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Characteristics of the Effluent Wastewater in Sewage Treatment Plants of Malaysian Urban Areas

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Recently, a lot of domestic wastewater is being generated due to the rise in the population in most urban areas in Malaysia. This implies that more contaminations are being produced which are likely to affect human health. The purpose of this research was to analyze the level of contaminants in the final treated wastewater from the sewage treatment plants in Malaysian urban areas and compare it with Malaysian standard A and B effluent discharged. The specimens used for the analysis were obtained from three wastewater sewage treatment plants in Johor (A), Kuala Lumpur (B), and Penang(C). Specimens were examined using chemical oxygen demand (COD) Vials, Nitrate Nitrogen ammonia vial, and total Phosphorus vial. The Hach DR 5000 UV-V Laboratory Spectrophotometer was used to measure the amount of COD, Nitrate, Nitrate, and Phosphorus. Also, the pH, turbidity, and BOD5 were done utilizing dissolved Oxygen machine and Lovibond Turbidity Meters. The level of BOD, COD were treated well and discharged according to the used standards. The findings revealed that phosphorus in plant c with 12 mg/L in February, Nitrate in plant A 22 mg/L in January, Nitrite in plant A with 18.2 mg/L in February, 19.4 mg/L in February in plant B and16 mg/L in February were found little greater than the prescribed effluent standard of Malaysian wastewater. It was recommended that the final treated water should be frequently and thoroughly treated for the purpose of reusing it for secondary intent. This study has important implications for protecting human health and the environment by identifying the effluent sewer treatment plant that has no proper treatment capability to produce water that is fit for domestic and irrigation purpose.

1. Introduction

Sewage treatment is described as a means of extracting the pollutants from sewage to get a product that can be reused or released to the environment (Abdel-Raouf, 2012).Conventional activated sludge is a system that is used for treating wastewater and thus it is used to treat domestic wastewater mostly where the sewage was created (Mc Carty et al., 2011). The sewage wastewater is a complicated model that has many discrete chemical features (Roehrdanz et al., 2017). These features are concentrations of COD, BOD, Nitrogen, phosphorus, Nitrite, and Nitrate which are immense, huge conductivity (which is as a result of huge dissolved solids), with pH that ranges between 7 and 8 (Li et al., 2013). Operating situations and procedures that are performed have an effect on the features and amount of the by-products and the formed waste. The characteristics and the quality differ both in domestic and industry waste with the help of the waste water (Ensink et al., 2007). The formation of the wastewater that is gotten from the same industry as well differs hugely from day to day (Rou et al., 2011). The best system to cure the rising outflow of the domestic wastewater in the urban areas and tropical regions globally is using the wastewater stabilization pond. The sequencing batch SBR reactor is recognized as a type of the activated sludge process which used for the wastewater treatment (Yeruva et al., 2015). It is used to treat sewage wastewater as well as the output from digested anaerobic. Besides, it is used for mechanical biological treatment facilities in batches. The oxygen dissolving method in the combined wastewater and activated sludge is used to minimize the organic matter represented by BOD and COD (Gonzalez et al., 2015). The plants that are used for the wastewater treatment are implemented as an efficient process for treating

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wastewater which is based on just a minimal technology and proper maintenance. However, at a considerable cost, their minimal capital and pneumatic loads are being esteemed for many years especially regions that are rural and in lots of nations where there is the availability of the satisfactory land (Sharafi et al., 2015). They mostly include an array of ponds where the wastewater takes about 20 d time to store and mostly a depth that ranges between one and three meters which are based on the pond type. There is usually a partial treatment of domestic wastewaters before they are now released into sewers; else their treatment occurs independently via reliable means of treatment in order for the treated drainage to be safe (Chin and wang 1981). Malaysian standard A prescribed that the effluent discharge limit of phosphorus into any inland water within the catchment is 5 mg/L and standard B to any other inland water or Malaysian waters is 10 mg/L (Kutty et al., 2014).

