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# EVALUATION OF WASTEWATER TREATMENT PLANTS IN AQABA GOVERNORATE, JORDAN

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## ABSTRACT

The objective of this study to evaluate the performance efficiency of wastewater treatment plant in Aqaba governorate in Jordan. One hundred twenty samples of wastewater were collected from both influent and effluent of Aqaba Wastewater Treatment Plant (AWWTP). Samples are analyzed for biochemical oxygen demand (BOD), chemical oxygen demand (COD) and total suspended solids (TSS) to evaluate efficiency of (AWWTP). BOD was nearly decreased to extremely low level and the decrease rate is 98.9 % while COD 97.3 % and TSS is 98.7 %. These rates of decrease of BOD, COD and TSS clarified the satisfying in general effectiveness of the plant. Regression equations for BOD, COD and TSS removal percentages were proposed which can be utilized to evaluate rapid effluent assessment after the treatment processes or optimal process control to improve the performance of (WWTP). The average Biodegradability index (BI) was found to be 0.46. The percentage removal of influent BOD, influent COD and influent TSS were found with high determination coefficient ($R^2$) 0.97, 0.97 and 0.89 respectively.

**Keywords:** BOD, COD, TSS, biodegradability indices, determination coefficient, Jordan.

## INTRODUCTION

The reduction of chemical oxygen demand (COD) and biological oxygen demand (BOD) of wastewater from coffee processing plant was assessed using activated carbon made up of Avocado Peels (APC) and commercial activated carbon (CAC) [1]. The maximum percentage reduction of COD and BOD concentration under optimum operating conditions using APC was 98.20% and 99.18% respectively and with CAC this reduction was 99.02% and 99.35% respectively. Also, three oxidizers were used to compare their treatment efficiency for COD & BOD reduction [2]. The used three different oxidants were Hydrogen peroxide, Sodium Hypochlorite, Calcium hypochlorite. The analysis showed that calcium hypochlorite proved a suitable oxidant as it reduced COD up to 69% and maximum COD removal occurred at 100oC and at a retention time of 1440 min. Moreover, the removal efficiencies for BOD increased from 27–70% to 76–94% for dosages of activated carbon in the range of 50–150 mg/l. In addition, for COD increased from 16–64% to 72–92.5% [3]. Furthermore, the laboratory experiments confirmed the high efficiency of the chemically enhanced mechanical treatment (CEMl) towards TSS and BOD/COD removal. The data obtained show that low dose chemical treatment in a large range of surface flow rate of precipitation provides a reduction of TSS and BOD/COD larger than 60% and 50%, respectively [4].

Fecal bacteria, BOD, and TSS from single house domestic wastewater effluents following primary treatment showed considerable potential for removal. Yearly average removal efficiencies ranged from 93-98% for FC and FS, 63-78% for BOD, and 46-90% for TSS [5]. Improvement of BOD and bacterial removal was documented by using macrophysics. The removal from wastewaters was realized through sedimentation, mechanical filtration, nutrient assimilation, oxygenation, and microbial attachment mechanisms [6]. The establish an empirical correlation between biochemical oxygen demand (BOD5) and chemical oxygen demand (COD) of the sewage flowing in Al-Diwaniyah wastewater treatment plant [7]. The strength of the wastewater entering the plant varied from medium to high. High concentrations of BOD5 and COD in the effluent were obtained due to the poor performance of the plant.

The main concept of wastewater treatment is to remove or reduce the excessive amounts of contaminants from the wastewater. This performance study was needed to evaluate the efficiency of a wastewater treatment plant in decreasing the pollutants level, to meet with the governmental environmental standards [8]. The correlation between BOD5 and COD will support in evaluating the treatment approaches. This shows that probably AHU wastewater is relatively biodegradable. As well as a correlation is established between the inlet and outlet parameters, especially when it comes to the BOD5 parameter confirmed that the process is very efficient in reduction the biological matter [9]. The removal efficiency has been observed and it was confirmed that the process used in such plant can be considered as an efficient method for removal of nitrogen and phosphate [10].

