

Monthly Monitoring Of Some Physico-Chemical Parameters in Domestic Wastewater Treatment Plant in Turkey: A Case Study On Selected Plant

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Abstract: In this paper, monitoring of some parameters in wastewater from domestic wastewater treatment plant is evaluated. The wastewater from the selected plant is characterized by COD, BOD₅, pH, TSS. The wastewater samples were collected from the inlet and outlet to monthly from a wastewater treatment plant to the city of Yozgat in Turkey for eight months from May 2013 to December 2013. Results of a detailed survey on the performance of a selected plant was given both in terms of influent and effluent quality and in comparison with the current legislation on discharge limits to receiving waters. The results of effluent showed that the values of these parameters are ranged on average between 16,7 and 27,2 mg/L for biological oxygen demand (BOD₅), between 22,3 and 36,2 mg/L for chemical oxigen demand and between <10 and 21 total suspended solid. All these values are beyond World Health Organization and Turkish Standards recommendations for wastewater discharge.

Keywords: sewage, monitoring, WHO, Turkey.

I. Introduction

Over the last century, environmental problems related to human activities have increased as a consequence of population growth. Pollution of water resouces has become a major concern for environmental monitoring physical, chemical and bacteriological parameters associated to water quality. In this context, wastewater treatment plants play an important role as human activity closely associated with sustainable. Activated sludge treatment has been used worldwide in secondary treatment systems. The wastewater purification performance of activated sludge treatment depends heavily on the metabolism with bacteria playing a key role in the purification process.

Sewage water is a complex matrix. These include high concentration of BOD, COD, high dissolved solid. Traditionally, the quality of treated wastewater is defined by the measurement of parameters such as chemical oxygen demand (COD), biological oxigen demand (BOD), nitrate, sulphate, etc. These parameters provide crucial information on the quality of the influent, effluent wastewater and performance of treatment plants [1]. Previous studies, on domestic sewage treatment systems have mainly focused on removal of chemical oxygen demand, biochemical oxygen demand, total suspended solid and nitrogen [2]. Information about the monitoring of these in domestic treatment systems is limited. Yozgat is a city in Turkey. The city is located at an elevation of 4380 ft (1,335 m), situated 170 km east of Ankara, near the head of a narrow valley through which the Ankara-Sivas road runs. According to 2009 census, population of the district is approximately 113,614 of which 73,835 live in the city of Yozgat. The main industries in Yozgat are textiles, food, cement, manufacturing and metallurgy [3-13].

According to national standards (Table 1), the receiving the water standards are based on organik load/ population equivalency [4]. The standards cover four main parameters without considering the bacteriological status.

Table 1. Discharge standards of domestic wastewater to receiving waters in Turkey [11].

Parameter	Composite sample (2h), Pop. 1000-10000	Composite sample (24h), Pop.1000-10000	Composite sample (2h), Pop.>100000	Composite sample (24h), Pop. >100000
BOD ₅ mg/L	50	45	40	35
COD mg/L	160	110	120	90
TSS mg/L	60	30	40	25
pH	6-9	6-9	6-9	6-9

In this study, wastewater samples (influent and effluent) were collected monthly from WWTP in Turkey for 8 months from May 2013 to December 2013. Typical pollution parameters measured in wastewater treatments plants such as chemical oxygen demand (COD), biological oxygen demand (BOD₅), pH and total suspended solids.

II. Materials and methods

2.1. Waste water treatment plant operation

Wastewaters in WWTP are treated by mechanical-biological method by using active sludge. In order to maintain quality raw and treated wastewater, the quality of activated sludge and optimal operating conditions, and the operation of wastewater treatment plant are daily monitored. Measurements of different physical quantities such as temperature, flow, redox potential, pH of water and conductance are performed daily by using standard laboratory equipment, instrument Sesinon (model 51935-00). Before and after treatment, the composition and quality of wastewater are determined daily by using standard analytical methods [5].

