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Fluctuation in Wastewater Characteristics: A Case study

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ABSTRACT

The wastewater characteristics are significant to decide line of treatment and performance evaluation of treatment system especially in decentralized treatment. In this study an attempt is made to characterize wastewater from campus of Walchand College of Engineering, Sangli for 4 months. The sources contributing to wastewater include residential building, ladies and boys' hostel. The temporal (hourly and daily) variation of wastewater quality was assessed and compared with the quality of source water. The parameters analyzed include pH, TDS,TSS, Chlorides,COD, and BOD.Significant variation in quality (except pH) was observed in the wastewater samples collected during morning, afternoon and evening hours. There is a significant temporal (hourly and daily) variation observed in wastewater quality (except pH). TDS in wastewater is governed by TDS in source water. The study has provided baseline data to design an appropriate decentralized treatment system for this wastewater.

Keywords: Characteristics, Decentralized, Domestic, Variation, Wastewater

I. INTRODUCTION

Wastewater is generated from different sources viz. domestic, and industrial. Domestic wastewater typically contributed by grey water and black water. Wastewater generated from various sources from householdis composed of suspended solids, organic solids, inorganics, and microorganisms. The composition of wastewater basically depends on the quality and quantity of source water used and the type of usage. It is evident that the quality varies temporally and spatially. The treatment system and its design are governed by quality of wastewater. Centralized wastewater treatment systems normally serve large areas wherein the quality of wastewater is more normalized and uniform. The limitations of centralized treatment systems have led to the use of decentralized systems particularly for the unsewered areas, institutions, and isolated buildings. The quality of wastewater fed to decentralized system is significantly different from that of centralized system. This is because of larger fluctuations in flow, and lesser quantity of flow. The fluctuations in wastewater quality are case specific. The studies [1] to [6] are carried out to assess the characteristics of wastewater from individual buildings viz., ladies hostel, and canteen establishments in campus of Walchand College of Engineering, Sangli.In all these studies, the wastewater samples were collected at a particular time of a day and exhaustive wastewater characterization was not carried out in these studies.

In this context, an exhaustive study is undertaken to characterize combined wastewater from domestic establishments in campus of Walchand College of Engineering, Sangli. The objectives of present study include

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assessment of source water quality, temporal (hourly and daily) variation in wastewater quality, and correlation between source water used and wastewater generated.

II. MATERIAL AND METHODS

2.1 Study area and source of wastewater

The wastewater samples were collected from a disposal location within the campus of Walchand College of Engineering, Sangli (Maharashtra). There are two sources of water supply to the college campus. The municipal water supply is used for potable use after re-treatment in college campus. The open wells located within the college campus are used to supply water for non-potable use. Thus the water in bathroom and other sanitary locations are supplied with groundwater. The wastewater generated from residential bungalows, ladies and boys' hostel is disposed of through a sewerto a disposal site wherein it is used for gardening.The contributory flow from these buildings is by 800 students. The typical usage of water from these buildings includes bathing, washing, and toilet flushing. The hostels are provided with septic tanks and effluent from septic tank flows into sewer. The greywater (from bathroom and washings) flows directly into sewers.

The water samples were collected at different times (morning, afternoon and evening) and days (Monday to Saturday) from taps in bathroom of hostels and other residential buildings to know the quality of source water at the point of use. The sampling duration was four months (February to May 2017) with frequency of grab sampling once in a week. The wastewater was collected from disposal location for the above said period. The sampling plan was made to assess the quality of wastewater on different days (Monday to Sunday) in a week, different times (morning, afternoon and evening) in a day with grab samples, and composite samples. The time of sampling in each of these days selected are morning (9 am), afternoon (1 pm) and evening (6 pm). The basis of this selection is to ensure adequate flow during sampling and the types of activity contributing to the flow are different at these times.The sampling was done in 2 L plastic cans which were thoroughly washed and disinfected.

2.2 Quality parameters

The parameters used to assess the quality of water supplied to non-potable purpose are pH, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Chloride, Chemical Oxygen Demand (COD) and 5 d Bio-Chemical Demand (BOD_5). The wastewater characterization was by pH, TSS, TDS, COD and BOD_5. The methods of analysis were referred to [7]. BOD_5 was measured using BOD trak apparatus (Hach make) and COD was determined by spectrophotometric procedure after digestion (Hach make COD digester). Chloride was determined by Argentometric method.TDS was determined conductivity procedure.

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III. RESULTS AND DISCUSSION

3.1 Source water quality

The analysis of water used for non-potable purpose is given in Table 1. The results show that the water has high TDS, slightly turbid which is evident in TSS, and contributed by organics (COD and BOD_5).The water drawn is from open wells located in college campus and are not protected. The water supplied for non-potable purpose from these sources is not treated.It is evident from the presence of organics (COD and BOD_5) that this water iscontaminated.Further, the variability in water quality parameters is observed for TDS, Chloride, COD and BOD_5. The variation in pH and TSS is insignificant.

