INVESTIGATION ON THE IMPORTANCE OF MAINTAINING PROPER TREATMENT PLANTS AT AUTOMOBILE SERVICE STATIONS

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INTRODUCTION

Automobile service stations play a very important role in maintaining vehicles and keeping them in good condition. Effluents from these service stations may cause air, water and soil pollution. On-site wastewater treatment is a prospective direction towards the reduction of pollution load before discharging. Some of the existing fuel pumps and fuel services stations are facilitated with car-washing and these places generate more polluted wastewater. The large car washing and service stations are compelled by the respective pollution control authorities to provide necessary treatment for the effluent water.

Normally in service centers, the chemical coagulant is used to remove solid particles and the cascade system is used to remove oil and grease. Alum is used as a chemical coagulant. Medium size oil trapping tanks, storage tanks and chemical tanks are established as a cascade system in well maintained automobile service centers. Then a large amount of grease and oil are removed in the oil trapping tank. Oil trapping tank and chemical tank are used to remove grease and oil in less maintained service centers. Storage tank can be seen in most of the service stations. Firstly wastewater comes to oil trapping tanks and then goes to the storage tank. The highest concentration of contaminants like sand and particles with high density are settled in storage tank sludge. The production of many of the Volatile Organic Carbon (VOCs) and metals are found in storage tank (Sauer and Tyler, 1992). This is an underground sump with a capacity of one day. Normally the capacity of this tank equal to the volume of wastewater disposed in a day.

In this reactor, it is expected to collect wastewater and to equalize in order to produce uniform wastewater prior to feeding to the main reactor. After that, wastewater comes to a chemical tank. Coagulants and flocculants should be added by using dosing pumps with an appropriate pH correction and the wastewater needs to be stirred using a mechanical stirrer. In this unit, the added coagulant destabilizes colloidal particles, hydrolyzes and then forms gelatinous floc that adsorbs most pollutants particularly organic pollutants (around 80%) and heavy metals such as Pb^{+} if present. After agitation the wastewater shall be detained for 1-2 hours for effective sludge drying beds (composed of gravel and fine sand on top of the gravel bed). The collected sludge will be dried and disposed. Next, remaining water is transferred to filters. Sand filters are used very frequently. Charcoal and activated carbon are also used in some service centers. Finally, treated water is added to the natural environment (Hammer, 2012).

A treatment plant that is used to treat wastewater effluent generated by automobile service stations, has a few necessary features such as, Oil separating tanks, Collection tank, Chemical mixing and coagulation tank, sedimentation tank and filters. Most of the auto mobile service stations have a treatment plant with all the features mentioned above. The treatment plant which follows all the steps mentioned above to treat wastewater effluent can be recognized as a Well Maintained Treatment Plant (WM). However, some service stations do not follow all the steps of

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the procedure can be categorized as a Less Maintained Treatment Plant (LM). The main objective of the present study was to find out whether there are any impacts on the environment due to the discharge of wastewater from automobile service stations.

METHODOLOGY

Six service stations from Dehiwala – Mt. Lavinia Urban Council (3 well maintained and 3 less maintained) and another six in the same manner from Kesbewa Urban Council in the Colombo district were selected for this study. Altogether 12 service stations were studied.

Effluent of well-maintained and less maintained service stations were analyzed for pH – potentiometer method, Electric conductivity (EC)- EC meter, Total Dissolved Solids (TDS) – TDS meter, Biochemical Oxygen Demand (BOD) – Winkler method, Chemical Oxygen Demand (COD) –Open reflux method, Oil and Grease – Hexane extraction method and Total Suspended Solids (TSS) – Oven dry method (Arnold, 2002). Statistical analysis was done using SPSS software (Version 16). Two paired test was done to find out the significant differences between two groups. Thedilution plate method (Parkinson, 1971) was used for enumeration of soil microorganisms of soil in the area where treated wastewater is disposed. Determination of the social, environmental and economic effects of service stations and their wastewater were done using a questionnaire. Fifty persons whose residences are near the auto mobile service stations were selected for the questionnaire survey.

