Modern Environmental Science and Engineering (ISSN 2333-2581)
November 2017, Volume 3, No. 11, pp. 805-810
Doi: 10.15341/mese(2333-2581)/11.03.2017/008
Academic Star Publishing Company, 2017
www.academicstar.us

Study on Wastewater Quality and Its Difference with Upstream and Downstream at Politeknik Mukah Drainage System

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Abstract: Effluents released from wastewater systems do contain pollutants of concern since even advanced treatment systems are unable to remove all pollutants and chemicals. This study was carried out on three different days to determine the wastewater quality of Politeknik Mukah drainage system based on physical and biological parameters. The water quality parameters studied were in-situ parameters of temperature, pH and Dissolve Oxygen (DO); and laboratory analyzed water quality parameters of Total Suspended Solid (TSS), Chemical Oxygen Demand (COD), Ammonic Nitrogen (AN), and Biochemical Oxygen Demand (BOD). The differences in the quality of wastewater at upstream and downstream based on Water Quality Index (WQI) was also carried out. Results showed that wastewater at upstream are affected by pollution rather than intermediate station and downstream station after being compared to WQI. The results indicated the impact of various anthropogenic activities which contribute to high values of BOD, COD, TSS and AN at upstream stations, as compared with the intermediate stations and downstream station. It is suggested that monitoring should be carried out continuously for proper management of this drainage system.

Key words: wastewater, water quality index, water quality parameter, drainage system

1. Introduction

Water is one of the most important commodities which human exploited than any other resource for sustenance of his life. Most of our demand water is fulfilled by rain water which gets deposited in surface and ground water resources. The quantity of this utilizable water is very limited on the earth. Though, water is continuously purified by evaporation and precipitation, yet pollution of water has emerged as one of the most significant environmental problems of the recent times [1]. Thus, water plays important roles where it was used in industrial, agriculture, recreational, transportation, water industry, food processing and many more. A report by the Malaysian Environmental Quality Department [2] states that the factors that contribute to the slipping of the water quality are mostly industrial, agriculture, domestic sewage and food processing.

Wastewaters are water that originally cleans, pure and unharmed which has been used by community in various ways. The wastewaters are drain away after application into drain or sewerage system which is either to be treated or direct dispose. Sewage may drain directly into major watershed with minimal or no treatment but this usually has serious impact on the quality of an environment and health of people. Wastewater, also written as “sewage”, is any water that has been adversely affected in quality by anthropogenic influence. It is originated from household waste, industrial waste water, storm run-off and ground water infiltration. Wastewater is basically the flow of used water from community [3].

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This study was conducted to determine the physical and biological parameters of wastewater at Politeknik Mukah drainage system and its difference between discharge points (upstream) and downstream based on WQI. Many water quality parameters were used in order to calculate the WQI, such as DO, pH, temperature, BOD, COD, AN, and TSS. Wastewater that discharged to the drainage from food premises at Politeknik Mukah named as upstream point. Meanwhile the downstream point is at the station where this wastewater is release to the main drainage (outside politeknik).

2. Methodology

The location for sampling of this study is at the Politeknik Mukah drainage system (Fig. 1). Eight wastewater quality stations were selected from the upstream to downstream of the Politeknik Mukah drainage system. The red marked points (station 1 and 2) are the upstream where the first effluents are being discharged. The first station will be nearby to the food premises whereas the other one is located 100 meters away from station one. Meanwhile, the downstream station is at point 7 and 8. The other stations are the intermediate stations.

