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Assessment of Quality Parameters in the Effluent and comparing it with Environmental Standards using the Effluent in Green Area Irrigation (Case study: Locomotive repair factories of Bafgh city)

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Abstract: *The aim of this study was to evaluate the performance of the wastewater treatment system for the re-use of effluent in green area irrigation. In this study, the chemical parameters of BOD, COD, TSS, and pH were tested seasonally from June 2005 to March 2018. The mean value of the indices for BOD, COD, TSS, and pH was obtained 130, 200, 92, and 8, respectively. Comparison of the parameters process with the EPA, FAO, WHO and DOE standards shows that the effluent of wastewater treatment plants is suitable for irrigation of green spaces. However, its application requires management, accurately planning, continuous investigation of the operation of the treatment system, and applying technical and engineering solutions for the treatment system. Using these solutions, it is possible to increase the quality of effluent to the most favorable level of standards of the Iranian Environmental Protection Agency and minimize the environmental and health impacts caused by its use.*

Keywords: *BOD, COD, TSS, effluent.*

INTRODUCTION

Increasing population growth and the promotion of the living standard and the development of industry and technology have led to the environment pollution and exacerbated degradation (Gahramani et al., 2014). Due to the problem of water shortage in Iran, its supply has great importance at present time. In such a situation, reuse of treated wastewater can be considered as one of the ways to cope with water shortage, so that treated wastewater must comply with international standards as well as Iran's Environmental Protection Agency in order to be re-used (Dasturani and Sadeghi, 2009). Raw wastewater contains many pathogens. Before its reuse, it should be treated with appropriate technology and be used in different parts. Therefore, for human and the environment health in reusing wastewater, standards and guidelines have been established by the World Health Organization, the United States Environmental Protection Agency, the Iranian Environmental Protection Agency, and European Union (Firouzabadi, Mahmoudabadi and Ahrampoush, 2017).
The use of wastewater in agriculture and its application for other purposes is a global practice. Statistics suggest that at least 20 million hectares of lands in 50 countries are irrigated with raw or nearly treated wastewater (Hussain et al., 2001). To use of effluent as an unconventional source of water in agriculture

requires special management in order to be used without leaving environmental and health hazards (Molavi and Mirzaee, 2010). The construction of wastewater treatment plants alone does not eliminate environmental concerns. However, to achieve the desired environmental standards, the operation of these treatment systems should be constantly monitored and evaluated (Cirja et al., 2008). Locomotive repair factories of Bafgh city have a sanitary-industrial wastewater system that its sanitary part includes wastewater of the toilets and water supply plant and its industrial part contains oil. Oily wastewaters are the wastewaters that include many organic matters and COD of these wastewaters are reported to be between 30 and 100 g / l (Asses et al., 2009). The discharge of these wastewaters into the environment and surface water will result in severe oxygen reduction and damage to aquatics life. The amount of fat and oil in these effluents is also about 1.5-15 g / liter, which can cause serious problems in wastewater treatment systems, including the sudden withdrawal of sludge from treatment system, reduction of oxygenation to microorganisms, accumulation and creation of bad odor (Asses et al., 2009; Cammarota and Freire, 2006). The discharge of industrial effluents which contains large amounts of oil in the form of suspended particles, light and heavy hydrocarbons, and other substances without treatment will result in the risk of environmental pollution. For this reason, the treatment of these wastewaters is important. The use of treated wastewater of these plants in the green space could be a replacement for other conventional sources for irrigation.

Many studies have been conducted in Iran for the reuse of wastewater so far which we refer to some of them. Hossein Molavi et al investigated the qualitative conditions of the Alborz Industrial City wastewater treatment plant for reuse of wastewater for agricultural and irrigation purposes. Based on the results of this study, a number of parameters were greater than the allowed level and required more treatment (Molavi and Mirzaee, 2010). Sadegh Dejkam et al investigated the reuse of wastewater of Ahwaz industrial city No. 2. The results of this study revealed that the effluent of this system has a good consistency with environmental standards and the standards for entering agricultural land. Hence, they suggested its use in irrigation of surrounding agricultural lands and irrigation of the green space of the town (Dezhkam and Khajehoseini, 2011).