## MATERIALS AND METHODS

In this study the performance of AWWTP was evaluated. This done based on the analysis of the quality of the influent and effluent of AWWTP. The data of the sewage quality were recorded for the period between 2008 until 2017 for BOD, COD and TSS. Wastewater samples before (inlet) any treatment and after (outlet) biological treatments were analyzed for of BOD, COD and TSS. All the laboratory analysis for the samples was done according to Standard Methods for examination of water and wastewater [11]. All statistical analyses of data were done

using Microsoft Excel spreadsheets with confidence levels of 95%.

## RESULTS AND DISCUSSIONS

The results of this study indicated that the mean of the BOD values before treatment (influent) and after treatment (effluent) were as shown in figure (1). The BOD value of the influent wastewaters were ranged between 391.2 to 309.3 mg/l with mean value of 349.6 mg/l. Whereas the BOD value of the effluent wastewaters were ranged between 4.6 to 5.9 mg/l with mean value of 5.2 mg/l. These results are in agreement with the results obtained by [9].

In the AWWTP plant samples the COD values ranged from 881.9 to 644.7 mg/l influent with mean value of 759.6 mg/l and from 26.1 to 20.9 mg/l in effluent with mean value of 24.1 mg/l as shown in Figure-2. The TSS values were ranged from 246.3 to 408.1 mg/l with mean value of 328.8 mg/l in influent and from 4.7 to 8.2 mg/l with mean value of 6.1 mg/l in effluent as shown in Figure-3. The TSS measurement was estimated the free particle distribution in the wastewater that give an indicator of the clarity of the wastewater.

The overall percentage of reduction of BOD, COD and TSS in the effluent treatment Plant has been shown in the Figure-4. The overall percentages of reduction BOD were ranged from 98.4 % to 98.8 % with mean value of 98.5 %. Also, the COD overall percentages of reduction were ranged from 95.9 % to 97.3 % with mean value of 96.8 %. Likewise, the overall percentages of reduction TSS were ranged from 97.2 % to 98.7% with mean value of 98.1 %.

The quality of the BOD, COD and TSS effluent from the AWWTP has been found to be lower than the expected from the Jordanian effluent standards for disposal to water bodies (BOD 30 mg/l, COD 100 mg/l and TSS 50 mg/l).

The changes in the average of biodegradability index were shown in the Figure-(5) in the different months of year. These data showed that the highest biodegradability index was in January, April and July (0.48) while the lowest was in March (0.43). It is necessary to know the biodegradability index of the untreated influent wastewater before choosing the biological wastewater treatment plant technology, as this choice would significantly influence the plant effluent quality. If BOD / COD > 0.6, the wastewater is fairly biodegradable, and can effectively be treated biologically. If 0.3 < BOD/COD > 0.6, seeding is necessary to treat it biologically, as the process is slow and so the acclimation of the microorganisms that will help in the degradation process. In case of BOD/COD < 0.3, biodegradation will not proceed, then it is not possible to treat biologically. This is due to the fact that wastewater generated from these activities inhibits the metabolic activity of bacterial seed due to toxicity. The BOD/COD ratio ranged 0.43 to 0.48 as shown in Figure-5 for the untreated sewage which a normal case is as indicated this wastewater is easily degradable by the biological processes.

To employ use of this analysis the removal percentages were calculated according to the Jordanian effluent standards. The regression analysis for BOD here showed high correlation $R^2 = 0.97$ Figure-6. For BOD, the treatment process in this plant has to be functioned to the regression equation: $y = 0.0002\ x + 0.8339$.

On the other hand, the regression analysis for COD here showed high correlation $R^2 = 0.97$ Figure-7. The treatment process in this plant has to be functioned to the regression equation $y = 0.0002\ x + 0.7517$ for COD. The regression analysis here showed high correlation, $R^2 = 0.89$ for TSS Figure-8. The treatment process in this plant has to be functioned to the regression equations, $y= 0.0004\ x + 0.7314$ for TSS.

High correlation was obtained from the regression analysis for BOD, COD and TSS indicating the high performance of the AWWTP.

## CONCLUSIONS

The objective of this study was to evaluate the performance of AWWTP. The results of this study are depending on the output from the experimental works and its analysis. The quality of the effluent from the AWWTP has been found to be lower than expected from the Jordanian effluent standards for disposal to water bodies (BOD is 30 mg/l, COD is 100 mg/l and TSS 50 mg/l) indicating excellent treatment. The quality of the effluent from the AWWTP has been -showing significant overall percentage reduction (BOD, COD and TSS). Biodegradability index for the investigated AWWTP which indicate the variability is very small. Regression analysis was performed for removal percentages of BOD, COD and TSS with the influent quality and a high correlation was obtained.