2.2. Water Samples

Water samples used in this study were collected from the effluents of secondary sedimentation in a WWTP. The WWTP has a treatment capacity of 26.000 m³/d, serving a community in the middle of Turkey. The basic treatment process of the WWTP is primary sedimentation, followed by an anaerobic–anoxic–oxic process as its secondary treatment. Eight groups of samples were collected from May 2013 to December 2013. The water samples were transported to laboratory on ice, stored at 4 °C and analyzed on the day of collection.

2.2. Analysis of waste water

The study was conducted sewage treatment plant Yozgat in Turkey. Samples were collected from the influent and effluent waste water at biological wastewater treatment plant. Samples were collected in first week of every month during the year 2013 from May to December. Samples were collected in glass containers, pre-cleaned by washing with non-ionic detergents, rinsed with tap water, 1:1 hydrochloric acid and finally with deionised water. Before sampling, the bottles were rinsed three times with sample water pH, temperature, BOD₅, COD and TSS were analyzed according to the methods prescribed by the APHA [5].

III. Result and Discussion

The wastewater quality analysis of influent of sewage treatment plant has been carried out for physico-chemical parameters like, pH, COD, BOD₅ and TSS. The results are given in Table 2.

Table 2. Physicochemical parameters of influent of sewage treatment plant

Parameters/ Months	May	June	July	Au	Sep	Oc	Nov	Dec
pH	8.82	8.50	8.63	8.52	8.54	8.58	8.52	8.55
COD	810	680	630	777	806	791	820	840
BOD ₅	607	510	472,5	583	604	593	615	630
TSS	198	212	161	205	228	178,5	185,5	192,2

The wastewater quality analysis of effluent of sewage treatment plant has been carried out for physico-chemical parameters like, pH, COD, BOD₅ and TSS. The results are given in Table 3.

Table 3. Physicochemical parameters of effluent of sewage treatment plant

Parameters/ Months	May	June	July	Au	Sep	Oc	Nov	Dec
pH	7,70	7,20	7,60	7,70	7,80	7,70	7,90	7,90
COD	33,2	28,6	35,4	26,7	22,3	27,1	33,4	36,2
BOD ₅	25	22	26,5	20	16,7	20	25	27,2
TSS	11	<10	15	<10	<10	11	18	21

Temperature also measured in WWTP. It usually depends on the season, geographic location and sampling time. During the period of investigation temperature values in between 13.5 to 20.6 °C. The minimum value was observed in month of December and the maximum value was observed in month of May. The variation in the water temperature may be due to different timings of collection and influence of season.

3.1 Chemical Oxygen Demand

The mean COD in the untreated wastewater was from 630 to 840 mg/L (Table 2). There was strong variation in COD concentrations over the sampling period. The minimum value was observed in the month of July while the maximum value was observed in the month of December in the influent of biological waste water plant in Yozgat in Turkey. The COD of the treatment wastewater is low in comparison to the range of COD values reported in the literature for domestic wastewater; including representative concentrations reported by Metcalf&Eddy Inc. (1991) of 250 mg/L, 430 mg/L and 800 mg/L for weak, medium and strong wastewater, respectively [6].