Methodology

The studied treatment plant is located at in Bafgh city locomotive repair plants with an area of 666 square meters. The wastewater treatment system of these factories includes a wastewater collection network and treatment plant, in which the wastewaters of baths, toilets, repair shops, halls, locomotive washing machines are collected by pipelines and enter into the wastewater treatment plant and they are treated there. On the routes of this collection system, there are manholes that direct the wastewater into treatment plant. First, there is a system for separating fat and oil, in which water and oil separated due to the volume of water, and the oil enters the oil storage tank and water enters into the wastewater treatment plant.

After wastewater entering into the treatment plant, the wastewater is poured into a pit called as pumping station and enters into a saturated tank. In this tank, the wastewater undergoes the pressure of PSI40 for 20 minutes due to separation of fat and oil. Simultaneous with opening the wastewater discharge valve from the saturation tank, the coagulant substance of aluminum sulfate and polymer is injected into the wastewater so that coagulation reactions to occur at defined time and then it enters flouting pond.

In the floating pond, according to the physics of the pond building, the coagulated oil and fat floats on the surface of the wastewater that should be collected manually by operator to prevent its entering the aeration pond and the remaining fat-free water enters into the biological treatment stage.

Biological treatment unit

It includes aeration tank, deposit tank, sludge storage tank and chlorination tank. The effluent enters into the aeration tank after removing the fat and oil in the flotation tank. One of the biological processes used in this treatment plant is the active sludge process. In the aeration tank, biological treatment is performed due to the presence of active sludge. Then, it enters to the deposit tank. In this tank, active sludge is deposited and enters the sludge return tank. Then, the effluent enters into the chlorinated pond and after enters into effluent tank after chlorine injection. Finally, it is used or irrigation after confirmation of the existing parameters.

The wastewater treatment method is active sludge with aeration type. This study was conducted as a descriptive cross-sectional study. The studied population was the results of 14-month experiments of wastewater treatment plant of these factories, which was carried out by Kavir-e Jonub Yazd Laboratory Complex. The studied parameters include BOD, COD, TSS, and pH. In the descriptive statistics section, the mean of the parameters was calculated and the results were compared using the mean and dispersion indices and excel software to confirm the reuse of treated effluent in green spaces of the factories with EPA, FAO, WHO, DOE standards .Sampling of effluent residues from the treatment process was performed seasonally from 2015 to 2018. Samples were taken in 100 ml plastic containers and kept at normal temperature to prevent the change and sent to laboratory to perform the tests.

Results

As seen in Diagram 1, the highest standard deviation is seen in June of 2014, June of 2017, and February of 2017. The best effluent COD for irrigating the green space compared to EPA standard was April, July and November months of 2009, and the best effluent COD for irrigation of green areas compared to WHO and DOE standards was in August 2015, February of 2016, August of 2017, and April, July, October months of 2018.