## ACKNOWLEDGMENT

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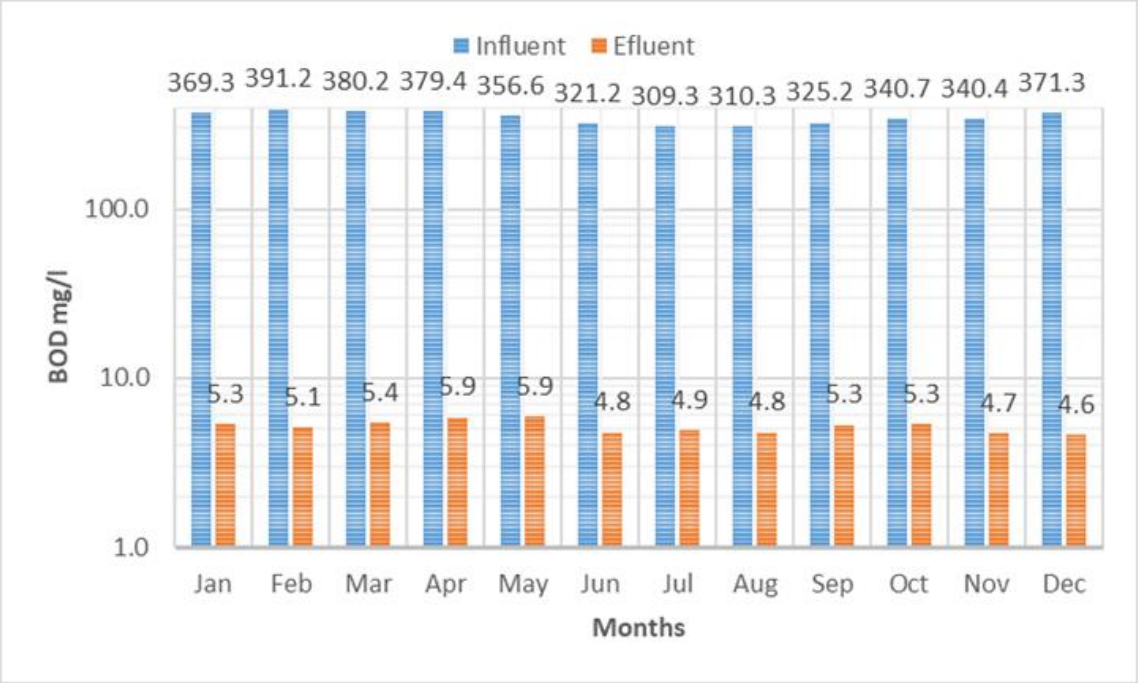


