Evaluation of Wastewater Characteristics in the Urban Area of Sulaimanyah Governorate in Kurdistan-Iraq

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Abstract: The population of Iraqi Kurdistan region is increasing rapidly. This has increased pressure on water supply and waste water management in the region. The Sulaimanyah city and other cities of Iraqi Kurdistan region are facing serious challenges in this regard. The present paper aims to study the characteristics of waste water in Sulaimanyah city, its harmful effects on environment and how to deal with these problems in order to safeguard the city from environmental pollution. All important parameters such as biological oxygen demand, chemical oxygen demand, total suspended solid, turbidity and phosphorus of waste water study were found higher than standard value. Only pH value was found in a standard range. Two types of samples of waste water were collected (stagnant and running) from three different places in Sulaimanyah. The values of different parameters for these samples are: pH range was 7.57-7.06, conductivity range is 190- 813 µS/cm, turbidity range was 37-250 mg/L, dissolved oxygen (DO) range is 3.25-6.5 mg/L, biological oxygen demand (BOD$_5$) range was 18-58 mg/L, chemical oxygen demand (COD) range was 10-110 ppm, phosphorous range was 3.48 -6.26 ppm and total suspended solid (TSS) 84-284 mg/L. Such type of water is not suitable for vegetation and other agricultural purposes.

Keywords: Wastewater, BOD$_5$, COD, Conductivity, TSS, Ph.

1. Introduction

Today is an important time for criticizing waste water effluent and thinking about water shortages, both occur with the ramifications of continuous population growth. In urban areas, the poor management of water use, and waste water management strategies might cause shortage of water (Jasim, Yousaf, & Kurdi, 2013). Environmental pollution will be unquestionably one of the major significant problems due to human activities, and waste water will be an important part of major threat for pollution in the affected area. The globally billions of citizens lack access to safe drinking water and face waste water sanitation problems (WHO, 2002). The Iraqi Kurdistan region might sewerage system problem. However, poor practices of using water raises serious question on how water is supplied to different cities including Sulaimanyah that has sewerage network system. Waste water is produced from human activities. Volume of waste water has been increased by domestic, industrial and commercial activities. Improved living conditions, and urbanization also play vital role in this regard. Scientific study reveals that waste water consists of 99.9% of clean water, but only 0.1% of solids or undesirable species (Topare, Attar, & Manef, 2011). In this paper, physiochemical characteristics of waste water from Sulaimanyah city are studied in order to determine their organic load and impact on environment. One of the difficulties to implement an appropriate waste water

treatment and management system is the current economic situation in the region. Lack of interest by relevant authorities in understanding the problems associated with waste water, its treatment and management might be another reason for what has been observed as a result of this study.

2. Study Area

Sulaimanyah city is the second biggest city in Iraqi Kurdistan region. Geographically it is located between latitude 45° 20' east and longitude north 35° 30'. Waste water enters into the Tanjero River from the southeast of Sulaimanyah city. This river runs for more than 20 km and passes through several villages and country sides before it sinks into Darbandikhan. The waste water samples were collected from Tanjero, Qaragull, and Tapilkarm sites of Sulaimanyah city. These samples were collected from stagnant and running waste water.

3. Sampling and Methodology

18 samples were collected in total from three different (Tanjero, Qaragull, and Tapilkarm) sites during July-September 2017. Among these, nine samples were collected from stagnant waste water and nine from the running waste water. The pH, electrical conductivity, turbidity, dissolved oxygen, BOD_5 were measured with the help of pH, turbidity and DO, and BOD_5 meter in the Ministry Lab of Natural Resources.

4. Results and Discussions

In this paper, eight parameters of physicochemical characteristics were checked. Three destinations of Sulaimanyah were selected which include Tanjero, Qaragull, and Tapilkarm. Also, from each station, two types (stagnant and running) of waste water samples were collected.

