

Physicochemical Quality of Oily Wastewater from Automotive Workshop in Kota Bharu, Kelantan Malaysia

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Abstract: Increase in the number of motor vehicle workshops around Kota Bharu has resulted in water pollution problems occur in this area. To prove this hypothesis is correct, a study was conducted where oily wastewater samples were collected from three different automotive workshops in Kota Bharu area. All the three workshops were identified as workshop K, P and T. The sampling was performed three times which were in February 2010, May 2010 and November 2011. The collected samples were analyzed for pH (4.24 – 7.57), temperature (27.2 – 29.8 °C), biochemical oxygen demand (57.8 – 318.2 mg/L), chemical oxygen demand (137 – 9881 mg/L), dissolved oxygen (0.15 – 9.42 mg/L), and oil and grease (14.2 – 90,500 mg/L). The lowest dissolved oxygen was recorded in May 2010 at automotive workshops K. Meanwhile, the highest biochemical oxygen demand and chemical oxygen demand were recorded in February 2010 at automotive workshop T (318.2 ± 1.89 mg/L) and in May 2010 at automotive workshops P (9881 ± 7.46 mg/L) respectively. The results showed that, all the parameters excepted pH and temperature were high and exceeded permissible level (Standard B) listed in the Third Scheduled, Environmental Quality (Sewage and Industrial Effluents) Regulations, 1979 of Environmental Quality Act, 1974.

Key words: physicochemical, oily wastewater, automotive workshop, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, oil & grease

INTRODUCTION

Oily wastewater is defined as liquid waste either from automotive workshop or oil industry and known as a combination of water with some surface oil, oil sludge or sediments which contained lubricants, cutting fluids and heavy hydrocarbon such as tars, grease and diesel oil, bacteria and light hydrocarbon at concentration that may vary from a few hundred parts per million to as much as 1 to 10 percent by volume. In addition, the oily wastes may also contain chemically and mechanically emulsified oils, acid/alkaline cleaner, solvents, suspended solids and heavy metals (Kanluen and Amer, 2000). This kind of wastewater widely produced from a variety of sources such as automotive workshop, crude oil production, oil refinery, petrochemical industry, metal processing, lubricant and car washing (Tri, 2002).

Automobile workshops are an important component of the services sector industry (Moorthi, *et al.*, 2008) because it is play important role for keeping vehicle in the best condition. As a result of rapid economic and infrastructure development, the number of vehicle in Kota Bharu has increased significantly which contribute to increase in number of automobile workshop. However, the discharges of this wastewater to sewer or environment have the potential to cause significant environment harm through the release of contaminants to the environment. This is because, the component of oily wastewater like oil will cover the surface of water and cut off oxygen diffusion from air to water (Kadarwati and Herlina, 2008) and contribute to biological oxygen demand (BOD) and chemical oxygen demand (COD) in effluents water (Yasin, *et al.*, 2012).

Several works on analysis of effluent wastewater physicochemical from automotive workshop have been reported. For example, Yasin, *et al.*, (2012) studied oily wastewater from different petrol pumps and services stations of Lahore and found pH, BOD, COD and oil and grease concentration in the average value of 8.3, 520 mg/L, 1330 mg/L and 1070 mg/L respectively. In addition, Mazumder and Mukherjee, (2011) also investigated the physicochemical characteristic of wastewater collected from different servicing points of a typical automobile garage and the results shows that, the value of COD, oil and grease and pH were ranged between 255 to 445 mg/L, 400 to 800 mg/L and 6.4 to 7.0 respectively for heavy vehicle sources. Meanwhile, the COD, oil and grease concentration and pH for wastewater from light vehicles sources were ranged from 227 to 378 mg/L, 150 to 700 mg/L and 7.1 to 7.6 respectively.

This study is aimed to assess the level of some physicochemical parameters in oily wastewater from automotive workshop in Kota Bharu before discharge into environment.

MATERIALS AND METHODS

Sample Collection:

In this research, oily wastewater in oil trap was collected from three automotive workshops in Kota Bharu (Figure 1). Oily wastewaters samples were collected in sterile sampling bottles. All the samples were preserved by adding 1 mL of Sulphuric Acid (H_2SO_4) per 1 litre of samples and storing in cool box filled with ice cubes. Lastly, samples were labeled and transport to the laboratory and stored in the refrigerator at temperature $4^\circ C$ prior to analysis. The samples were collected between the periods of February 2010 to November 2011.