2. Materials and Method

Sewage treatment samples were collected from three different sewage treatment plants in Malaysian urban areas. The current urban areas plants that were used for domestic wastewater treatment were locations in Johor Bahru (A), Kuala Lumpur, (B) and Penang (C). The samples were collected from three sewage treatment plant (STP) from November 2016 to March 2017. The Samples were analysed to determine those parameters which indicate the high polluted water in the effluent of STP. However, the collected samples were chafed in glass containers, pre-cleaned by washing with non-ionic detergents, and rinsed in tap water. The oven at 150 ºC was used to heat COD vials samplings for 2 h, Phosphorus vials for 30 min. Analyzing the collected samples from the selected areas was done in the laboratory. The Hach DR 5000 UV-V Laboratory Spectrophotometer was used to measure the amount of COD, Nitrate, Nitrate, and Phosphorus. The samples of COD heated in the oven to 150 °C within 2 h while Phosphorus heated to 150 °C within 30 min. On the other hand measuring the pH, turbidity, and BOD5 quantities were done utilizing dissolved Oxygen machine and Lovibond Turbidity Meters.

3. Results and Discussion

During the period of analysis, the pH of effluent wastewater samples differed between 6.5 to 7.98 for Johor STP, 7.65 to 8.43 for STP Penang, and 6.5 to 7.9 for the emission of Kuala Lumpur STP. Thus, in February the least value was examined, and the highest value was as well examined in the effluent of the STP located at Johor Bahru. The least value was examined in March, and the highest value was examined in February for the effluent STP located at Penang. Finally, the least and highest value were examined for STP Kuala Lumpur as shown in Table 1. The Malaysian standard A has prescribed the maximum permissible limit of pH ranges between 6 and 9.0 and standard B between 5.5 and 9.0. However, pH value of various specimens is between the desirable and convenient range. The results are given in Table 1.

Table 1: The least and highest effluent, COD, BOD, Turbidity, pH, Nitrite, Nitrate, and P for Malaysian urban areas STP

Parameters	Units	Johor Bahru Plant A					Kuala Lumpur Plant B					Penang Plant C				
		Nov	Dec	Jan	Feb	Mar	Nov	Dec	Jan	Feb	Mar	Nov	Dec	Jan	Feb	Mar
BOD	mg/L	45.9	43.7	50	51.2	48.9	6.6	8	37	19	13.5	36	37.5	19	13.5	40
COD	mg/L	145	160	162	144	143	114	127	122	134	123	155	164	170	160	151
Turbidity	FNU	14.2	12.7	17.3	20.6	14.9	14.6	24	33	36	37.5	13.8	30.4	17.3	16.4	12.8
PH	-	6.7	6.8	7.98	6.5	7.33	7	6.7	7.3	6.5	7.9	7.86	7.65	8.23	8.4	7.58
Nitrate	mg/L	10	21.5	22	12	11.8	6.7	7	7.97	6.4	8.89	10	13.6	11.2	12.8	15.4
Nitrite	mg/L	15	13.3	16.8	18.2	14.5	16	14.1	15.8	19.4	15.2	7	9	14	16	8.9
P	mg/L	7.4	6.5	8.6	10	9.9	6.8	5.2	7.8	9	8.8	8.9	10.1	11.5	12	9

3.1 BOD (Biological oxygen demand)

Based on the study the Biological oxygen demand was varied from 43.7 mg/L to 51.2 mg/L in the effluent sewage wastewater treatment Johor plant A, 6.6 mg/l to 37 for the effluent sewage treatment plant Kuala Lumpur B and 36 mg/L to 40 mg/L for sewage treatment Penang plant C. The maximum value was observed on the month of February and the minimum value was in the month of December for Johor Plant A. The minimum value was detected in November and also the maximum in the month of January for effluent domestic wastewater treatment plant B. The highest value was observed in March and the lowest in Jan for Plant C sewage treatment plant as shown in Figure 1. However, the higher amount of BOD indicated the higher pollution of the domestic wastewater. This means the amount of the biodegradation organic materials was too high.

