Performance of a Full-Scale Activated Sludge Process for Sakket (Musrata – Libya) Municipal Wastewater Treatment Plant

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Abstract: The study aimed to evaluate the effects of temperature and sampling time on the efficiency of remove the organic matter and the suspended solids from Musrata municipal wastewater treatment plant. Many laboratory experiments have been conducted to determine parameters such as BOD_5, COD, TSS and VTSS. The samples of water were collected before and after treating wastewater by means of activated sludge process among different time of the day i.e., 9a.m, 11a.m and 1p.m, with the temperature ranges between (10-20)^oC and (25-30)^oC during February and November 2011, respectively. The results revealed that at 16^oC during February the removal percentage of BOD_5, COD, TSS and VTSS were 90%, 80%, 80% and 89%, respectively. At 28^oC during November, the removal percentage of BOD_5, COD, TSS and VTSS were 90%, 85% and 85% and 86%, respectively .Such results successfully verified the significance of using the activated sludge process to treat wastewater in both warm and cold area.

[Khaled Shahot, Ibtesam Habib and Ahmed Ekhmaj. **Performance of a Full-Scale Activated Sludge Process for Sakket (Musrata – Libya) Municipal Wastewater Treatment Plant.** *N Y Sci J* 2015;8(10):34-37]. (ISSN: 1554-0200). http://www.sciencepub.net/newyork. 7

Keywords: biological treatment, Activated sludge, wastewater treatment, organic removal, suspended solids removal.

1. Introduction

Used water is a form of wastewater that is made up of various substances such as food scraps, human waste, soaps, oil, chemicals and domestic wastes. The sewage's flow usually goes through a huge underground pipe network to wastewater treatment place as that is where the treatment of contaminated water is carried out using different ways for pollutant removal. Sewage treatment is crucial as there is a scarcity of natural water resources and the higher demand for supply of clean water. Furthermore, huge volumes of wastewater being sent back to the natural water resources will affect the source's water quality.

These matters put an emphasis on water development's technology. Organic matter (BOD_5/COD) and total suspended solids (TSS) are the base pollutants present in municipal wastewater with a potential of causing deleterious effects to public health and the environment. Several methods have been applied in conventional wastewater treatment technologies to remove these pollutants (Metcalf and Eddy, 2003).

In this regard, specific attention is essential to evaluate current wastewater treatment amenities' impact on environment (Jamrah, 1999). Many studies among the world have been performed to evaluate the municipal wastewater treatment. For instance, A comprehensive incoming wastewater description and performance assessment was conducted on Erzincan City, Latin America's local wastewater treatment plant (Nuhoglu et al., 2004) in which 15 percent of wastewater are treated in treatment plants (with variable levels of real treatment). Wastewater treatment plants that belong to the Town Municipal are assessed by different technologies at Las Rozas, Madrid, Spain (Colmenarejo et al., 2006) and description of wastewater that flows in and out for performance assessment at Sivas, Turkey (Coskuner and Ozdemir, 2006) are among the significant influences

In recent decades, the role of biological process in sewage treatment has increased significantly (Shahot and Ekhmaj, 2012, Khaled et al., 2014 and Molinos-Senante et al., 2015). The activated sludge process (ASP) is the most commonly used process for wastewater treatment. Improving its performance is necessary from economical and environmental point of views.

This paper focuses on evaluation of ASP in wastewater treatment plant as a function of temperature and time. The efficiency of pollutant removal from wastewater using a manner of activated sludge was performed through the parameters of BOD_5, COD, TSS and VTSS.

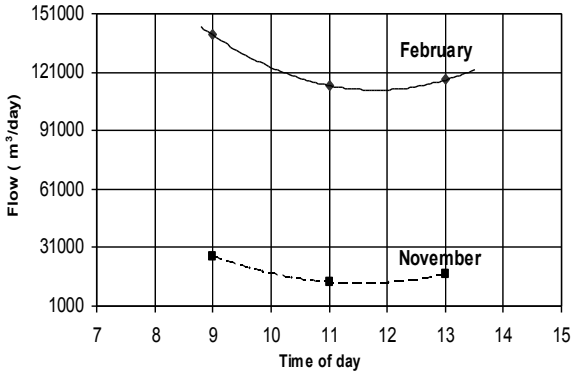
2. Material and Method

The Sakket wastewater treatment plant is established in 1989. It is located 13 km South of