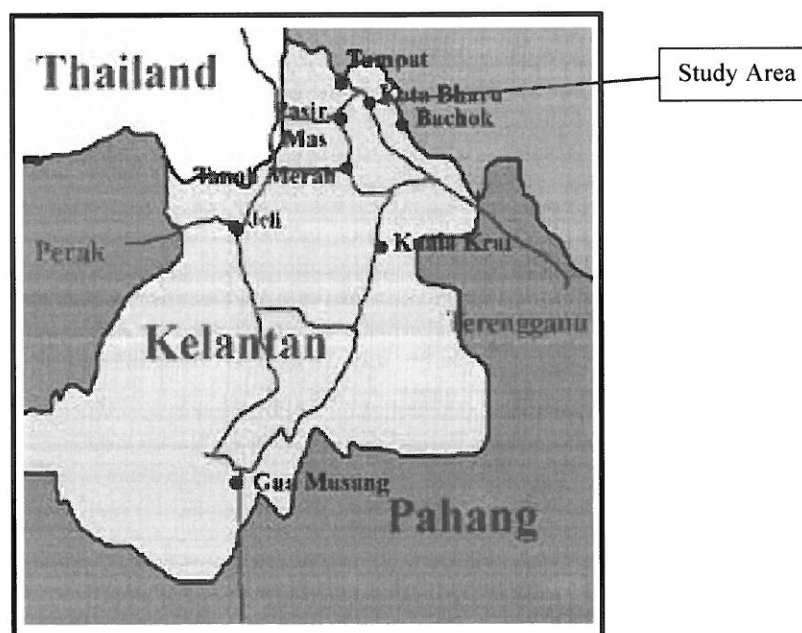


Fig. 1: Study Site (Source: Google Map)

Measurement Of Physicochemical Parameters:

Several pollutant parameters of oily wastewater were measured in order to identify the characteristics and component of wastewater. At each automotive workshop, three in-situ parameters were measured following the standard procedure of U. S. Environmental Protection Agency (2007) which are temperature, Dissolved Oxygen (DO) and pH using model Hanna and YSI instruments. Meanwhile, for laboratory analysis there are another three parameters were analyzed namely biological oxygen demand (BOD), and chemical oxygen demand (COD) and oil and grease (O&G). The biological oxygen demand (BOD) and chemical oxygen demand (COD) analysis were measured in accordance with standard method procedures (APHA, 1992; HACH 2003). On the other hands, the biological oxygen demand (BOD) in oily wastewaters samples was measured based the standard methods for water analysis handbook HACH. This method was adapted from Standard Methods for the Examination of Water and Wastewater (Klein and Gibbs, 1979). The dissolved oxygen content was measured before and after 5 days incubation at $20^\circ C$ in BOD bottle. Meanwhile, the determination of chemical oxygen demand (COD) was analyzed by reactor digestion method using HACH spectrophotometer as described by Eaton, *et al.*, 1995. For oil and grease (O&G) analysis, the sample was sent to independent lab (UKM UNIPEQ). Oil and Grease analysis was carried out according to the Standard Methods for the Examination of Water and Wastewater (2005) 21st. Edition, APHA, AWWA, WPCF.5520D and GC-MS/MS respectively. The results of physicochemical were compared with Environmental Quality Act., 1974: Environmental Quality (Sewage) Regulation 2009.

RESULTS AND DISCUSSION

The results of physicochemical wastewater quality from three different automotive workshops in Kota Bharu for three different months are presented in Table 1 and Table 2. The results of these analyses were then compared where possible to the recommended present Environmental Quality (Sewage and Industrial Effluents) Regulations, 1979. The level of pH varies between 5.68 ± 0.28 to 6.81 ± 0.01 for workshop K; 4.24 ± 0.04 to

5.94±0.06 for workshop P and 6.48±0.04 to 7.57±0.01 for workshop T in the oily wastewater for three different months respectively. Results of the study demonstrated that oily wastewaters from different sampling location have different pH. The results showed that, oily wastewater from workshop K and workshop P more acidic compared to workshop T. Only oily wastewater from automotive workshop K and T complied with Environmental Quality Act., 1974: Environmental Quality (Sewage) Regulation, 2009.

On the other hand, the temperature recorded was ranged from 27.7±0.00 to 29.8±0.07°C for workshop K, 27.2±0.28 to 28.8±0.21°C for workshop P; and 27.5±0.28 to 28.7±0.50°C for workshop T. Temperature of oily wastewater plays important roles in changes the physical and chemical properties of wastewater. High temperature can affect the solubility of oxygen by reduce the amount of oxygen. However, these values were complied Environmental Quality Act., 1974: Environmental Quality (Sewage) Regulation, 2009. The present study indicated that the temperature for all oily wastewaters were within the mesophilic range (27.2±0.35 to 29.8±0.07°C), it is an ideal temperature for biodegradation in aquatic environment (Zobell, 1964; Atlas, 1992).

In terms of dissolved oxygen (DO), the value ranged from 0.15±0.03 to 9.42±0.02 for workshop K while, the value ranged from 0.22±0.11 to 9.14±0.06 for workshop P for three different months were recorded. Meanwhile, dissolved oxygen value ranged from 1.28±0.21 to 3.57±0.06 was obtained for workshop T. Based on the results of study, the dissolved oxygen of all oily wastewater is relatively low and can affect the aquatic biological life (Akan, *et al.*, 2008). According to Ademoroti, (1996b) a healthy body of water should have dissolved oxygen of at least 5.2 mg/L. The different of DO level might be due to seasonal changes. In general, during rainy season (November), oxygen concentration tend to be higher because the interaction between rain water and oxygen (Murphy, 2007). In addition, water temperature also affects the dissolved oxygen level which the increasing water temperatures lead to a decrease in DO concentration (Barnes, *et al.*, 1997; Holmbeck-Pelham and Rasmussen, 1997). Similarly, a different in dissolved oxygen level might due to the different depth of wastewater and services activity (Water on the Web, 2007).