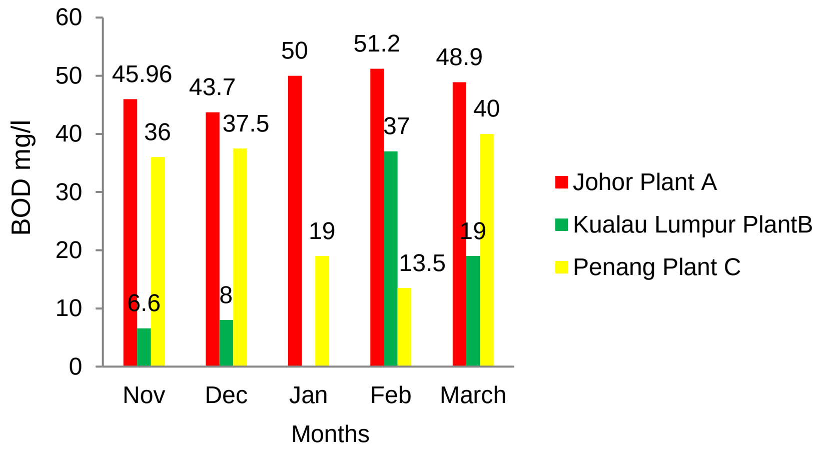

Figure1: Variation of BOD in the effluent domestic wastewater plants

3.2 Chemical oxygen demand (COD)

The experiments were done to evaluate the amount of Chemical oxygen demand of the domestic wastewater plants in Malaysian urban areas. However, the amount of domestic wastewater and the used technologies were not the same, so COD results were different from plant to other. As shown in Figure 2, the COD values were varied from 143 mg/L to 162 mg/L in Johor Bahru plant A, 114 mg/L to 134 mg/L in Kuala Lumpur plant B and 155 mg/L to 170 mg/L in Penang Plant C of the effluent domestic wastewater treatment plants. The COD values were used to measure the pollutant in wastewater and natural water (Belfroid et al., 1999). However, it was clearly shown in Figure 2 that the highest value in plant A of COD was in January and the minimum was in March. On the other hand the minimum value of COD in plant B for the effluent domestic wastewater treatment was in November while the highest was in February. The chemical oxygen demand COD was showing the amount of oxidant which basically reacts with the sample under specific conditions.

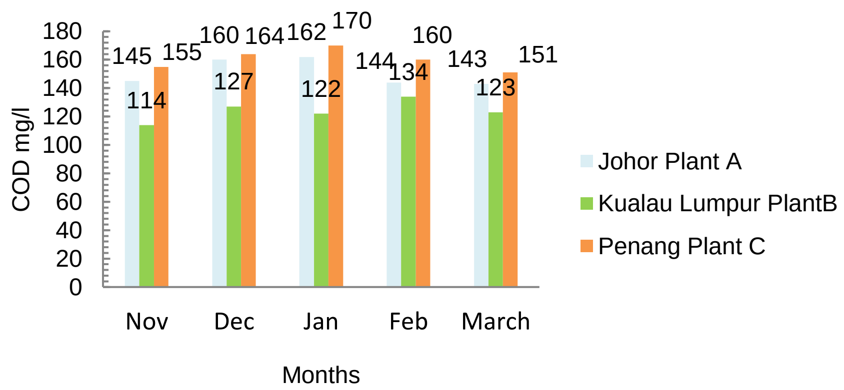

Figure 2: Variation of COD in the effluent domestic wastewater plants

3.3 Turbidity

Turbidity is defined as cloudiness or the haziness of the fluid caused by some invisible particles to the naked eye. Measuring the turbidity is considered a key to test the water quality. According to the obtained results from the laboratory the effluent wastewater turbidity results were varied from 12.7 FNU to 20.6 FNU for Johor Plant A. The obtained turbidity results for Kuala Lumpur Plant B were widely different and in the ranges of 14.6 FNU to 37.5 FNU while Plant C DWW treatment plant turbidity results varied from 12.8 FNU to 30.4 FNU. The highest result of turbidity was observed in plant B wastewater treatment in the month of March and with the lowest in November. On the other hand the minimum amount of the effluent turbidity was observed on Plant A wastewater treatment plant in December and the maximum was in February. For the Plant C sewage wastewater treatment turbidity, the effluent wastewater was the highest in January and the lowest in March. However, the obtained results were compatibly stipulated with Malaysian standard A. Figure 3 is showing the variation of turbidity of the effluent domestic wastewater treatment plant in Malaysian urban areas.