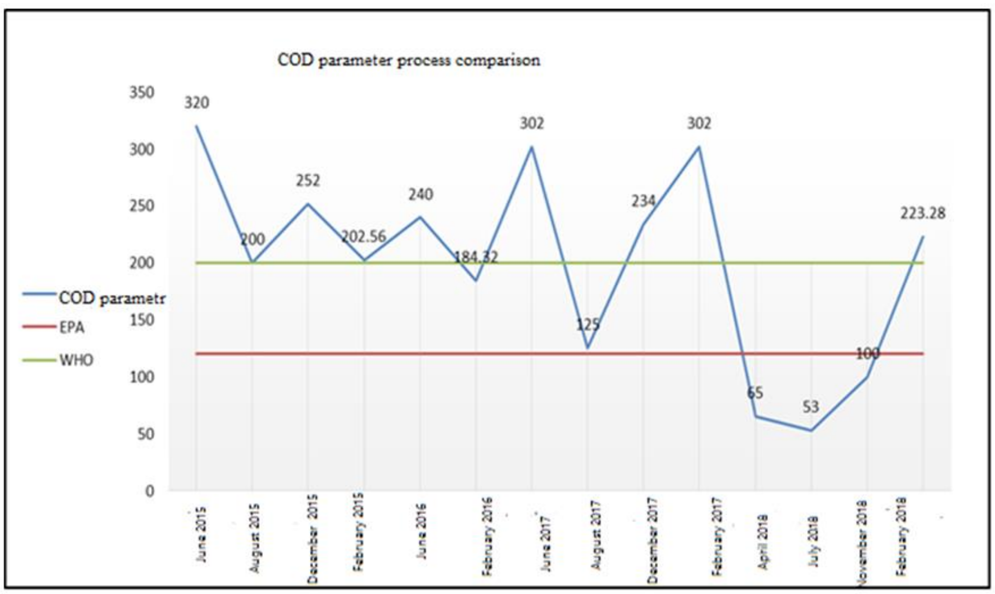


Diagram 1 - Results of comparing the COD parameter according to EPA, WHO and DOE standards

According to Diagram 3, the first, middle, and third quartiles show the figures 118.75, 212.92 and 264.5, respectively, indicating that 25% of the data is less than 118.75, 50% of the data is less than 212.92 and 75% of data is less than 264.5, which 25% of the data is acceptable relative to EPA standard and 50% of the data is acceptable relative to WHO and DOE standards.

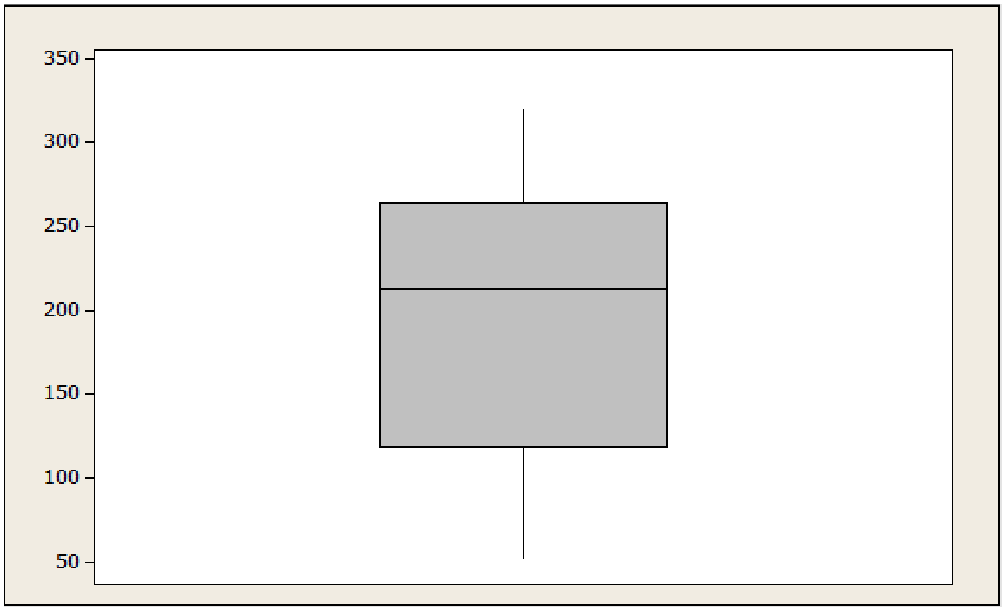


Diagram 2-Dispersion diagram of COD parameter data

As shown in Diagram 3, the most standard deviations were in February of 2015. The best effluent BOD for irrigation of green space compared to the WHO and DOE standards was seen in August of 2015, February of 2016, April of 2017, April, July, October of 2018.

