Assessment of Influent and Effluent properties in Rainy season of STP of Shivanagara, Davangere city

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Abstract— **The project entails a study of the properties of the wastewater at Shivanagara of Davangere City's STP, with a correlation analysis and WQI to follow. Samples of influent and treated effluent were gathered in order to examine the characteristics over the rainy season. Color, pH, Alkalinity, BOD, COD, DO, TSS, TDS, Turbidity, EC and Chromium are among the properties that are analysed. Values were within the approved levels, indicating that STP was very effective in eliminating all pollutants and making effluent acceptable for disposal. Because of increased runoff during the rainy season, the influent may contain more contaminants, and treatment system overload may result in lower-quality effluent. Pollutants increase during the rainy season due to runoff, affecting both influent and effluent. To determine how dependent each parameter was on the others during the several seasons, the WQI and Correlation Index were computed. Samples were found to be having almost positive correlation among the each parameter. And also the WQI values were found out be satisfactory with restriction for drinking purpose but can be used for irrigation purpose. Seasonal fluctuations in influent and effluent quality indicate that, in order to maintain maximum performance throughout the year, treatment procedures must be adaptable and sensitive to changes in the surrounding environment.**

Index Terms— **Influent, treated effluent, correlation analysis, wqi**

I. INTRODUCTION

One such abundant resource in the environment that is vital to the existence of all types of species is water. Numerous human activities, urbanization, industrial expansion, and population growth are causing water to become increasingly contaminated and depleted of its quality. Selecting a water source with the fewest possible impurities is the most crucial part of the water supply system. The WW quality evaluation is essential to providing environmental and public health protections. Therefore, wastewater treatment is crucial to removing and reducing the harmful effects of pollutants in the water. The goal of treatment is also to get the adulterants down to levels that are safe to dispose of [1]. One such specifically constructed unit for treating wastewater or sewage is the STP. The artificial process of eliminating or altering the undesirable elements found in sewage. to make it less disagreeable and hazardous for disposal is known as sewage treatment. The process of determining and characterizing the unique qualities or attributes of a specific thing or material is known as characterization; in this instance, waste water characteristics are being examined. Sewage characterization is crucial for efficient waste disposal and management [2]. It evaluates in order to determine the necessary treatment techniques and extent, as well as potential advantageous uses for the waste. The process of characterizing wastewater commences with its many qualities and characteristics. Wastewater that has undergone partial or full treatment during a STP's treatment process is referred to as effluent. In order to stop more contamination, this treated effluent needs to be adequately treated before it is released into any surrounding water sources. Because treated effluent is accessible for agricultural use year-round and is not dependent on the weather or precipitation, it is observed to function as a continual source of water [3].

II. STUDY AREA

Davangere is a seventh largest city of Karnataka and it is at the central part of Karnataka state. Geographically situated at 14” 31 N and 75” 58 E. It serves as an administrative headquarters for the Davangere district. It is one such city which was selected for the Smart City scheme of the Central government. According to the 2021 Census population of city is about 5,30,000.

Davangere district has background of various crops cultivation. One STP is located at the Shivanagar, budihal road Davangere having the capacity of 20MLD, it is shown in the Figure.1 below. The influent from surrounding various areas are sent into this STP and after treating effluent is released. The effluent which was treated from this STP will be released to the canal of the Doddabudihal, Chikkabudihal finally joining the river.

Fig 1. STP of Shivanagara, Davangere city

III. METHODOLOGY

Both the incoming influent and effluent samples were collected during the month of June-July from the STP located at Shivanagara of Davangere city. The influent was collected at inlet of STP and effluent was collected at outlet after all the treatment process. Waste water entering the inlet of STP has to undergo several processes and steps of treatment, hence it takes around 4 hours and later it is released as a treated effluent. Samples of influent and effluent was carried in polythene containers and stored in refrigerator at 4^0 C to stop the microbial activity.

Color: Spectrophotometer

pH: pH Meter

EC: Electrical conductivity meter

Turbidity: Nephelometer

TDS: TDS Meter

DO: Winkler's Method

BOD: Winkler's Method

COD: Open Reflux Method

IV. RESULTS AND DISCUSSION

The Influent and Treated effluent characteristics value of STP for Rainy seasons are analysed. Result from experiments conducted are obtained are given in the table 1.