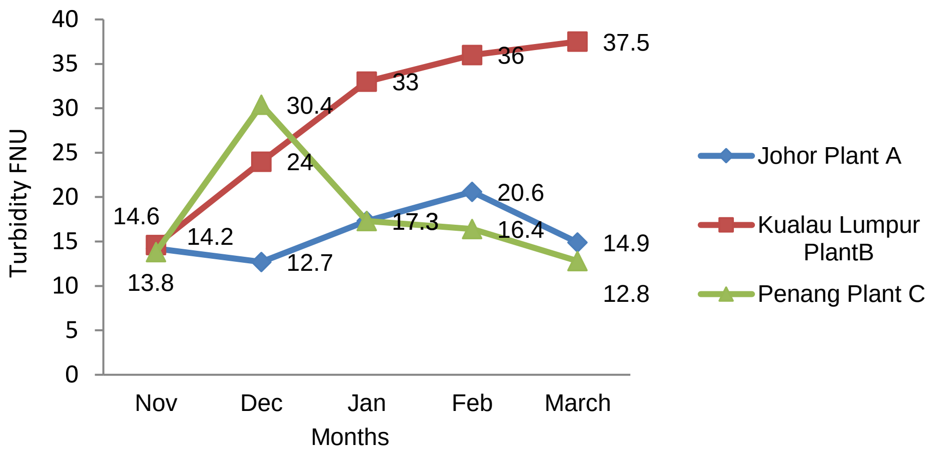

Figure 3: Variation of turbidity of the effluent wastewater treatment

3.4 pH

PH of the effluent wastewater is used to measure the hydrogen ion activity in the effluent water (Ochado et al., 2016). Random samples have been taken from the effluent wastewater for three sewage treatment plants from Malaysian urban areas. The results described the differentiation in pH for the targeted plants during the investigation. As shown in Figure 4 for Johor Bahru Plant A, the minimum and maximum values were noted in February with 6.5 mg/L L and 7.98 mg/L in January. The Plant B, STP recorded the minimum rate for the effluent PH with 6.5 mg/L in February and 7.9 mg/L in March while Plant C, STP recorded the highest value in January with 8.23 mg/L and the minimum value in March with 7.58 mg/L. However, Malaysian standard A has recommended a maximum permissible limit of pH 6.0–9.0 and standard range from 5.5–9.0. Therefore, the observed pH values for the three plants were within the described and suitable range.

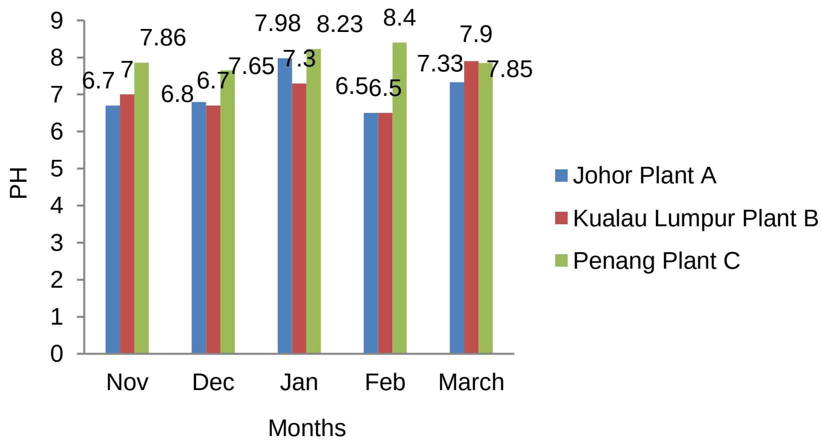

Figure 4: Variation of PH in the effluent STP plants

3.5 Nitrate and Nitrite

Based on the observed results showed in Figure 5 for Johor Plant A effluent STP, the Nitrate values were varied from 10 mg/L to 22 mg/L. The maximum value was observed in January while the minimum was in November. On the other hand, the values of nitrite in the effluent for the same STP varied from 13.3 mg/L to 18.2 mg/L and the highest value was observed in February while the lowest value was in December. Regarding to Plant B STP effluent, the Nitrate was varied from 6.7 mg/L to 8.89 mg/L while the Nitrite values were from 14.1 mg/L to 19.4 mg/L. The highest value was observed in March and the lowest in February. The minimum Nitrite value was noticed in December and the highest in February. The highest value in the effluent of Nitrate for Plant C STP was varied from 10 mg/L in November to 15.4 mg/L in March, while the Nitrite varied from 7 mg/L in November to 16 mg/L in March. According to the Malaysian standard for effluent sewage discharged, standard A is applicable to discharge into any water within any catchment areas, and standard B is applicable to discharge into any other inland waters or Malaysian waters. However, discharging limit of nitrate based on standard A to the river need to equal or less than 20 mg/L, and equal or less than 50 mg/l for standard B within the catchment area. On the other hand, the discharge limit of nitrate for the enclosed waster body based on both standard A and B need to equal or less than10 mg/L.