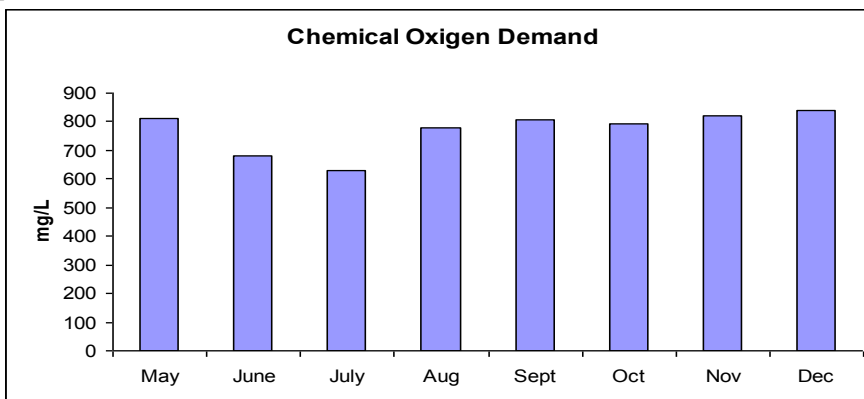


Figure 1. Variation of COD in Influent of WWTP

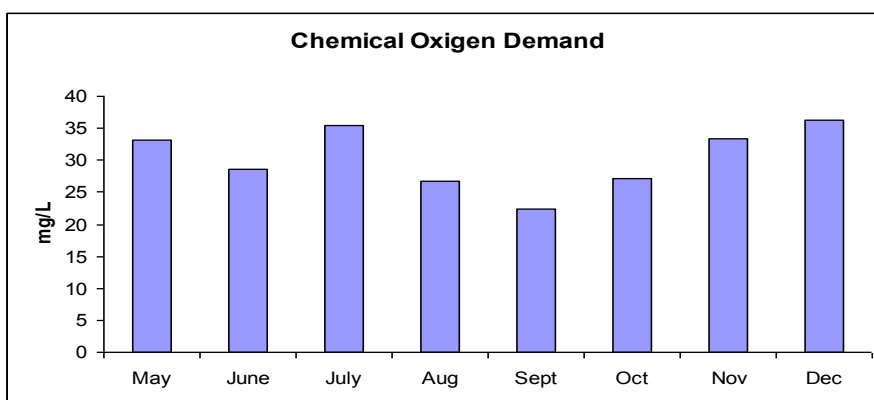


Figure 2. Variation of COD in Effluent of WWTP

3.2 Biological Oxygen Demand

In the present study, BOD₅ varied from 16,7 mg/L to 27,2 mg/L in the effluent of domestic waste water treatment plant. The minimum value was observed in the month of September while maximum value was observed in the month of December. BOD₅ indicates the present of microbial activities and dead organic matter. BOD₅ is directly linked with decomposition of dead organic matter present in the wastewater and hence the higher values of BOD₅ can be directly related with pollution status of the wastewater. The higher values of BOD₅ means present of more biodegradable organic matter [9-10].