Table 1: Physicochemical parameter of oily wastewater samples from three different automotive workshops in Kota Bharu

Parameters	Automotive workshop K			Automotive workshop P			Automotive workshop T		
	Feb 2010	May 2010	Nov 2011	Feb 2010	May 2010	Nov 2011	Feb 2010	May 2010	Nov 2011
pH	5.81±0.15	5.68±0.28	6.81±0.01	4.24±0.04	5.34±0.02	5.94±0.06	6.80±0.14	6.48±0.04	7.57±0.01
Temperature (°C)	29.1±0.14	29.8±0.07	27.7±0.00	27.2±0.35	28.8±0.21	27.2±0.28	28.2±0.28	28.7±0.50	27.5±0.28
DO (mg/L)	0.17±0.04	0.15±0.03	9.42±0.02	0.22±0.11	0.49±0.08	9.14±0.06	1.28±0.21	1.43±0.04	3.57±0.06
BOD (mg/L)	292.6±3.5	263±1.51	263.7±2.3	305.5±1.4	278.2±1.0	268.9±2.4	318.2±1.8	280.5±0.4	57.8±10.7
COD (mg/L)	9092±7.0	8086±6.1	930±24.9	7217±22.0	9881±7.4	1801±43.7	317±15.0	1413±5.8	137±14.8

Data in the table were means and standard deviations (mean±S.D)

Biochemical oxygen demand (BOD) parameter is an important parameter to evaluate the quality of oily wastewater especially from the automotive workshop. The biochemical oxygen demand (BOD) test is defined as the oxygen required for the microorganism to carry out biological decomposition of organic matter or dissolved solid in the wastewater under aerobic conditions at standard and its most widely used parameter of organic pollution applied to the wastewater (Sulieman, *et al.*, 2010). BOD value for oily wastewater from workshop K and P are in the ranged of 263±1.51 to 292.6±3.55 mg/L and 268.9±2.44 to 305.5±1.43mg/L respectively for three different months. While, the workshop T showed that, the range of BOD was between 57.8±10.7 to 318.2±1.89 mg/L for three different months. Another parameter that can be used to measure the content of organic matter of oily wastewater is chemical oxygen demand (COD). This parameter is useful in the control of treatment process (Sulieman, *et al.*, 2010). The results showed that, the concentration of COD for oily wastewater from workshop K were ranged from 930±24.9 to 9092±7.00 mg/L, P were ranged from 1801±43.7 to 9881±7.46 mg/L, and T were ranged from 137±14.8 to 1413±5.86 mg/l.

Basically, the level of BOD and COD of all the stations exceeded the maximum permissible limit set by Environmental Quality Act., 1974: Environmental Quality (Sewage) Regulation, 2009 and cannot be discharged to the environment. The high concentration of COD and BOD recorded in oily wastewater might due to the use of chemical which are organic or non organic that are oxygen demand (Akan, *et al.*, 2008). In addition, the present of free oil, emulsified oil, diesel and gasoline also contributes to higher level of BOD and COD concentration (Yasin, *et al.*, 2012).

Result obtained from this study was in line with the finding from Kurian and Natarajan, (1997) where they found that the value of BOD and COD for 40 samples collected from 10 automobile service stations were ranged between 75- 570 mg/L and 270-1640 mg/L respectively. Ratnapriya, (2002), also investigated the physicochemical characteristic of oily wastewater collected from 24 service stations which are situated along the Mahaweli River in order to evaluate the pollution level of wastewater generated from service stations and results

shows that, the value of BOD, COD and pH were ranged between 245-338mg/L, 609-1020 mg/L and 7.6-7.7 respectively.

Meanwhile, the concentration of oil and grease is 90500.0 mg/L for automotive workshop K; 60800 mg/L for automotive workshop P and 14.2 mg/L for automotive workshop T (**Table 2**). The values obtained for all the sampling points were higher than standard stated in Environmental Quality Act, 1974: Environmental Quality (Sewage) Regulation 2009 of 10.0 mg/L.

Table 2: Concentration of Oil and Grease in oily wastewater samples from three different automotive workshops in Kota Bharu

Sampling Point	Oil and Grease (mg/L)
Automotive workshop K	90500.0
Automotive workshop P	6080.0
Automotive workshop T	14.2

Conclusion:

As a conclusion, the result for physicochemical parameters monitor in three different automotive workshops in Kota Bharu was not comply with Standard B set under the Environmental Quality Act., 1974: Environmental Quality (Sewage) Regulation, 2009 except temperature.

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