Musrata city and has an elevation of about 70 m above sea level. The plant was designed and operated for biological wastewater treatment with activated sludge processes. The sewage passed several stages i.e., entail three steps—primary, secondary, and tertiary so that contaminants are separated out. The effluents of the produced water are injected by chlorine gas and used as valuable source of irrigation and nutrients. In addition, the treated sewage sludge is used for farmland fertilizer purposes (Mokhtar and Esmahel Ejhan, 2008)

To achieve the objectives of the study, the discharge of STP was determined and many samples of water were collected from two locations i.e., influent and effluent at three different time during the whole day (9 a.m, 11 a.m and 1 p.m) on February and November 2011.The large discrepancies in the sampling temperature between February (10-20 ^{o}C) and November (30-35 ^{o}C) have led to study the effects of different temperature on organic matter and suspended solids removal. Water samples were carried to laboratory immediately to determine various wastewater quality parameters such as BOD_5, COD, TSS and TVSS according to (APHA et al., 2005).

3. Results and Discussion



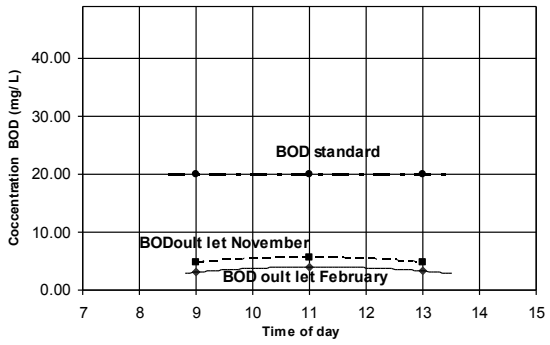
Figur 1. Flow of sewage treatment plant per time

3.1 Flow

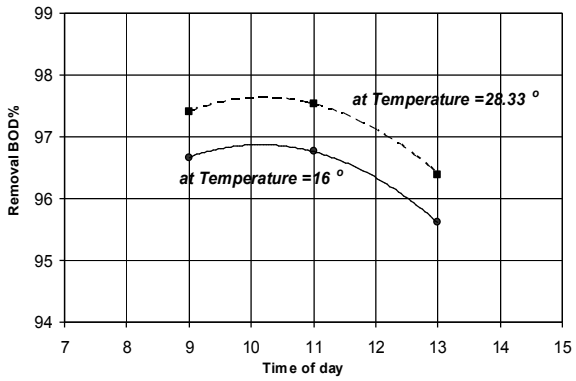
The flow of wastewater varied considerably from 19000 during November to -140000 m^3/day during February, as shown in Figure 1. The flow of the used water was normal during 9 a.m, 11 a.m and 1 p.m hours day and it reached a maximum value of 140000 m^3/day in the morning. Maximum flows occurred during the morning hours. In most cities where the low flow occurs from 4 to 8 a.m morning, the peak flow occurs from 8 to 9 a.m and 12 to 3 p.m (Metcalf and Eddy, 2003). However, the relative magnitude of the peaks and times at which the occur vary from country to country and with the size of country and the size of sewers (Pescod., 1992).

3.2 Reduction of BOD_5

It was found that the concentrations of BOD_5 before and after treatment were about 250 mg/L and less than 10 mg/L, respectively. Figure 2 shows the relationship between the hours among day and the concentrations of BOD_5 in mg/L for wastewater after treatment. The figure clearly reveals there is a significant reduction in the concentrations of BOD_5 after treatment. This demonstrates the effectiveness of the plant in removing pollutants even at a low temperature (down to 12 ^{o}C). The obtained concentrations of BOD_5 after treatment were much lower than the maximum allowable concentration of BOD_5 as adopted by Libyan water quality standards for BOD_5 (20 mg/L). Figure 3 shows the percentage of removal BOD_5 to be at the highest value at 11 a.m at different temperatures 28-16 ^{o}C. The removal percentages of BOD_5 were 97.53% and % 96.76 on November and February, respectively.



Figur 2. Reduction of BOD



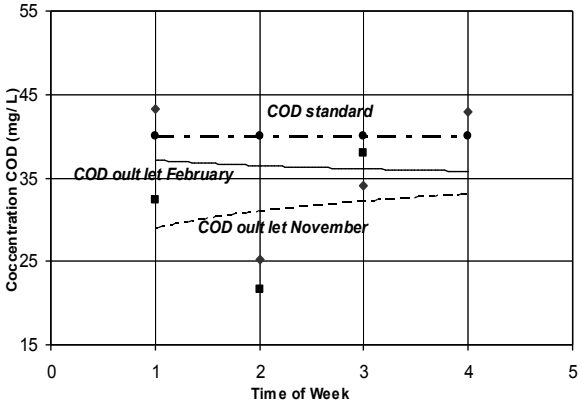
Figur 3. Removal of BOD at different temperatuer per time