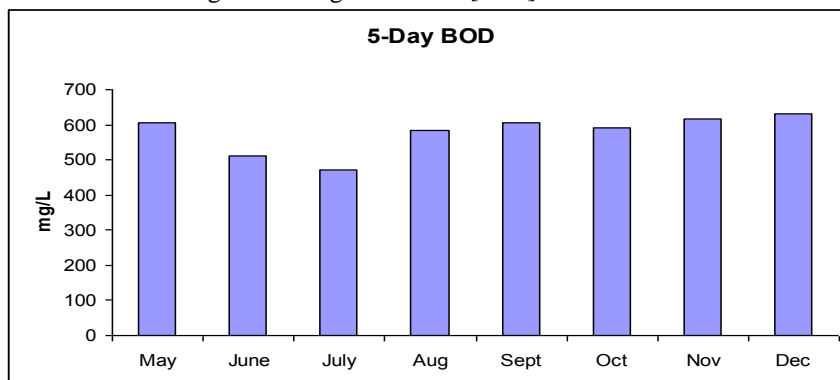


Figure 3. Variation of BOD₅ in Influent of WWTP

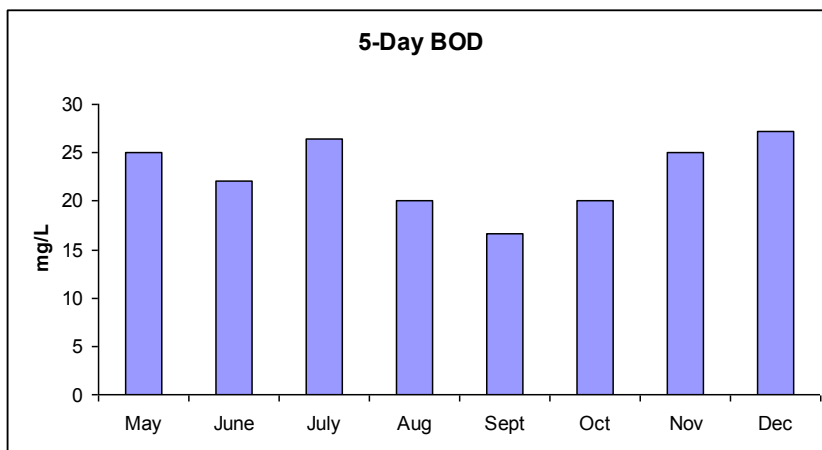


Figure 4. Variation of BOD₅ in Effluent of WWTP

Total Suspended Solids

The concentration of suspended solids (TSS) in the untreated sewage was 161 ± 212 mg/L, whereas from treated effluent varied from $<10-21$ mg/L respectively. Figure 5-6 shows the variation of suspended solids from the inlet and outlet of wastewater treatment plant. The values shows suspended solids are in permissible limit as compared with Turkish Standards [12].