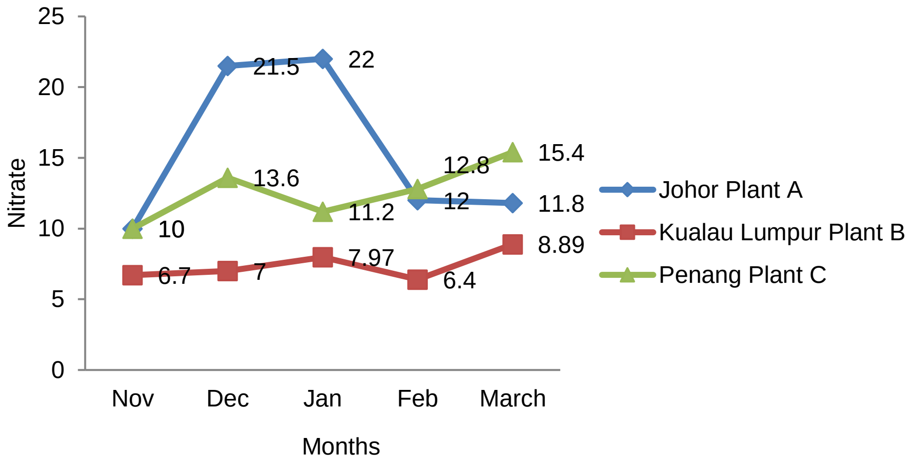

Figure 5: Variation of Nitrate for the effluent wastewater treatment

3.6 Phosphorus

To increases the reliability of measuring phosphorus in the effluent STP in Malaysian urban areas, each sample was tested twice. The values of phosphorus in the effluent domestic wastewater vary from plant to other. The observed value of the effluent phosphorus in Johor plant A STP has the highest value of 10 mg/L in February and the lowest value of 6.5 mg/L in December. The minimum value of the observed effluent phosphorus in the STP in Kuala Lumpur plant B varied from 5.2 mg/L to 9 mg/L. However, the highest value was observed in February and the lowest was in December. Regarding to the value of phosphorus in Plant C STP, the values varied from 8.9 mg/L in November to 12 mg/L in February. Therefore, the observed value of phosphorus for Plant A and Plant B were within the described and suitable range. On the other hand Plant, C STP has the highest value of the effluent phosphorus with 12 mg/L which was not applicable to the described value of Malaysian standard A and B as shown in Figure 6.

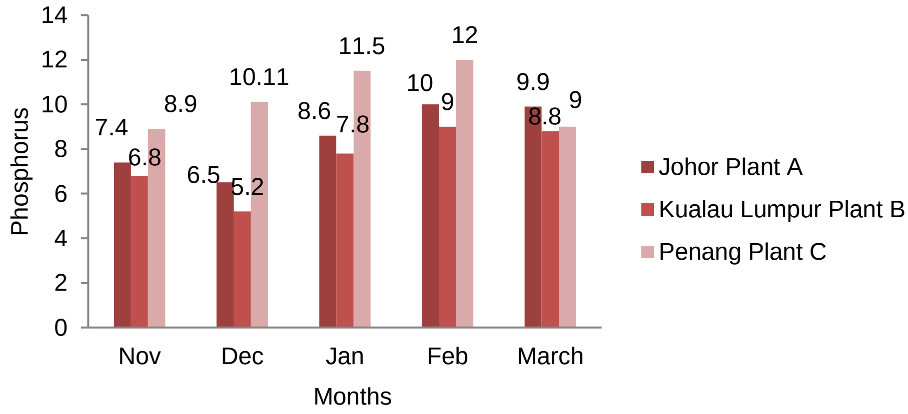

Figure 6: Variation of Phosphorus for the effluent wastewater treatment

4. Conclusion

The present study reveals that the qualities of the effluent sewage treatment plants were differed based on the location and the type of the used technologies. Based on the obtained results the concentration of the turbidity, BOD, COD, Nitrate in plant B and C, Nitrite in plant C for the effluent wastewater found within the permissible limit prescribed by Malaysian standard A and B. The concentration of phosphorus in the effluent wastewater for plants A and B was within the admissible to discharges into any inland waters or Malaysian waters. Correspondingly, the concentration of phosphorus in the effluent wastewater in plant C, Nitrate, Nitrite in Plant A, Nitrite in Plant B and C were higher than the Malaysian standard A and B for sewage water discharge limit. Therefore, discharging the effluent water from plant C to water bodies utilizing for domestic or irrigation purpose without proper treatment will affect the human health and environment.

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