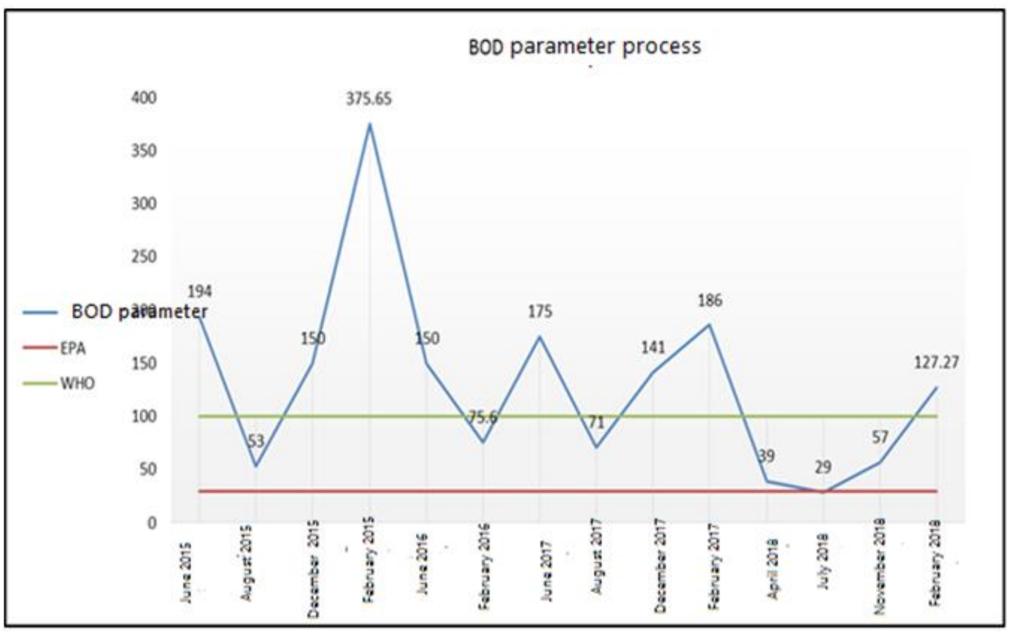


Diagram 3- The results of comparing the BOD parameter with the EPA, WHO and DOE standards

As shown in Diagram 4, the first, middle, and third quartiles are 56, 134.135 and 177.75, respectively, indicating that 25% of the data is less than 56, 50% of the data is less than 134.135 and 75% of the data is less than 177.75 and 25% of the data is acceptable compared to EPA standard and 50% of the data is acceptable compared to WHO and DOE standards.