Table 1: Physicochemical characteristics of stagnant waste water samples collected from different sites of Sulaimanyah city

S. No.	Parameters	Tanjero	Qragull	Tapikarm
1	pH	7.06	7.57	7.13
2	Conductivity (µs/cm)	361	813	195
3	Turbidity (NTU)	37	155	180
4	TSS (ppm)	44	187	168
5	COD (mg/L)+	61	110	45
6	Phosphorus(ppm)	5.76	5.93	6.26
7	BOD_5 (mg/L)	58	40	42
8	DO (mg/L)	4.1	2.1	3.2

Table 2: Physicochemical characteristics of running waste water samples collected from different sites of Sulaimanyah city

S. No.	Parameters	Tanjero	Qragull	Tapikarm
1	pH	7.12	7.03	7.26
2	Conductivity (µs/cm)	290	290	390
3	Turbidity (NTU)	104	250	67
4	TSS (ppm)	89	284	84
5	COD (mg/L)	10	53	35
6	Phosphorus(ppm)	3.66	4.38	3.48
7	BOD_5 (mg/L)	29	30	19
8	DO (mg/L)	5.66	4.45	7.26

The pH value also tells about the main sources of the growth of microorganisms in waste water. Generally, it requires a pH between 6.5 and 7.5 for optimal growth. The pH value higher than 8.5 and lower than 5 directly influences the growth of microorganisms (Bouknanaa et al., 2014; WHO, 2006). The pH value in waste water samples from Sulaimanyah city were found to fall in the range of 7 to 7.5.

BOD_5, "Higher BOD, means higher organic matter "Microorganisms use water, which is dissolved by the atmospheric oxygen for biochemical oxidation of organic matter (Ammary, 2004). In stagnant waste water samples from Tanjarow (Sulaimanyah city), BOD_5 is found in high amount, which is 58 mg/l. While in running waste water sample from the same destination BOD_5 is 28 mg/l. High BOD_5 is due to central sewerage system which contains black and gray water. Also, the lower range of BOD_5 in samples of running water at the third destination (TapiKarm) 18 mg/l was noticed. This clearly shows that waste water in Sulaimanyah does not undergo any treatment.

Phosphate is the main form of total phosphorus in water and waste water body. It is found two forms in waste water bodies. The first one is organic and the second one is inorganic form. High concentration of phosphate form of phosphorus compound may produce an issue of water bodies (algae). Phosphate concentration in waste water samples collected from for the direct discharge into the environment was found higher. According to standard value of phosphate is (3 ppm) (Cleary, Slater, & Diamond, 2009). The value in table indicates that in Sulaimanyah city, there is higher range because of direct discharge of waste water. High concentration of phosphate recorded in the stagnant waste water samples as compared to the running waste water samples flow of wastewater at all three destinations.

Turbidity is the amount of suspended matter such as the clay, silt, inorganic matter and organic matter in water and waste water. The presences of these matters in water change the color and form of water. The turbidity measures the sprinkling of the light on the suspended particle in water and its value equivalent to 5 NTU is suitable for drinking (WHO, 2006). Furthermore, the turbidity was found more in running waste water samples than in stagnant waste water samples.

Dissolved Oxygen is the most significant element in water quality control. The concentration of

dissolved oxygen content of water is affected by the temperature. Reduction of the dissolved oxygen in water can encourage the microbial depletion of nitrate to nitrite. At 40°C, the concentration is 10.05 mg/l, while at 8°C dissolved oxygen in wastewater is (20.4 mg/l) (WHO, 2006). The samples collected from Sulaimanyah was found to contain dissolved oxygen between 3.25 to 6.71 mg/l.

COD is the amount of oxygen equal to organic matter. Also, it is the amount of oxygen required to oxidize the organic compound completely to CO_2 and H_2O (Bitton, 2016). It is the most important and rapidly measured variable for categorizing water bodies. The value of COD is higher than the value of BOD_5. Generally, this indicates that less number of compounds can be biologically oxidized than the number which can be chemically oxidized (Kwak, Khang, Kim, & Kim, 2013). The COD is negatively correlated with CO_2, pH and nitrate and positively correlated with conductivity and turbidity. Water contamination can be categorized by the chemical oxygen demand value according to (EPA globally, 2000). It is assumed that, the range of COD between (4-8) ppm is low level and (12 -16) ppm is high level. COD in the waste water samples of Sulaimanyah indicates high level contaminations. Especially the Qaragull area waste water samples were found highly contaminated because of the waste water discharge from industry without any treatment.