Table 1. Analyzed influent and effluent characteristics of STP

SN.	Parameters	June		July	
		Influent	Effluent	Influent	Effluent
1	Color (PtCo)	729	53	710	52
2	pH	7.14	7.28	7.12	7.26
3	Alkalinity(mg/l)	473	307	461	304
4	BOD (mg/l)	360	5.8	370	5.8
5	COD (mg/l)	736	40	728	36
6	TSS (mg/l)	373	7.0	356	6.0
7	TDS (mg/l)	530	347	515	335
8	Turbidity (NTU)	949	3.7	944	3.9
9	EC (Si/m)	815.38	533.84	792.30	515.38
10	Chromium(ppm)	0.021	0.012	0.021	0.012

After the tests for the influent and effluent samples for the rainy season the values of colour were 729 PtCo and 53 PtCo for June and 710 PtCo and 52 PtCo for July (Fig.2), values of pH were 7.14 and 7.28 for June and 7.12 and 7.26 for July (Fig.3), values of Alkalinity were 473 mg/l and 307 mg/l for June and 461 mg/l and 304 mg/l for July (Fig.4), values of BOD were 360 mg/l and 7.8 mg/l for June and 370 mg/l and 5.8 mg/l for July (Fig.5), values of COD were 736 mg/l and 40 mg/l for June and 728 mg/l and 36 mg/l for July (Fig.6), values of TSS were 373 mg/l and 7 mg/l for June and 356 mg/l and 6 mg/l for July (Fig.7), values of TDS were 530 mg/l and 347 mg/l for June and 515 mg/l and 335 mg/l for July (Fig.8), values of Turbidity were 949 NTU and 3.7 NTU for June and 944 NTU and 3.9 NTU for July (Fig.9), values of EC were 815.38 Si/m and 533.84 Si/m for June and 792.30 Si/n and 515.38 Si/m for July (Fig.10) and values of Chromium were 0.021ppm and 0.012 ppm for June and 0.021 ppm and 0.012 ppm for July (Fig.11).

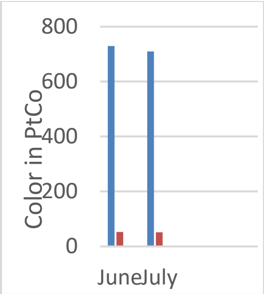

Fig 2. Variation of color

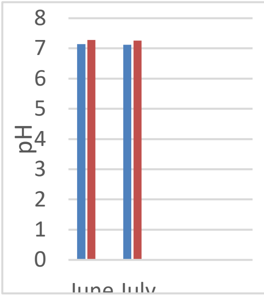

Fig.3 Variation of pH

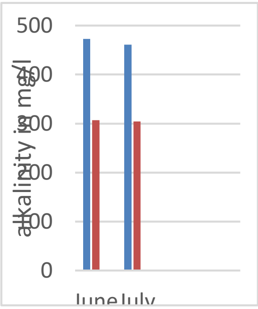

Fig.4 Variation of Alkalinity

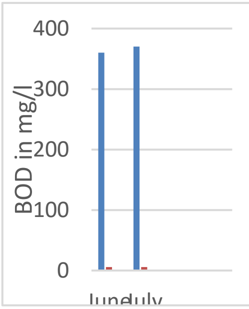

Fig.5 Variation of BOD

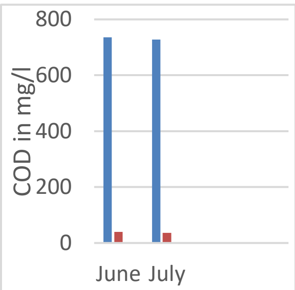

Fig.6 Variation of COD

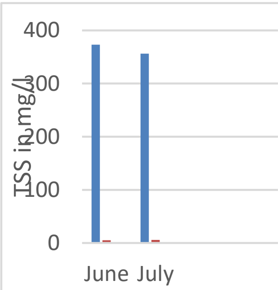

Fig.7 Variation of TSS

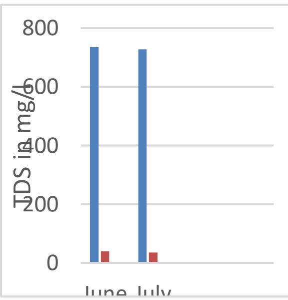

Fig.8 Variation of TDS

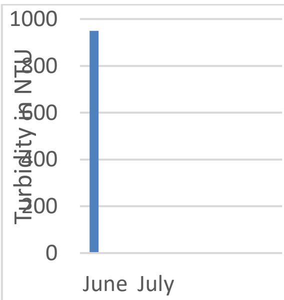

Fig.9 Variation of Turbidity

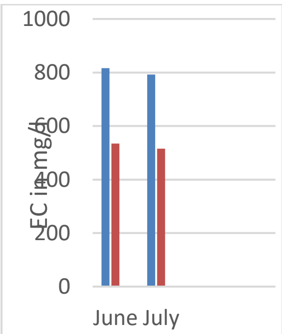

Fig.10 Variation of EC

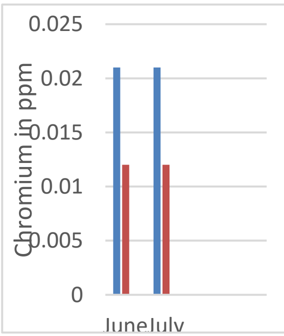

Fig.11 Variation of Chromium

WQI calculation

A WQI, is mathematical expression used to indicate the suitability a body of water is for a given application or purpose. The process simplifies the interpretation of the overall water quality by combining several measures of water quality into a single result [4]. Compare the obtained index value data in the Table.2. On comparison, all the effluent samples belongs to the range between 89-97. Hence we can conclude that effluent samples belongs to the category of Poor Quality which indicates it is not preferable for drinking and can be allowed for irrigation purpose [5].