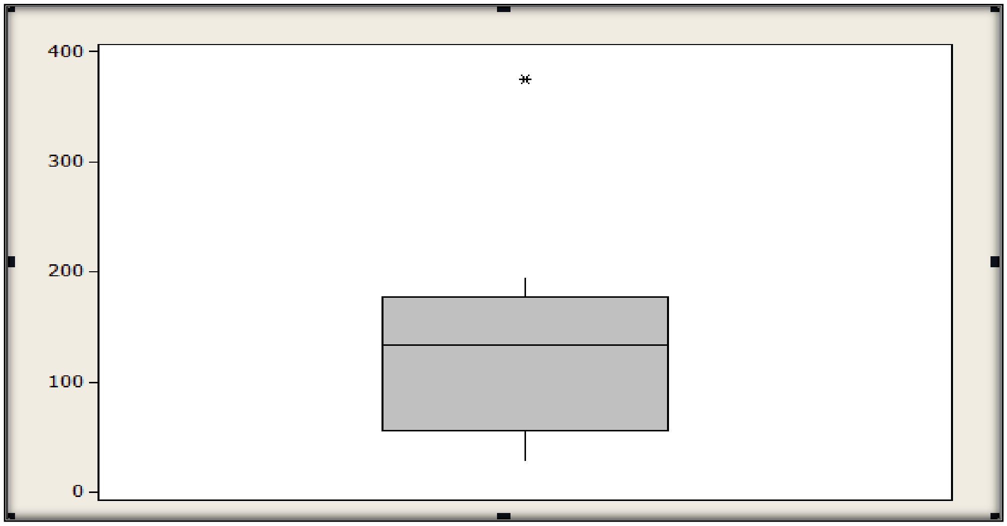
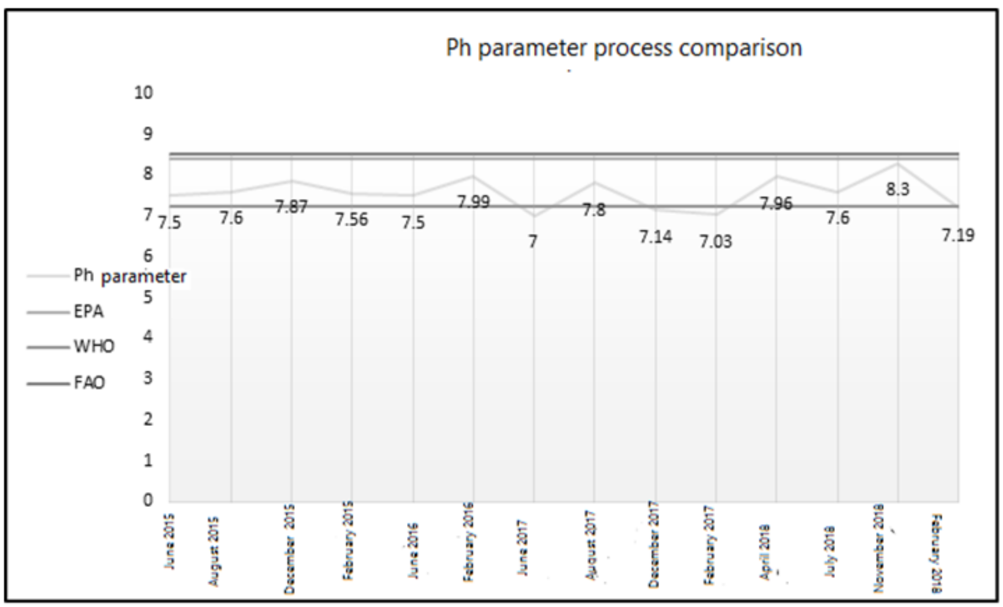


Diagram 4-Dispersion diagram of the BOD parameter data

According to Diagram 5, all measured values are between the standards and the effluent is suitable in all seasons in terms of ph.



Graph 5 - Results of comparison of pH parameter with EPA, FAO, WHO and DOE standards

According to Chart 6, the first, middle, and third quartiles are 7.17, 7.58 and 7.79, respectively. It indicates the low dispersion of data of pH parameter and this dispersion is acceptable to all standards except the WHO standard