**Figure-1.** BOD values of influent and effluent.

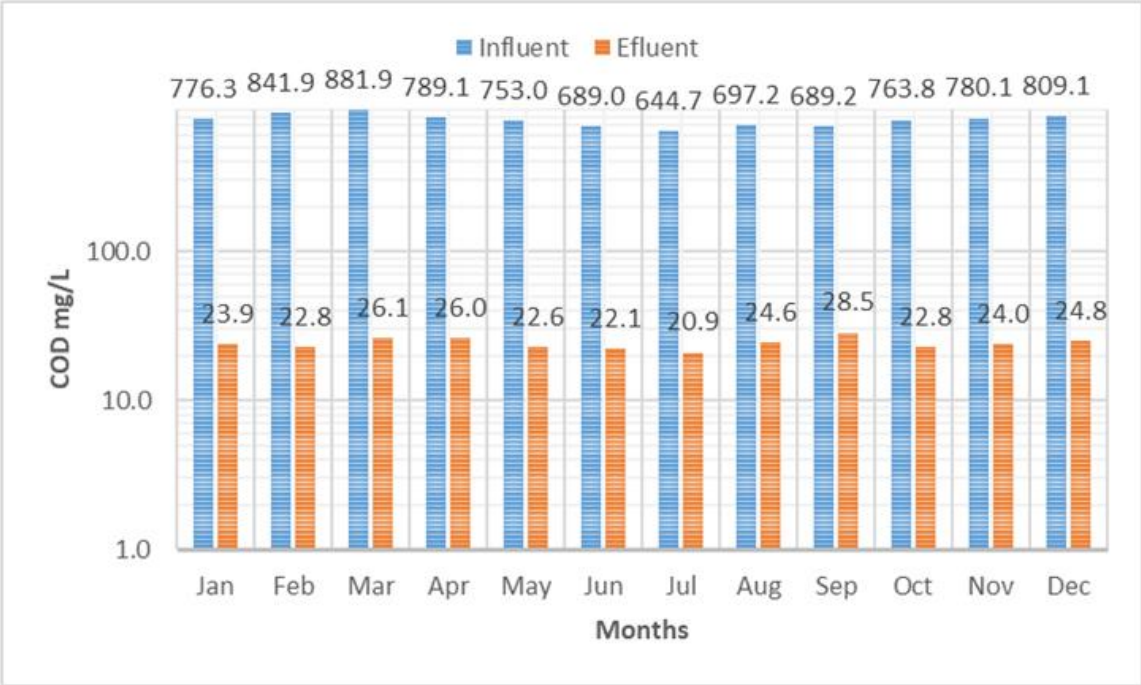


**Figure-2.** COD values of influent and effluent.

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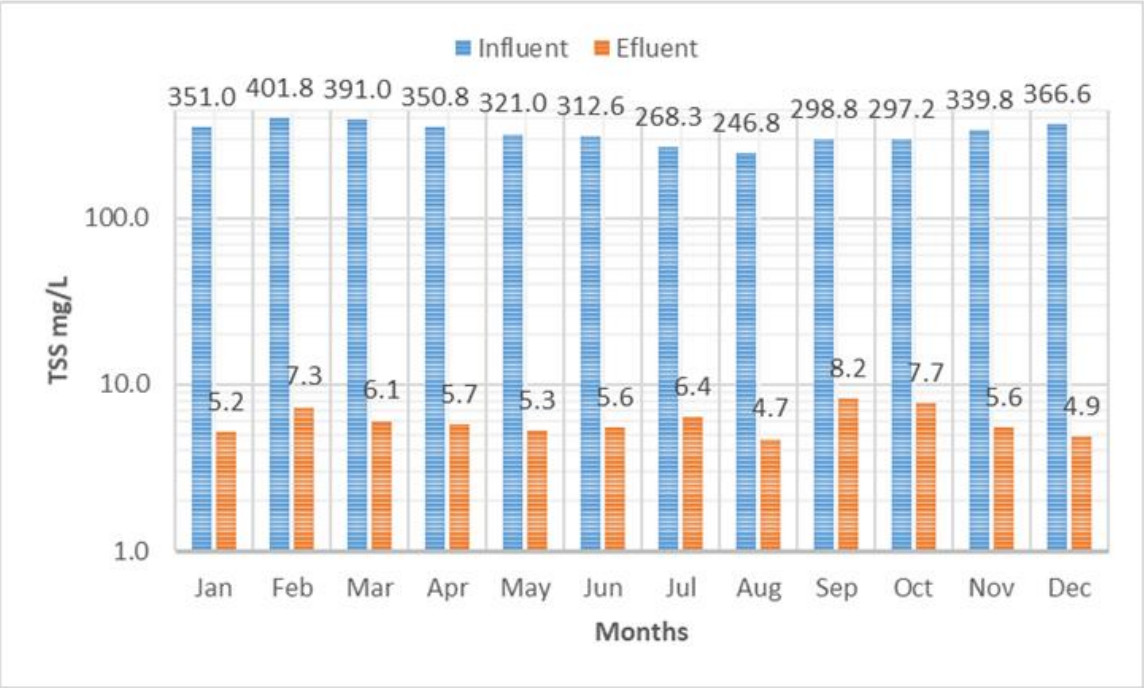