Table 1: Quality of source water supplied for non-potable use

Parameter	pH	TDS	TSS	Chloride	COD	BOD_5
Source water	7.49±0.25	1269±430	6.68±1.46	275±65	40±23	11±6
All values are in mg/L except pH						

3.2 Temporal variation in quality of wastewater at different times in a day

The temporal (hourly) variation in wastewater quality is shown in Fig. 1. The results show that there is not much variation in pH and lies within 7 to 8. TDS values observed are in the range 1000 to 1600 mg/L with more variability in the morning and relatively consistent in the evening hours. There is significant contribution to TDS by source water. 50% percent of the TSS values are around 200 mg/L in the morning hours with maximum value of 575 mg/L. The variability for TSS is found to be more in the evening hours. The observed pattern of variation for chlorides is same as that of TDS. There is significant addition of chloride after usage. 50% chloride values are around 400 mg/L. The organic strength of wastewater

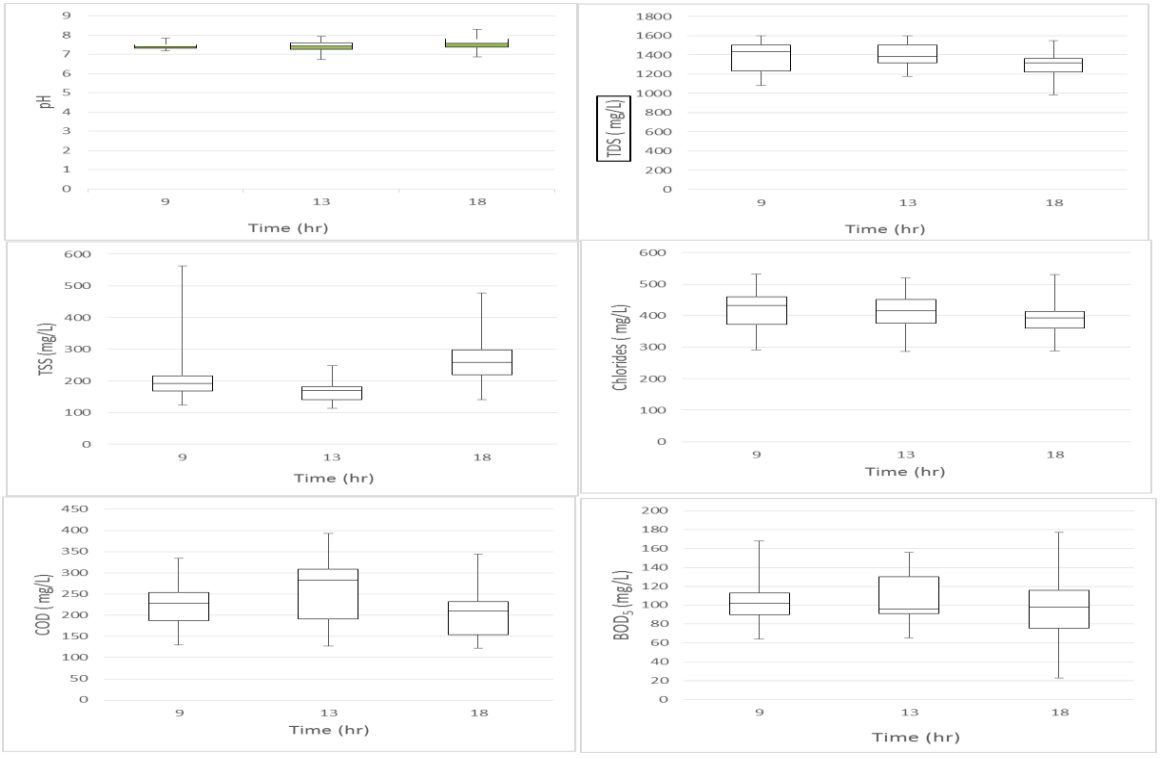

Fig. 1: Temporal (Hourly) variation in wastewater quality at disposal location

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(expressed in terms of COD and BOD_5) varies more in afternoon and evening hours when compared to morning hours. The maximum COD and BOD_5 observed are 400 mg/L and 180 mg/L respectively. The observed characteristics are very significant in view of the biological treatment of wastewater in a decentralized system. The flows received in the treatment systems are low and larger detention times are not preferred for wastewater. In this context, it is appropriate to treat wastewater as and when received into the system.

3.2.Temporal variation in quality of wastewater on different days:

Fig. 2 shows the temporal (daily) variation in wastewater quality at disposal location. The results show that there is a wide variability in observed values of the parameters assessed. There is no typical pattern that can be established. The higher range is observed for BOD (20 to 180 mg/L) and least variability is for pH. The different parameters have smaller or larger variability on different days. The skewness is also not consistent. However, considering both hourly and daily variations some useful observations can be made. Maximum TDS was observed on Tuesday and Thursday in morning and afternoon hours. TSS was observed to be highest on Wednesday in morning hours.