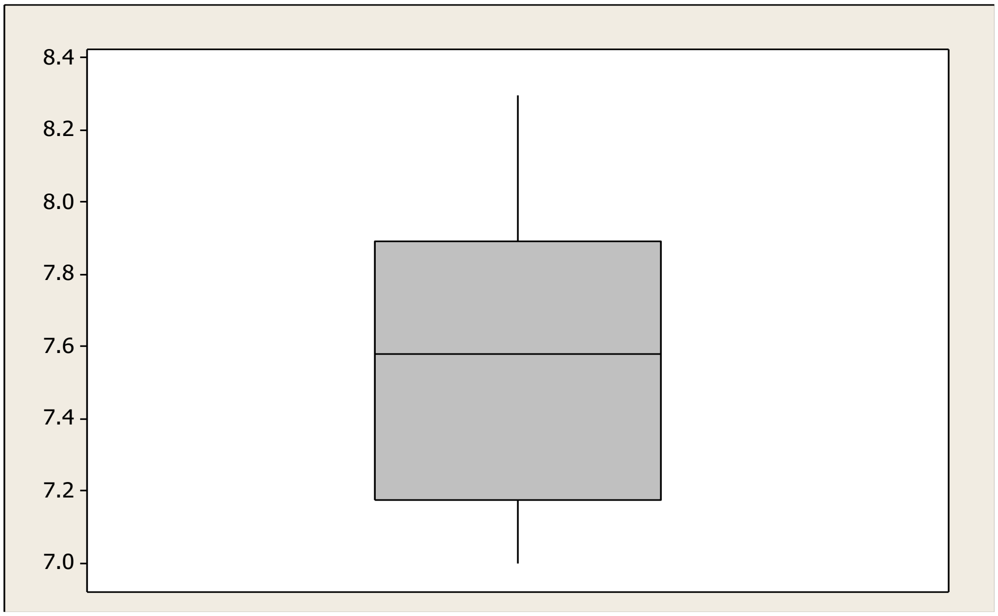


Diagram 6-Dispersion diagram of the pH parameter data

As shown in Diagram 7, the highest standard deviations were seen in December and February months of 2017. The best effluent TSS for irrigation of green space compared to WHO and DOE standards is related to June, August and December of 2015, June and February of 2016, June and August of 2017, and in April, May, November and February of 2018.

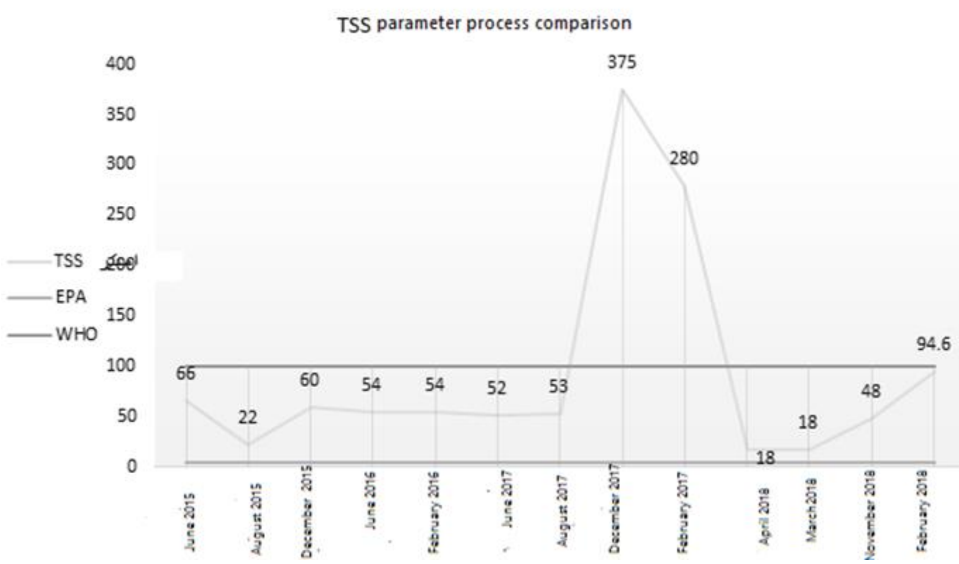


Diagram 7 - The results of comparing the TSS parameter with the EPA, WHO and DOE standards

According to Diagram 8, the first, middle and third quartiles are 21, 57 and 140.95, respectively, and only 70% of the data is acceptable to the compared to WHO and DOE standards.