**Figure-3.** TSS values of influent and effluent.

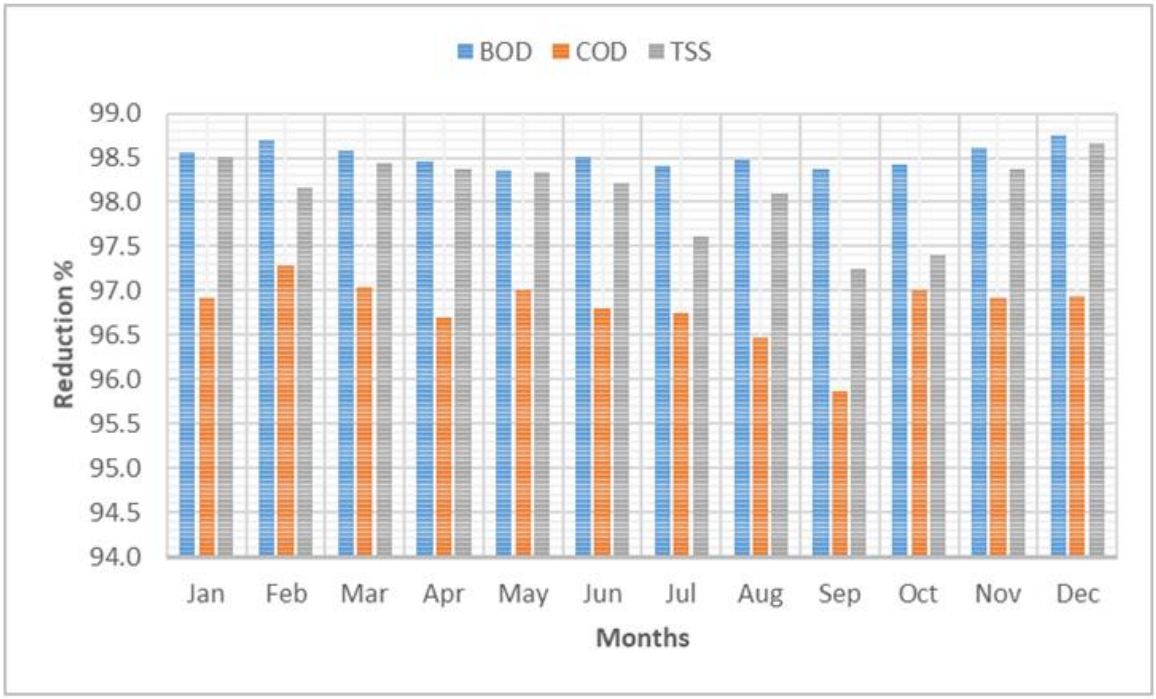


**Figure-4.** Overall reduction of BOD, COD, and TSS.

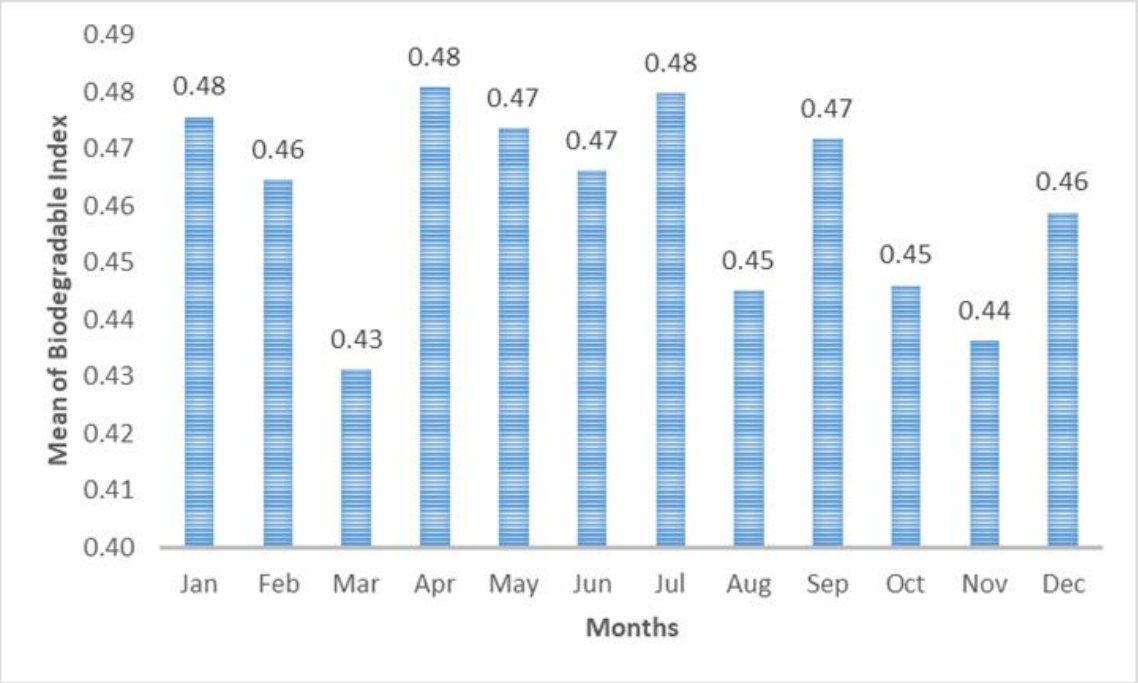