The data on wastewater quality and its variation is useful for deciding appropriate treatment system.The decentralized system is normally receives the inflow intermittently. In this case, the residence time of wastewater in the inlet tank/settler/equalization tankis shorter when the flow rate is higher. There is a less scope for normalization of wastewater quality in a available residence time. The quality of wastewateras and when received affects the performance of the treatment system. Thus, temporal fluctuation is to be considered in designing the treatment system. TSS, COD and BOD_5 are important parameters to size the units of treatment. The hourly fluctuations of TSS in morning on Wednesday will govern the design of settling tank. BOD_5 and its variation during evening of Monday and Wednesday is useful in the design of biological system.

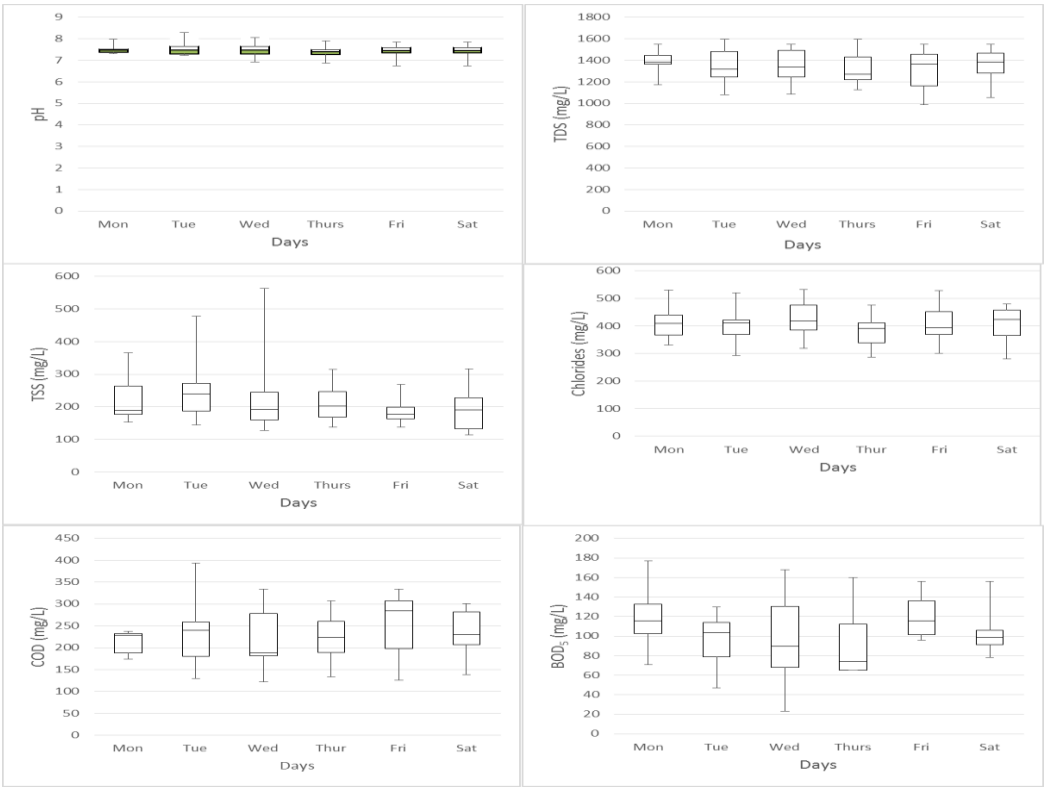

Fig. 2: Temporal (daily) variation in wastewater quality at disposal location

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3.3.Quality of wastewater composite samples

The results of wastewater quality based on composite sampling are given in Table 2. It can be seen from the results that there is no much fluctuations in the quality of composite wastewater except for TSS and BOD/COD. The settleable/non-settelable nature of TSS and bio-degradable/non-biodegradable nature of organic matter imparts the variability to these parameters.

Table 2: Wastewater Quality in Composite samples

Day \ Parameter	pH	TDS	TSS	Chlorides	COD	BOD_5
Monday	7.63	1269	202	394	280	200
Tuesday	8.10	1410	286	348	195	123
Wednesday	7.40	1410	295	336	276	165
Thursday	7.80	1363	148	366	256	154
Friday	7.88	1410	191	324	258	145
Saturday	7.08	1395	219	346	205	140
All values are in mg/L except pH						

3.4.Correlation betweenquality of source water and wastewater generated

The comparison of source water quality and quality of composite wastewater shows that there is significant increase in TSS, Chloride, COD and BOD_5. The activities which contributed to these include washing (clothes and utensils), toilet flushing, and bathing. However, pH and TDS are not affected. TDS in wastewater is governed by the TDS of source water.

VI. CONCLUSIONS

The study on variability in quality of wastewater generated from residences and hostels was conducted in the campus of Walchand College of Engineering, Sangli for a period of 4 months. Grab and composite sampling procedure was adopted for wastewater characterization. The source water was also analyzed. The following conclusions are drawn based on the study carried out.

a. The temporal (both hourly and daily) variation in wastewater quality for all parameters (except pH) is quite significant. In particular TSS, COD and BOD fluctuate relatively more.
b. There is no typical pattern of fluctuation (hourly or daily) for any quality parameter can be established.
c. TDS in wastewater is largely governed by its value in source water.

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