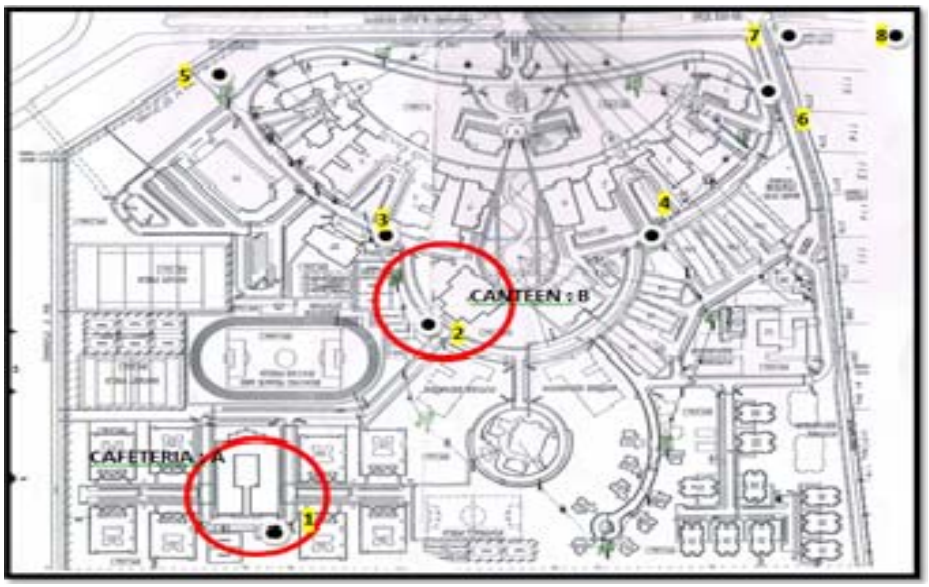

Fig. 1 Location of sampling stations.

Water sampling has been carried out three times during at different days. Water samples were collected in specific bottles according to APHA (2009) [4]. Each sampling was performed only in the morning section on the consecutive days in order to minimise the variation due to sampling time. Temperature, DO, and pH were measured in-situ as field parameters, while BOD, COD, TSS, and AN were analyzed in the laboratory. All water samples were placed in an ice box to preserve and minimize contamination during transportation to the laboratory for further analysis.

3. Results and Discussion

Fig. 2 shows the graph of data for the present study. The ranges of the temperatures value are from 28°C to 30°C. Based on the graph of temperature versus station, shows an inclination of the temperature value from first to the next stations. Station 7 and 8 in which is a downstream station of both recorded the highest value of 29.67°C, respectively. Furthermore, the temperature was increased progressively from upstream to downstream. Thus, this has cause the wastewater around the station to experience colour changing and unpleasant odour [3]. The temperature does affect the chemical reaction and biological activities of the water sample.

Graph pH versus station, shows the highest pH value was at station 5 and 6 following by stations 7, 8, 1, 2, 3