3.3 Reduction of COD:

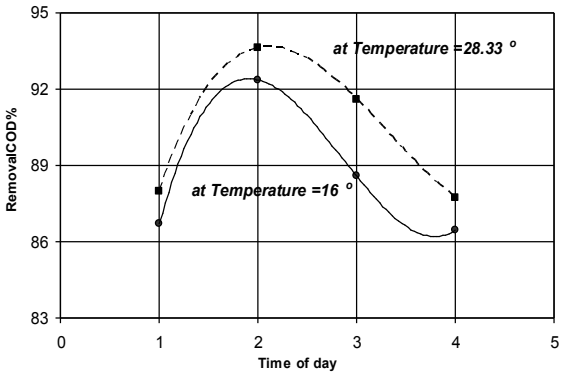
Figure 4 shows the relationship between time of sampling per week and the concentrations of COD. The concentrations of COD in the sewage before treatment were about between 428 and 445 mg/L on

February and November, respectively. Moreover, their concentrations after treatment decreased dramatically to be in range between 30 and 37 mg/L, whereas the lower concentration was found in November samples. It can be noted from Figure 4, that the concentrations of COD are below the allowable concentration of COD (40 mg/L) which adopted by Libyan water quality standards for COD concentrations. .

Figure 5 shows the percentage removal of COD concentrations are higher under warm conditions than cold conditions. For instance, the highest percentage removal of COD concentration 93.62% and 92.37%, was found within the second week of November (at 28 ^{o}C) and February (at 16 ^{o}C), respectively. However, these results revealed that the efficiency of the plant to reduce the concentrations of COD was acceptable within such different in temperature.



Figur 4. Reduction of COD

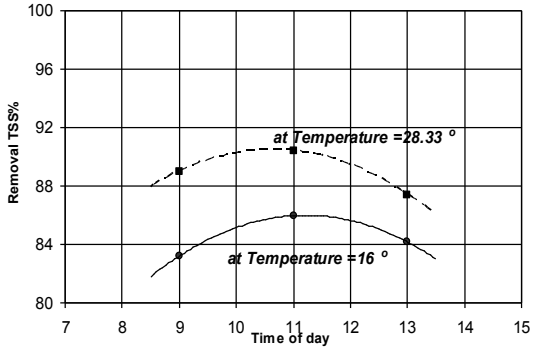


Figur 5. Removal of COD at different temperatuer per time

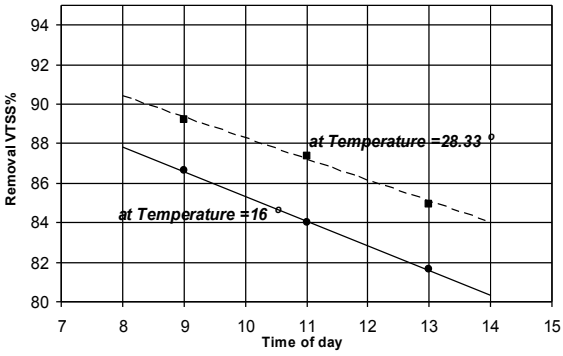
3.4 Removal Percentage of TSS and VTSS

Figure 6 shows the percentage removal of total suspended solids (TSS) at different time (i.e., 9a.m, 11a.m and 01p.m) on November and February where the temperature was 28 and 16 ^{o}C, respectively. The maximum removal percentage of total suspended solids 90.43% and 86% were found at 11 a.m on November and February, respectively.

The relationship between the percentage of removal of volatile total suspended solids (VTSS) and time in hours can be noted through Figure 7. The highest removal percentages of VTSS were quite closer in both months. It is also seen that a higher removal percentages of VTSS resulted in a higher temperature whereas they were 89.19% at 28 ^{o}C and 86.66% at 16 ^{o}C in November and February samples, respectively.



Figur 6. Removal of TSS at different temperatuer per time



Figur 7. Removal of VTSS at different temperatuer per time

4. Conclusion

The present study showed that activated sludge system of Musrata city sewage treatment plant was working well and very effective to reduce BOD_5 and COD at different temperatures, hours of day time and months. The results also revealed that the higher efficiency to reduce BOD_5 and COD were noted in November when the temperatures were higher than in February. The percentage removal of TSS and VTSS were very high as well. Similarly, the higher performance of the percentage removal of TSS and VTSS occurred in November. Such results encourage the capability of using activated sludge system under wide range of temperatures.

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10/11/2015