakistan State Oil (PSO), and Total Parco. For field survey, petrol pumps and private garages were randomly selected but it was tried to cover major areas of Lahore i.e., Dharmpura, Chouburji, Sadar, Defence, Ferozepur Road, Cavalry Ground, Sanda, Gulshan Ravi as shown in Table 1.

Table 1: Selected sampling locations in Lahore

Batch No.	Sampling Locations
1	PSO WAPDA Petrol Pump, Ferozepur Road Lhr
	Express Lube Caltex, Defence Chowk, Lhr
	Universal service station, Dharampura, Lhr
	Kamanwala PSO Service station, G.T. Road Lhr
2	PSO WAPDA Petrol Pump, Ferozepur Road Lhr
	Express Lube, Caltex, Defence Chowk, Lhr
	Garrison, Shell Filling Station, Cantt, Lhr
	Universal Service Station, Dharampura, Lhr
	Kamanwala PSO service Station, G.T. Road. Lhr

A questionnaire was prepared to inquire the employees about practices adopted at the service stations. The questionnaire include questions about number of vehicles washed per day and oil change, their activities regarding usage of water per car wash, disposal of waste oil, water separator installation, employee trainings about environmentally safe practices disposal of sludge. It was decided that in first batch collect one sample from each of five selected service stations in one day, and in second batch collected one sample from the same service stations 5 days after rain.

The most appropriate estimation of pollution load due to service stations in Lahore could be done if following data was available:

1) Total number of washing stations in Lahore including private garages and car wash area in the premises of retail outlets.
2) Total number of vehicles being washed on each service station.
3) Amount of water consumed per vehicle wash.

But all of this information is nearly impossible to collect as number of carwash area in retail outlet premises can be known by consulting the respective company and hence the vehicles wash per service station. Amount of water consumed per car wash cannot be properly estimated because all service stations that were visited during survey, none of them had any check and balance in this regard. WASA could provide the data of amount of water supplied to service stations but many of service stations have their own underground water supply system. Amount of water supplied by WASA also utilized for rest of works at the service stations other than a vehicle wash, so their data couldn't provide accurate information. But WASA charges all service stations for their sewerage discharge, which can be helpful in estimating the pollution load due to a service station, but at the same time WASA has no particular maintenance of data in this regard as they have fix amount of billing charges for the service stations not based on the amount of wastewater discharged in the sewerage. Hence to encounter this problem, the only way was the estimation through technical specifications. So at selected five service stations, 1.5 liters of bottle was filled through the same pressure nozzle that was used to spray water on car. A stopwatch was used to note time for filling of the bottle. Then time consumed for washing of vehicle was noted and hence it was estimated that how much water is consumed per vehicle wash. Water used for different types of vehicle washing is listed in table 2. Water consumption for buses was inquired by Daewoo motors and for the rest for vehicles i.e., Vans and heavy vehicles are assumed to take similar times and water. Data of total number of vehicles registered in the Lahore city was collected from Transportation office, and frequency of vehicle washing was asked by different car owners, rickshaw drivers and one of the commercial bus companies (DAEWOO). The information so collected was used to estimate the wastewater generation in the Lahore city due to service stations, and then it was calculated per day. Finally it is assumed that all the water, which is consumed for vehicle washing, is going to sewers hence the results thus obtained are rough estimates and

assumptions based." Grab sampling method "was adopted. One liter of each sample was collected. As season was compatible and samples were readily taken to the laboratory so freezing of samples was not required. Samples were taken at the time when car was being washed at the filling or the service station. Sample was taken twice in a month, one before rain and one after rain.

Table 2: Water Consumption for Vehicle washing

Vehicles	Time outer body dust removal	Time for inside dust removal	Time for final wash	Time required to fill 1.5 liter bottle	Total water consume (liter)
Cars	7 min	4 min	5 min	6 sec	240
Rickshaw	3 min	3 min	5 min	6 sec	165
Bike	3 min	-	3 min	6 sec	90

RESULTS AND DISCUSSIONS

Following parameters are analyzed and compared with the NEQs to access the water pollution caused by the service stations in Lahore:

1) BOD
2) COD
3) Oil and Grease
4) Iron
5) Suspended solids

Experimental results of the samples show that BOD values are much higher than that of the NEQS as shown in table 3. Average BOD value of all samples is 520 mg /lit, whereas NEQs specification for BOD demand is 80 mg/L in discharge waters. BOD shows organic contaminants present in the wastewater that are biodegradable. On the basis of literature survey it can be concluded that in carwash wastewater, BOD is caused by the animal dung and bird droppings that are washed away with water (Cosgun & Esin, 2006). Free oil, emulsified oil, diesel and gasoline presence also contributes to higher levels of BOD. Detergents or shampoos used to wash vehicles also contribute to BOD. On site survey, it was observed that very rarely oil water separator was used, and all wash water goes into the sewer system directly. Therefore BOD values are so high. Lab analysis shows that average COD value of samples is 1330

mg/L while according to NEQS it should be150 mg/L. COD of car wash wastewater is 9 times greater than that of required value according to NEQS. COD in wastewater shows the presence of contaminants that are stable and not easily biodegradable (Béchet, Durin, Legret, & Le Cloirec, 2006). Diesel, gasoline, waste engine oil, oil emulsions, all contributes COD in car wash wastewater. Experimental results show that car wash wastewater contain very high contents of oil and grease i.e. average oil and Grease value of samples 1070 mg/L while according to NEQS it should be 10 mg/L; hence it is 107 times greater than the standard (Andersen, Bratli, Fjeld, Faafeng, Grande, & Hem, 1997). During sampling, managers and workers of the service stations reported that no oil could be present in car wash water; though they were themselves ignorant to the reality. These oil contents were present in the wash water because mostly the vehicles have leaky engines, people use to spray diesel or waste engine oil and some times kerosene on under carriage, and oil spills on the washing floors, all find their way in the sewer system. Literature reveals that oil/ water separators are also failed to keep values of oil and grease to 10 mg/L in effluent because of formation of oil emulsions due to detergents. Detergents surround oil droplets with a layer of detergent molecule to give them a water-soluble coating (Harrison & Wilson, 1985; Lin, Chen, Huang, Hwang & Chang-Chien, Lin, 2005).

Iron contents were found to be relatively higher but not much alarming. Average iron value for the samples is 4.14 mg/L, while according to NEQs it should be 2.0 mg/L; hence it is 2 times greater than the required value. Iron contents could be due to rust under carriage as well as iron present in the waste oil that is used to spray under carriage (McKenzie, Money, Green & Young, 2009). An average value of suspended solids in samples is 308.5 mg/L while according to NEQs it should be 150 mg/L; hence it is 2 times greater than required value. Sand, silt, animal dung or bird droppings, all these can be present as suspended solids in car wash wastewater. These solids do not settle in settling or grit removal chambers and make the wastewater turbid as well. Hence it is found that in car wash wastewater, Oil and Grease, BOD, COD, Iron and suspended solids are over limits to the NEQs. The reason is the presence of hydrocarbons, biodegradable detergents and spray of waste oil on undercarriages, silt and clay (Bhatia, 2002).

Table 3: Experimental Results

Parameters	Experimental Results										Avg. Values	NEQS	Remarks / Limit
Sample #	1	2	3	4	5	6	7	8	9	10			
BOD mg/L	285	300	450	375	400	690	435	1140	522	600	520	80	Over
COD mg/L	1080	856	1480	1260	1260	2100	780	2020	1740	720	1330	150	Over
pH	9.02	8.52	7.99	8.60	8.27	8.15	8.65	6.20	9.20	8.3	8.3	6-10	Within
Chlorides mg/L	240	80	160	100	99.96	99.9	99.9	99.9	98	99.9	112	1000	Within
Sulphates mg/L	160	169	333.3	145	360	142	151	980	125.3	115.7	268	600	Within
Iron mg/L	2.25	5.3	1.8	2.4	1.35	4.3	5.0	5.8	6.6	6.6	4.14	2.0	Over
SS mg/L	308	110	680	380	450	240	5.5	640	172	99	308.5	150	Over
TDS mg/L	227	110	160	450	50	70	127	230	83	55	156.2	3500	Within
Oil and Grease mg/L	1160	1020	970	1530	670	-	-	-	-	-	1070	10	Over
Chromium mg/L	-	-	-	-	-	-	-	-	-	-	-	1.0	-
Nitrates mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphates mg/L	0.139	0.13	0.80	0.37	0.17	0.54	0.075	0.084	0.485	0.22	0.3	-	-
Alkalinity mg/L	600	640	900	620	560	500	550	470	390	590	-	-	-
Settleable Solids mg/L	3.5	1.9	10.6	7.5	1.6	5	10	2	21	3	-	-	-