**Figure-5.** The monthly average of biodegradability index.

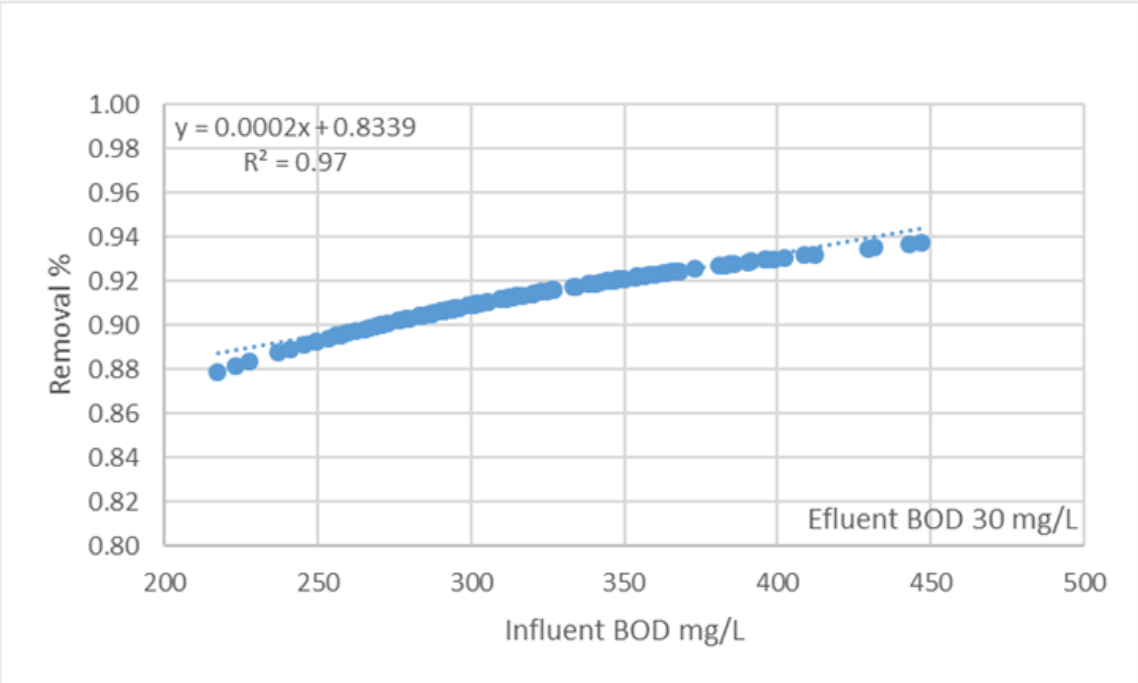


**Figure-6.** Regression analysis for standard effluent for BOD and removal %.

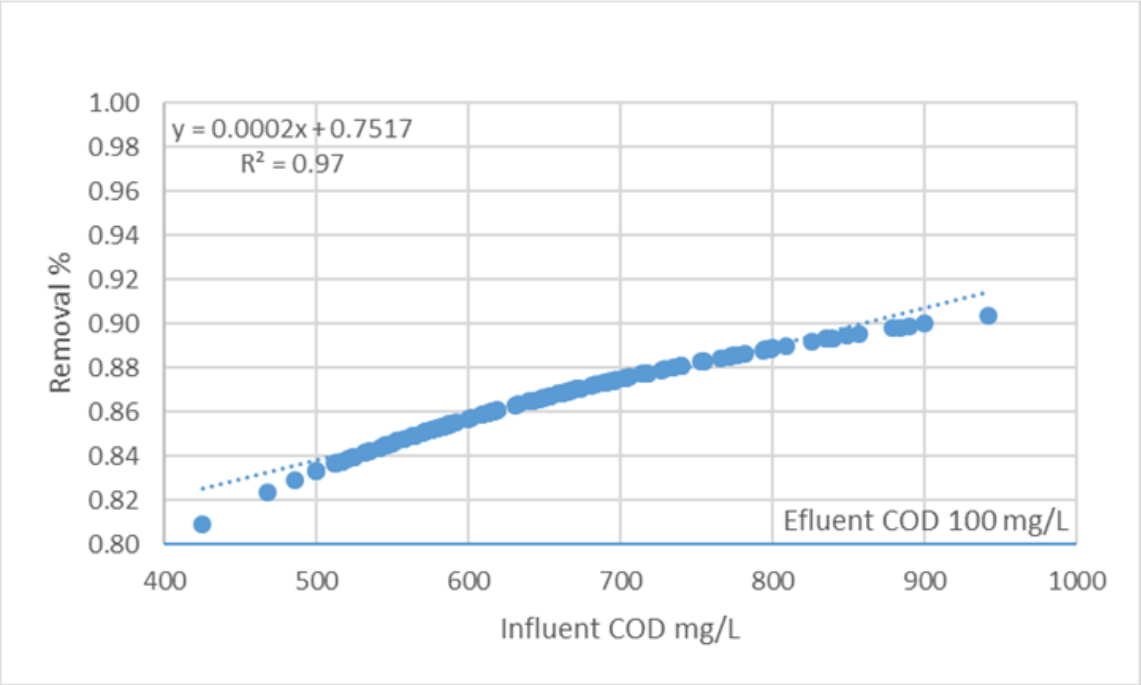