TSS (Total suspended Solids) is the amount of composed algae, clay, and fine mineral. The human activities results in high concentration of TSS (Safari, Mulongo, Byarugaba, & Tumwesigye, 2012). In samples from Sulaimanyah higher concentration of TSS were noticed. In general 30ppm of TSS concentrations is considered suitable or acceptable in natural waters (ISO, 2006). The main reason of high TSS values is the centralized sewerage system is the in Sulaimanyah.
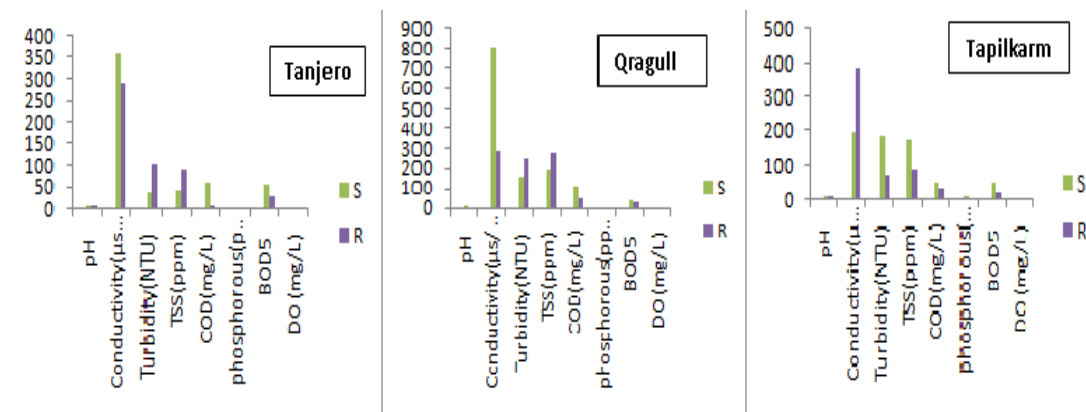

Figure 1: Above figure shows comparison of samples of stagnant waste water and samples of running waste water in Tanjero, Qargull and Tapikarm Sulaimanyah

Note: S stands for stagnant waste water sample and R stands for running waste water sample.

The pH value observed is an optimum value and falls in the standard range. The observed value of pH is acceptable to be discharged into the environment without treatment. The value of TSS was observed much higher than the standard values. The use of waste water in industry, agriculture and recharging the ground water are the main purposes for treating wastewater. The high value of BOD_5 changes the color of waste water samples into gray and Black water. In order to reduce the pressure

on fresh water resources and to reduce health risks, safe use of waste water needs to be ensured in the best possible way.

5. Conclusion

The waste water in Sulaimanyah city of Iraqi Kurdistan region is found unsuitable to be discharged into environment without treatment. These issues associated with waste water might cause serious problems to environment and public health. The pH or alkalinity value in waste water samples is in standard ranges but turbidity is exceeding permissible and standard value. The majority of the channel waste water is polluted by industry. BOD_5 for the stagnant waste water samples is higher than the waste water samples of running water. The higher values of BOD_5 in waste water samples indicate higher contaminations and effect the environment in a bad way. COD and electrical conductivity wastewater value were found in line with standard values. Such type of waste water can be used for irrigation purposes for growing crops but it is not suitable for vegetables.

6. Recommendations

It is proposed to develop an overall system for waste water management with proper planning. Waste water is rich source of renewable energy if managed properly. In doing so, environment can be protected from pollution, more water will be available for irrigation, risks to public health could be minimized and agricultural land can be fertilized free of cost. It's the time to prepare and adapt a new strategic approach to find a suitable solution for waste water management in Sulaimanyah. More active and improved monitoring of waste water is required and a comprehensive check needs to be put in place on discharging waste water into environment.

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