RECOMMENDATIONS

1) At service stations, Best Management Practice (BMPs) should be adopted for all activities.
2) To stem air pollution, Stage I and II Vapor Recovery System must be installed.
3) Fiberglass material should be used for USTs construction to avoid corrosion.
4) Conventional Oil/Water separators should be used necessarily. For space constraint calescence Plate Separators are the best option. Waste oil recycling needs to be promoted.
5) Sludge collected from service stations should be tested for its toxicity before its disposal.
6) All oil retail companies should upgrade their environmental policies and practices by making policy regarding wastewater pollution abatement. The testing of effluent on regularly bases and workers training for the BMPs should also be the part of the environmental policy.
7) Pakistan EPA should revise laws regarding the service stations. It should be mandatory to submit the EIA report before constructing the service station. Penalties should to be mentioned and applied on transgressors.
8) NWFP EPA guidelines for service stations should be revised for any changes and made mandatory for all service stations. EPA should randomly schedule audits.

CONCLUSIONS

Effluents from the service stations cause damages to the environment. In this study, practices in foreign countries are adopted for local service stations and listed in the recommendations section studied through literature and local practices were evaluated by site surveys (Arnold, 2002; Wesley, Eckenfelder, 1997). Wastewater samples from different service stations were collected and analyzed.

1) At all the retail outlets and the private garages water is consumed negligently. Roughly 90 to 350 liters of water is used for washing average vehicle. The generated wastewater is discharged directly into the sewers, or drains without any treatment except very couple of retail outlets that have oil/water separators.
2) Waste oil is dripped out manually or by suction machine. It is stored in drums that are mostly in very bad conditions. Poor house keeping cause leaks and spills to the sewers and storm drains. Waste oil is discharge in the sewers or sold.
3) Service stations of oil retail companies are still far better than the local or private garages. Safety, Health and Environment (SHE) guidelines of retail oil companies are silent regarding proper site location of the retail outlet, site hydrology, proper design of the dispensing area and car wash bay, discharge of car wash wastewater, sludge removal, vapor recovery of the escaped vapors from the USTs and dispensing nozzles.
4) People are unaware of the safe environmental practices, as in many service stations. In spite of written instructions from the oil company that it is not permissible to spray waste oil on undercarriage, employees has to do it on forcing attitude of car owners.
5) Samples of wastewater of service stations were collected and analyzed for BOD, COD, PH, PO_4, NO_3, Alkalinity, SO_4, Fe, Cr, TS, TDS, SS and Settle able Solids. Average values of tested parameters is found to be BOD 520 mg/L, COD 1330 mg/L, pH 8.3, Cl 112 mg/L, SO_4 268 mg/L, Iron 4.14 mg/L, SS 308.5 mg/L, TDS 156.2 mg/L, Phosphates 0.3 mg/L, Oil and Grease 1070 mg/L. The most critical values are of BOD, which is 7 times greater, than NEQS, COD 9 times greater, Oil and Grease 107 times greater, Iron 2 times greater and suspended solids 2 times greater than the NEQS.
6) Emission of gasoline vapors during dispensing from trailer to the USTs (underground storage tank), from dispensers to the vehicles and

from USTs, cause air pollution. Petrol vapors when emitted in air, contribute in formation of ground level Ozone that damages respiration system if inhaled. Benzene an important constituent of gasoline is known human carcinogenic.

7) Wastewater from service stations threatens surface water resources. High amounts of BOD cause DO depletion in the receiving stream. Oil and grease can coat the fish gills and take to death, toxic hydrocarbons are fatal to the aquatic life and humans, and grease can cause loss of hydraulic capacity of sewers and fouling of wastewater treatment plant Suspended solids cause turbidity in water, impair photosynthesis, clog the fish gills, and damage their productivity.
8) Leaking USTs or piping system pollutes ground water and soil of the site BTEX (benzene, toluene, ethlyle benzene, xylene) and are gasoline constituents that contaminate the ground water, and if contaminated ground water is used for drinking, can cause cancer, damage of kidney, liver, and central nervous system.
9) In Pakistan environment has been given low priority, EPAs strategies and PEPA laws are so lenient that violators are not following the environmental laws and guidelines.

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