RESULTS AND DISCUSSION

The results for changes of Biochemical Oxygen Demand (BOD) (Fig 3.1), Chemical Oxygen Demand (COD) (Fig.3.2), Total Dissolved Solids (TDS) (Fig 3.3) and Oil & Grease (Fig 3.4)are given below. The values for BOD (sig=0.012, $P<0.05$), COD (sig=0.003, $P<0.05$), Oil and grease(sig = 0.015, $P< 0.05$) and TDS (sig=0.013, $P<0.05$) of the effluent showed significant differences between well maintained (WM) and less maintained (LS) service stations, but no significant differences were recorded for pH and TSS. The average BOD value for less maintained treatment plants takes 6 times greater than the declared value (30 mg/l) by Central Environmental Authority(CEA). Recorded COD value for well-maintained service stations was around 60-200 mg/l and 215- 630 mg/l for less maintained service stations. Average COD value for less maintained treatment plants is 2 times of greater(250 mg/l) than the value declared by CEA. Around 4.0- 12 mg/l value for oil and grease recorded for well-maintained service stations and 8- 36 mg/l recorded for less maintained service stations. Oil and grease value for less maintained treatment plants takes 2 times greater than CEA stands (10 mg/l). Well maintained service stations recorded 28- 64 mg/l range for TSS and less maintained service stations recorded 56- 1172 mg/l. TSS value for less maintained treatment plants takes approximately 6 times greater than CEA stands (50 mg/l).

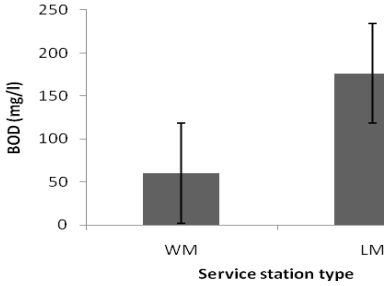

Fig.3.1 Change of BOD in WM & LM

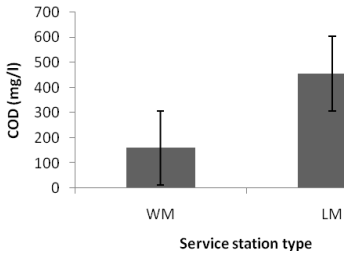

Fig 3.2- Change of COD in WM & LM

According to Fig.3.5, there was no significant difference between well maintained and less maintained service stations for bacterial colonies. The result of the questionnaire indicated that 32% have been affected due to the labor force of the service stations and nearly 22% of the people who work at sites reported that they are suffering from health problems. 20% of residents indicated that they have been affected by vehicles and customers who come to the stations. All (100%) said that they are affected by noise. Soil degradation (18%), disposed solid wastes (32%), and wastewater (36%) & water droplet (30%) are the other social and environmental effects by these stations.

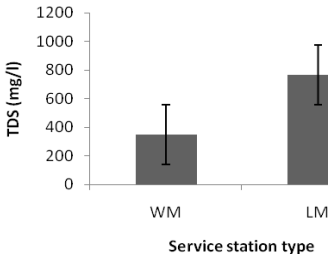

Fig 3.3- Change of TDS in WM & LM

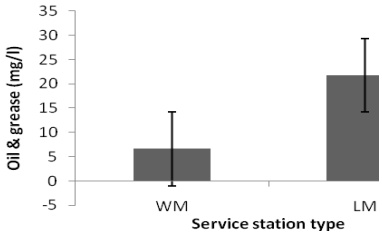

Fig 3.4-Change of Oil & grease in WM & LM

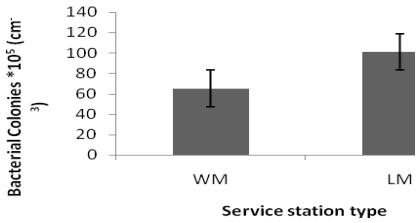

Fig 3.5 Change of Bacterial Colonies in soil in WM & LM

BOD indicates organic contaminants (biodegradable) present in a body of water. Diesel, emulsified oil, free oil and gasoline in wastewater contribute to higher levels of BOD (Yasin*et. al*, 2012). Shampoos and detergents used to wash vehicles also contribute to BOD. WM service centers use correct dosage of Alum and certain amount of organic contaminants are removed by Alum. Further, storage time of wastewater in WM automobile service centers is higher than that of LM service centers thus giving more time for settling with Alum. Therefore, less BOD value recorded for well-maintained service stations is justifiable. If BOD in effluent water is not controlled as in WM, aquatic bodies are in great trouble due to high demand for oxygen. COD in wastewater shows the presence of contaminants that are stable and not easily biodegradable (Bechet*et al*, 2006). Further, the high concentration of COD and BOD recorded in automobile wastewater might due to the use of chemical which are organic or non-organic that are oxygen demand (Akan, *et al.*, 2008). Diesel, gasoline, oil emulsions, waste engine oil also contribute COD value in effluent water (Yasin*et. al*, 2012). The significantly different values reported in this study could be due to the contamination of above mentioned substances in LM service stations. It is obvious that if proper control for oil and grease is happening, the COD should be automatically reduced. Oils and grease are present in the wash water because mostly the vehicles have leaky engines and people also use to spray diesel or waste engine oil and sometimes kerosene on under carriage. Oil and water separators used in well maintained service stations are able to maintain less oil in effluent wastewater. However, as reported by Harrison & Wilson (1985), detergents surround oil droplets with a layer of detergent molecule to give them a water-soluble coating. Therefore, water/oil separators too may fail to keep values of oil and grease to 10 mg/L (National