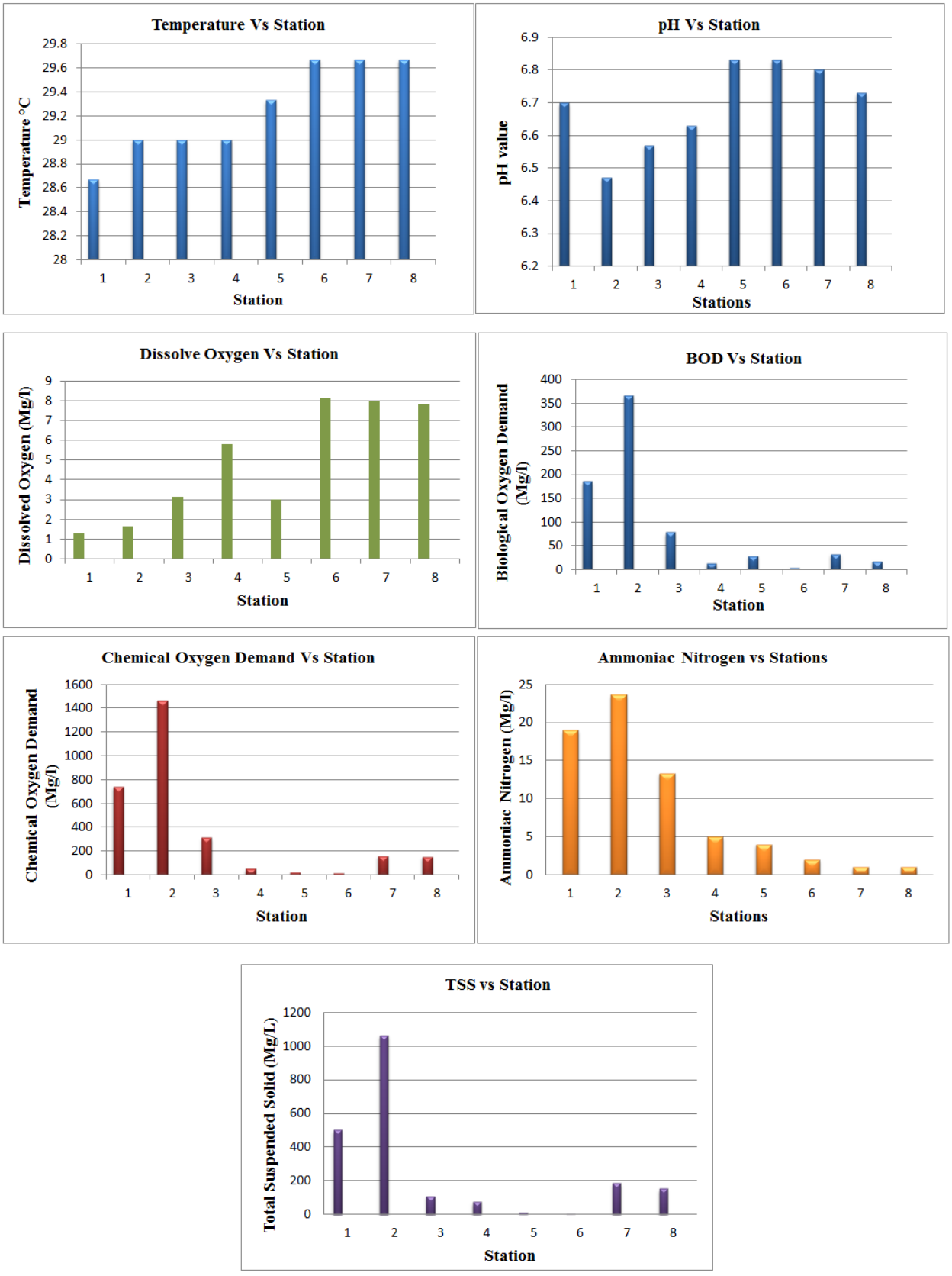

Fig. 2 Variation of the parameters for the different sampling station.

and 4. The station which has highest value is where other source of domestic waste is being drained (mixing point). The average value of pH was among range from 6.47- 6.83. The value at each station was in acidic condition as it is below 7. This proves that the water samples have the concentration of hydrogen ion higher than hydroxide ion. Hence, the pH value of the wastewater was in class II according to Interim National Quality Water Standard (INQWS). Class II water needed only conventional treatment which are not harmful to human and suitable for recreational activities. Somehow, it is affecting some aquatic species that are sensitive to the variation.

The data of DO on each station shows that the lowest dissolved oxygen was at station 1 and 2 which is the upstream or the source point of where the wastewater was being discharged. The biological decomposition of organic matter uses the oxygen more. Then, it is followed by slight fluctuation at station 3 to 4 and then to station 5. Hence, oxygen from the surrounding was diffuse into the water. At the downstream, where the last station of wastewater before being release to the environment shows a high concentration of DO. The wastewater flow has undergone a self-purification process where the water is cleanse and also due to rapid flow. The condition of low DO was not healthy to the aquatic habitat and life which are more likely to get pollute. The depletion of oxygen at this point is higher and was relatively harmful to aerobic microorganism and anaerobic microorganism starts to thrive [5].

The ranges of BOD are within 4 mg/l to 367 mg/l. The highest BOD values are situated at station 1 and station 2 respectively 185.3 mg/l and 367 mg/l. This is the upstream station where the wastewater discharges to drainage. The BOD value declined at station 3 which is 78.3 mg/l, this station where the mixing point from other source of wastewater are channelled here including effluent from station 1 and station 2. The other effluent that channelled at the mixing has low phased of contamination, so its affect the BOD at station 3. The BOD also decreasing the downstream which is station 4 and station 5, and station 6 respectively 12.8 mg/l, 29.1 mg/l, and 4 mg/l. This caused by the ability of wastewater to rid itself of pollutants, water self-purification. The slow flow rate of wastewater also affects the BOD value, because it is hard for oxygen to dissolve into water from the atmosphere.

The ranges of COD are within 15 mg/l to 1467 mg/l. The highest COD was recorded at station 1 and station 2 respectively 740 mg/l and 1467 mg/l. This is where the wastewater discharges to drainage. The presence of organic and inorganic materials thrown out from food premises contribute to high concentration of COD and high phase of contamination. The COD declining at mixing point which is station 3 with 312 mg/l. The COD again decrease at station 4, station 5, and station 6 when there is less oxygen dissolve into the water from the atmosphere that causes the microorganisms dying. The COD increase within small value at station 7 and station 8, 160 mg/l and 153 mg/l because wastewater from another source is also channelled here.