**Figure-7.** Regression analysis for standard effluent for COD and removal %.

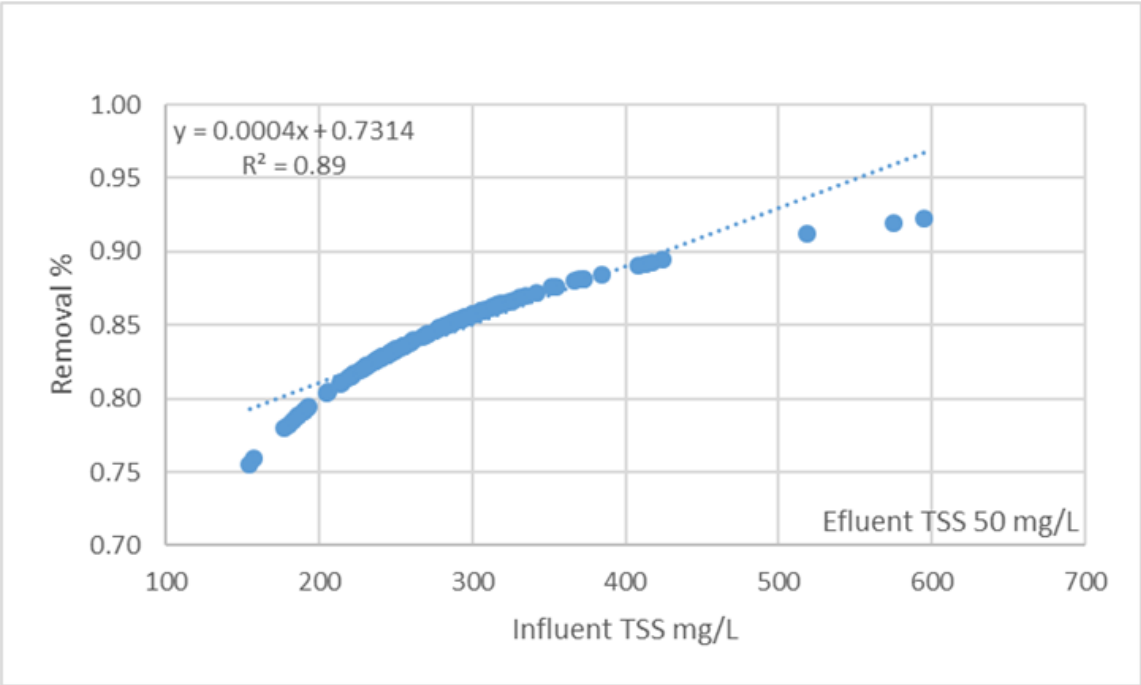


**Figure-8.** Regression analysis for standard effluent for COD and removal %.