Table.2 WQI calculation for the Rainy Season

Parameters	Mean Value	Unit Weig (Wi)	Sub index(Qi)	WiQi
pH	7.27	0.15478	18	2.786042
DO	5.6	0.263126	84	22.10259
BOD	6.4	0.263126	93.75	24.66807
TDS	341	0.002631	68.2	0.179452
Turbidity	4.2	0.263126	128	33.68013
EC	524.61	0.000585	23.316	0.013633
Colour	61	0.052625	244	12.84055

$\sum wiqi = 96.2704$

Efficiency: The efficiency of a treatment plant typically refers to how effectively it remove contaminants or treats waste[6].

Removal efficiency: This indicates the percentage of contaminants or pollutants removed from the influent stream by the treatment process. Higher removal efficiencies imply more effective treatment. It is given by the expression [7].

$$\text{Efficiency} = (\text{influent} - \text{effluent})/\text{influent} \quad (1)$$

- BOD removal efficiency is given by,

  $E_{BOD} = (BOD_{inf} - BOD_{eff})/BOD_{inf}$

  $E_{BOD} = (368-6.16) \div 3\ 68.16 = 362 \div 368.16$

  $= 98.32\%$

- COD removal efficiency is given by,
  $E_{COD} = (COD_{inf} - COD_{eff)}/ CODinf$
  $E_{COD} = (735.2 – 37.6) \div 735.2 = 697.6 \div 735.2$
  $= 94.88\%$

- TSS removal efficiency is given by,

E_{TSS} = (TSS_{inf}-$TSS_{eff)}$/ TSS_{eff}

E_{TSS} =(385.6-5.8) ÷ 385.6 =379.8 ÷ 385.6

= 98.49%

- Turbidity removal efficiency is given by,

$E_{Turbidity}$= ($Turbidity_{inf}$-$Turbidity_{eff}$) / $Turbidity_{eff}$

$E_{Turbidity}$ = (985-4.06) ÷ 985

= 99.58%

Correlation analysis

A table that shows the correlation between the waste sample numerous variables is called a correlation matrix [8]. The correlation can be displayed in each cell of the table. The range of correlation coefficients is -1 to +1, where: A perfect positive correlation is shown by a +1, which indicates 2 variables are directly related to each other. Changes in one variable do not anticipate changes in the other, as indicated by a correlation score of 0.A perfect negative correlation is shown by a value of -1, which indicates 2 variables are indirectly related to each other [9]. Table.3 shows correlation of parameters for rainy season.

Table 3. Pearson's correlation analysis of parameters for influent of STP

Parameters	Color	pH	Alkalin	BOD	COD	TSS	TDS	Turbidi	EC	Chromium
Color	1	0.886	0.995	0.588	0.868	0.950	0.986	0.916	0.986	0.975
pH	0.880	1	0.917	0.455	0.899	0.851	0.935	0.951	0.935	0.916
Alkalinity	0.995	0.917	1	0.546	0.898	0.959	0.996	0.942	0.996	0.975
BOD	0.588	0.445	0.546	1	0.287	0.315	0.496	0.391	0.496	0.701
COD	0.868	0.899	0.898	0.287	1	0.882	0.902	0.836	0.902	0.831
TSS	0.950	0.851	0.959	0.315	0.882	1	0.968	0.933	0.968	0.877
TDS	0.986	0.935	0.996	0.496	0.902	0.968	1	0.965	1	0.965
Turbidity	0.916	0.951	0.942	0.391	0.836	0.933	0.965	1	0.965	0.912
EC	0.986	0.935	0.996	0.496	0.902	0.968	1	0.965	1	0.965
Chromium	0.975	0.916	0.975	0.701	0.831	0.877	0.965	0.912	0.965	1

V. CONCLUSION

Higher influent flow rates and diluted pollutant concentrations are usually the outcome of the rainy season. Because of increased runoff during the rainy season, the influent may contain more contaminants, and treatment system overload may result in lower-quality effluent. Wastewater that has been improperly or completely treated runs the risk of being released into the environment if the treatment system is overloaded or poorly managed. Increased contamination of the receiving water bodies may result from this. The concentration of pollutants in the influent may be diluted by the higher flow rates experienced during the rainy season. Lower BOD, COD, and TSS concentrations may result from this. Analysed parameter of the treated effluent were within the acceptable range for disposal on both surface water and land irrigation discharge. According to an analysis of the WQI, the effluent had a satisfactory water quality index with restriction for drinking purpose. The efficiency of removal of turbidity, BOD, COD and TSS was found 99.58%, 98.32%, 94.88% and 98.49% respectively.

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