The lowest AN value was at station 8 and 7 which is good. These two stations are the downstream of the flow where the wastewater was being drained. It has fine aerobically processes occurring. Meanwhile, the station 2 and 1 are the highest among all the station of respectively 23.67 mg/l and 19 mg/l. Besides, station 1 and 2 are where the domestic wastewater from the food premises which is the main factor for such circumstances to happen. The anaerobic process occurs at these points where the decomposition of organic matter will lower the dissolve oxygen level, thus slowing down the rate at which ammonia is oxidised to nitrite (NO_2) then to Nitrates. Nevertheless, the intermediate stations where from upstream to downstream show a constant decrease of ammoniac nitrogen level of the wastewater in the drainage.

Tables 1 and 2 show full data of the study and wastewater classes and status based on WQI at each eight station after analyzed. It indicates that station 1 was slightly polluted meanwhile station 2 was polluted.

Station 1 shows the range in Class II of wastewater classification. It needs conventional treatment. Meanwhile, station 2 shows that it is polluted. The water at this area needs an intensive treatment as in to prevent environmental problem to occur. Somehow, others station are in clean status.

Table 1 Data of the study on wastewater quality study.

Station	Parameter & Batch																				
	Temperature (°C)			pH			Dissolved oxygen (mg/l)			Biological oxygen demand (mg/l)			Chemical oxygen demand (mg/l)			Total suspended solid (mg/l)			Ammoniac nitrogen (mg/l)		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1	28	32	28	7.6	6.8	5.7	1.47	1.70	0.70	305	83	168	1220	330	670	608	754	146	40	13	4
Average	28.67			6.7			1.29			185.33			740			502.67			19		
2	28	30	29	7.3	6.8	5.3	2.13	1.63	1.26	253	690	158	1010	2760	630	679	2330	177	45	22	4
Average	29			6.47			1.67			367			1466.67			1062			23.67		
3	28	30	29	7.5	6.9	5.3	6.66	1.53	1.26	28	184	23	110	735	90	95	228	4	13	18	9
Average	29			6.57			3.15			78.33			311.67			109			13.33		
4	28	30	29	7.8	6.9	5.2	4.39	6.23	6.79	14	15.4	9	54	68	35	20	195	10	7	6	2
Average	29			6.63			5.8			12.8			52.33			75			5		
5	29	30	29	8.2	6.9	5.4	6.5	1.28	1.22	2.92	78.4	6	14	24	23	13	20	2	2	6	4
Average	29.33			6.83			3			29.11			20.33			11.67			4		
6	29	30	30	8.3	6.9	5.3	7.11	7.98	9.32	2.36	5.6	4	12	18	15	1	13	3	4	1	1
Average	29.67			6.83			8.14			4			15			5.67			2		
7	29	30	30	8.1	6.8	5.5	7.09	8.20	8.55	49	7	42	195	120	166	13	530	11	1	1	1
Average	29.67			6.8			7.95			32.67			160.33			184.67			1		
8	29	30	30	7.9	6.8	5.5	7.69	7.78	8.03	41	6.6	5	165	275	18	16	767	52	1	1	1
Average	29.67			6.73			7.83			17.53			152.67			278.33			1		

Table 2 Wastewater clasess and status at each station.

Stations	Waste water classes	Waste water status
1 (Upstream)	II B	Slightly Polluted
2 (Upstream)	III	Polluted
3	I	Clean
4	I	Clean
5	I	Clean
6	I	Clean
7 (Downstream)	I	Clean
8 (Downstream)	I	Clean

4. Conclusion

The monitoring of wastewater quality for drainage system at Politeknik Mukah demonstrated that the water quality can be classified from slightly polluted to clean status. The water quality at upstream (Station 1 and 2) is lower than quality of water at downstream (Station 7 and 8). WQI at upstream is low as waste from food premises is in a high concentration at this station. Based on the data that had been obtained, it can be seen clearly that the amount of TSS and COD at this station is high thus decrease the reading of WQI. At downstream, water is in a good condition. Water from all stations with different readings will mix at downstream. At downstream, both stations is classified in the same class. Eventually, the analysis indicated that the wastewater quality is slightly polluted. Therefore, the wastewater can be used for irrigation with precaution, and it is in need for any form of treatment to be used for domestic purposes. In general, low water quality was found at upstream stations. In contrast, high water quality was recorded at the downstream stations of the drain. Based on the INQWS, most of the parameters measured remained in Class I from the intermediate station to the downstream stations. Various anthropogenic activities have caused significant changes in the water quality of the drain.

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