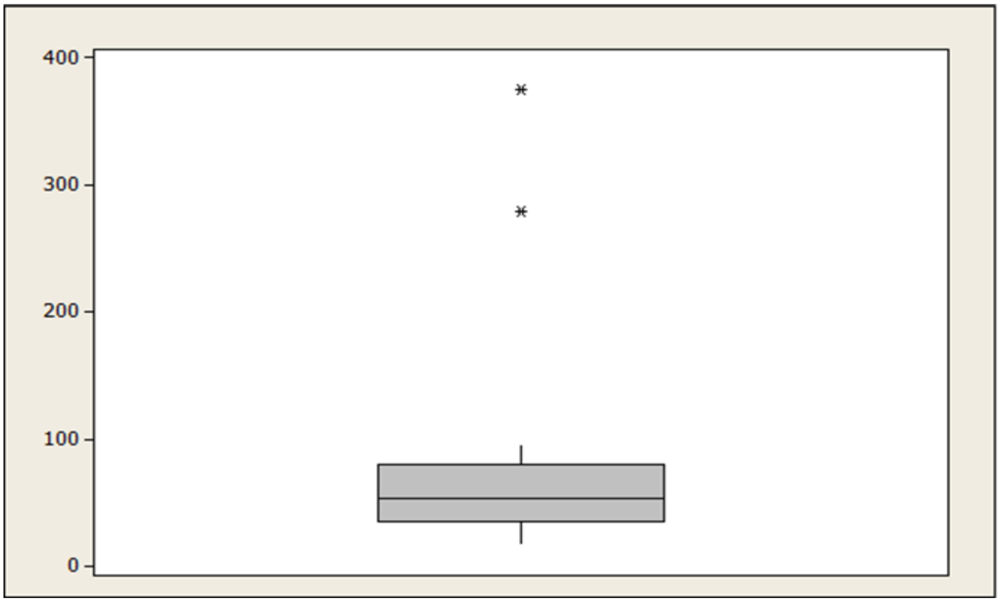


Diagram 8-Distribution diagram of TSS parameter data

Discussion and Conclusion:

In some months, COD has increased and exceeded the standard values.
The low BOD / COD ratio can be a factor in the high COD content in the effluent, since it indicates an increase in toxic and non-degradable biological substances in the wastewater which negatively affects the activity of microorganisms in the active sludge (Ghahramani et al., 2010).
The unit and standard of each of the parameters are given in Table 1.

Table 1 - Parameters in the quality standards of treated wastewater in irrigation

row	Parameter	unit	EPA	WHO	FAO	DOE
1	BOD	Mg/L	30	100	-	100
2	COD	Mg/L	120	200	-	200
3	TSS	Mg/L	5	100	-	100
4	pH	-	6.8-5.4	7.25	8-6.5	8-6.5

The results of 14-month measurements are presented in Table 2.

Table 2- Results of measurements on the effluent since 2015 to 2017

Measurement seasons														Parameter
February 2018	Novembe r 2018	July 2018	April 2018	February 2017	December 2017	August 2017	June 2017	February 2016	June 2016	February 2015	December 2015	August 2015	June 2015	
127.27	57	29	39	186	141	71	175	75.6	150	375.65	150	53	194	BOD
223.38	100	53	65	302	234	125	302	184.32	240	202.56	252	200	320	COD
94.6	48	18	18	280	375	53	52	54	54	49	60	22	66	TSS
7.19	8.3	7.6	7.96	7.03	7.14	7.8	7	7.99	7.5	7.56	7.87	7.6	7.5	Ph

The range of values and mean of pH, TSS, COD and BOD are presented in Table 3.

According to Table 3 and the high standard deviation and range of BOD and TSS parameters, it can be stated that the dispersion is high and the mean of all values is higher than the EPA standard and the mean values of TSS are lower than the WHO and DOE standards and they are acceptable. The mean values of COD are equal with WHO and DOE standards and acceptable. The mean values of BOD are higher than the values of the WHO and DOE standards and are not acceptable. Due to the low standard deviation and range of pH parameter, it can be stated that the dispersion is low and the mean PH value of the proposed standards is lower and acceptable.

Table 3- mean, SD and range of the parameters

Parameters	COD	BOD	TSS	Ph
mean	200	130	92	8
SD	83	87	104	0
range	267	347	357	1

The results of this study show that all of the qualitative parameters, except for BOD, are in the standard range and in the allowed level for irrigation applications.

Acknowledgments
This article is the result of collecting the data from the wastewater treatment plant of Bafgh locomotive repair factories and environmental studies. We thereby appreciate the management of these factories.

Recommendations

In order to improve the quality of the effluent and improve the performance of the system in the future, the following recommendations are presented:

1. Contamination control at the production site
2. The coagulation process can be a suitable method for the treatment of oil wastewaters
3. In recent decades, advanced and modern methods have been proposed in recent years, including MBRs, due to the increased quality and stricter standards of treatment plants.

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