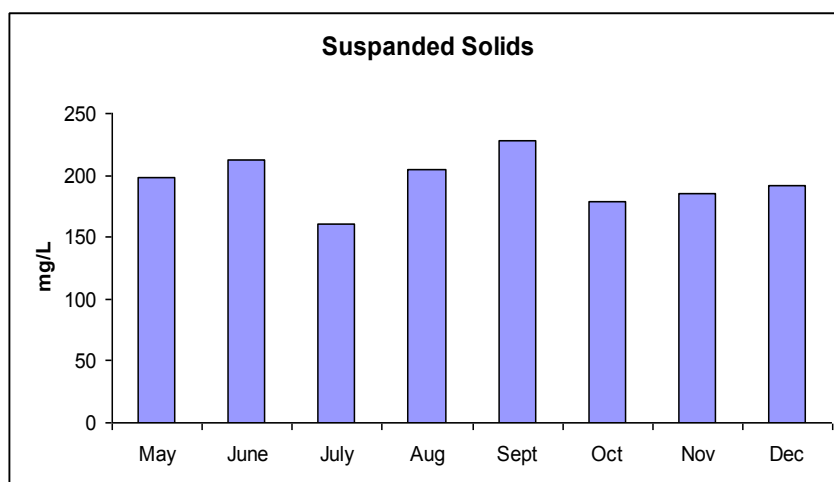


Figure 5. Variation of Suspended Solids in Influent of WWTP

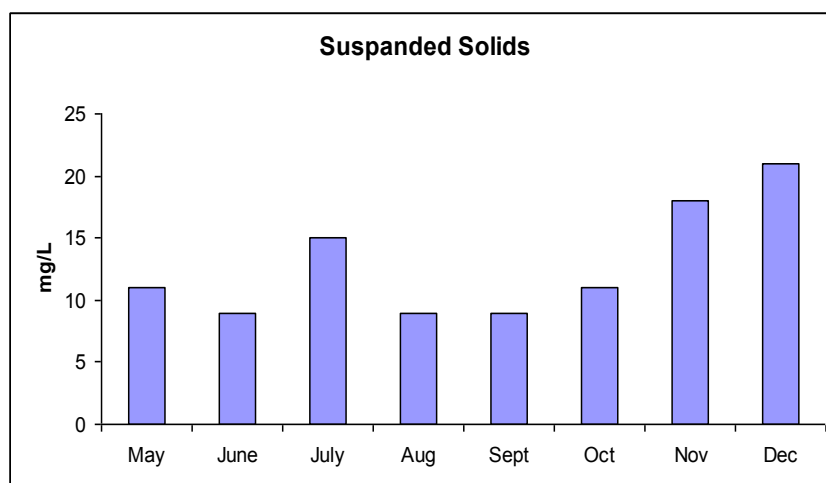


Figure 6. Variation of Suspended Solids in Effluent of WWTP

Water pH

pH measurements are common in wastewater treatment plant. The pH of the raw sewage was 8.52-8.82 and the system reduced the pH to values close to 7.20-7.90. These results are consistent with the behavior of pH in other treatment plants. There was no significant difference. WHO recommended maximum permissible limit of pH from 6.5 to 9.2 [7-8]. pH value of different samples is within the desirable and suitable range. Figure 7-8 shows the variation of suspended solids from the inlet and outlet of wastewater treatment plant

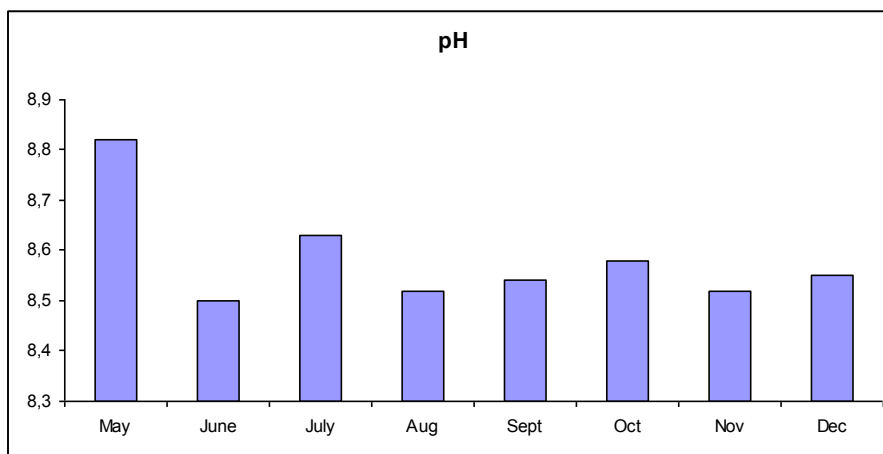


Figure 7. Variation of pH in Influent of WWTP

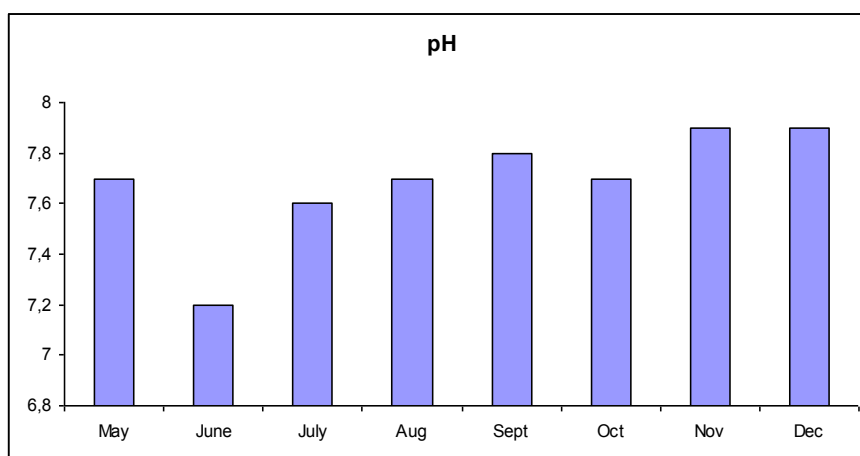


Figure 8. Variation of pH in Effluent of WWTP

IV. Conclusion

This study evaluated the physico-chemical properties rather than bacteriological parameters of a domestic wastewater treatment plant in Turkey. The physico-chemical characteristics of effluent is light brown in colour, pH shows alkaline nature of the effluent, TSS, BOD₅, COD are the parameters from the treated effluent is low in concentrations compared to Turkish standards. The concentration of the investigated in the water samples from Yozgat/Turkey were found below the guidelines for waste water given by WHO. The study showed a need for a continuous pollution monitoring program.

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