Environmental Act, No. 47 of 1980) in effluent due to the above effect. However, the results of this study shows that reasonable control is happening with oil/water separators used in WM. Serious thought should be given to the control of oil and grease in service stations as it contributes to reduce oxygen in water bodies affecting aquatic life (Arnold, 2002). The dissolved solids do not settle in settling or grit removal chambers and make the wastewater turbid as well (Yasin*et al*, 2012). TDS can be removed in oil trap, collection tank, sedimentation tank and filtration tank. Therefore, TDS in WM service centers is always lower than LM service centers.

Contamination of the soil by wastewater containing detergents, fuel, oil and grease discharged from service stations soil causes it to lose its useful properties such as fertility, water-holding capacity, permeability and binding capacity (Moorthi*et.al*, 2008). The results obtained in this study clearly show that the affected soil has a less number of bacterial colonies. Though there are no significant differences of bacterial colonies between WM and LM soils, this is something to be concerned with as reduced soil quality as indicated by the number of bacteria could affect the fertility of the soil. As reported by Nduka and Orisakwe, 2009, high heavy metal content, high BOD level, high EC & low pH have been recorded in potable water near automobile service stations. Therefore, it is clear that improper disposal affects people's immediate environment including human health. Based on the questionnaire survey, it is apparent that the literacy level of the people who maintain these places vary and this too could affect the use of correct procedures such as proper operation, correct dosage of Alum and detergents as well as having proper oil and water separators.

CONCLUSIONS/RECOMMENDATIONS

1. A significant difference has been recorded for BOD, COD, TDS and Oil and grease of the automobile effluent between WM and LM auto mobile service stations. Establishing and maintaining proper waste treatment plants for service stations should be made compulsory.
2. No significant difference between WM & LM has been recorded for biological measurements.
3. Noise is the main problem which is present due to the daily functioning of waste treatment plants at auto mobile service stations. Health problems, reduced soil quality, disposed solid wastes, wastewater, water droplets are other social and environmental effects of these stations.

REFERENCES

Arnold, E.(2002) - Standard Methods for the Examination of Water and Wastewater, 18thedition, American Public Health Association, Washington DC.

Bechet, B, Durin, B., Legret, M. and Le Cloirec, P, (2006) - Colloidal specification of heavy metals in run off and interstitial waters of a retention/infiltration pond, *Water Science and*

Technology, 54pp. 307-314. Hammer, M.J.(2012) - Water and wastewater technology, 7th edition, pp 289- 373, PHI Private Limited.

Parkinson, D., Gray, T. R. G. and Williams, S. T. (1971) - Methods for studying the ecology of soil micro-organisms.I.B.P. Handbook No. 19. Oxford: Blackwell.

Moorthi, P.S., Deecaraman, M. and Kalaichelvan, P.T. (2008) - Bioremediation of Automobile oil effluent by *Pseudomonas* sp. *Advanced Biotech* 34- 37.

Nduka and Orisakwe (2009) – Effects of effluent from Warri refinery and petrochemical company(WPRC) on water and soil qualities of "contagious host" and impacts of communities of Delta state, Nigeria, *The Open Environment Pollution Toxico. Journal* (1): 11-17

Sauer, P.A. and Tyler, E.J. (1992) Motor vehicle waste fluid impact on septic tank/ wastewater infiltration system, Small scale waste management project publication, 1-17. The Gazette of the

Democratic Socialist Republic of Sri Lanka Extraordinary, No 1534/18, 2008/02/01, National Environmental Act No 47 of 1980.

Yasin, S., Iqbal, T., Arshad, S., Rustam, M. and Zafar, M. (2012), Environmental pollution from automobile vehicle service stations, *Journal of Quality and Technology Management*, 8 , 61- 70.