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Chemical treatability study of disposed wastewater generating from sewage treatment plant in Ahmedabad city

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Abstract: Development is necessary for a country to improve its economy. But along with the development due to rapid industrialization, population explosion, disposal of waste to fresh water bodies etc has adverse effect on the eco-system. Disposal of untreated or partial treated wastewater in water source directly is one of the most common causes of water pollution. Wastewater is mostly generated from domestic, industrial, commercial, agricultural, civil and structural waste. Common effluent treatment plant (CETP) and sewage treatment plants (STP) – A collective effort for the treatment of effluent especially for cluster of small scale industrial units at low unit costs are installed in cities for the treatment of industrial and domestic wastewater. Physical, chemical and biological processes are available for the treatment of wastewater. The characteristics of treated wastewater before disposal to freshwater body should be under the permissible limit given by Gujarat pollution control board. Disposal of untreated sewage into water bodies leads to eutrophication which is increase in concentration of chemical elements required for life. It also causes many health implications, negatively disrupt river and lake ecosystem which leads to environmental degradation. The present study is focused to check the water quality of disposed wastewater and to inform the authority, law makers and people about the genuine issues which can affect them. Also quick action can be taken to control the pollution level.

Key words: *Wastewater, treatability, contaminants, disposal, ecosystem.*

I. INTRODUCTION

Now a day's sources of water pollution are many. The main pollution is due to disposal of sewage and industrial waste discharged into the rivers, ponds or lakes. Septic tank discharge is also a major cause for the water pollution. Urban rainfall runoff from roads, car parks, pavements which contain oils, animal faeces, litters mix with the water body. According to central pollution control board, during 2015 the estimated sewage generation in the country was 61754 MLD as against the developed sewage treatment capacity of 22963 MLD. Because of the hiatus in sewage treatment capacity, about 38791 MLD of untreated sewage (62% of the total sewage) is discharged directly into nearby water bodies [7&8]. The five states viz Maharashtra, Tamil Nadu, Uttar Pradesh, Delhi & Gujarat account for approximately 50% of the total sewage generated in the country. Maharashtra alone accounts for 13% of the total sewage generation in the country. Maharashtra, Gujarat, Delhi, Uttar Pradesh & Gujarat account for 67% of the total sewage treatment capacity installed in the country. Discharge of untreated sewage in water causes both surface and ground water is the most important water polluting source in India [6]. Out of about 38000 million litre per day of sewage generated treatment capacity exists for only about 12000 million litre per day. Thus, there is a large gap between generation and treatment of wastewater in India. Even the treatment capacity existing is also not effectively utilized due to operation and maintenance problem. Operation and maintenance of existing plants and sewage pumping stations is not satisfactory, as nearly 39% plants are not conforming to the general standards prescribed under the Environmental (Protection) Rules for discharge into streams as per the CPCB's survey report [9]. In a number of cities, the existing treatment capacity remains underutilized while a lot of sewage is discharged without treatment in the same city.

Preliminary treatment is required to remove the coarse solids and other large materials from raw wastewater. Removal of these materials is necessary to enhance the operation and maintenance of subsequent treatment units. A number of unit operations are engaged in the preliminary treatment of wastewater to eliminate undesirable characteristics of wastewater. The operations include use of screens and grates for removal of large materials, comminutors for grinding of coarse solids, preaeration for odour control [14]. Primary wastewater treatment, it involves physical separation of suspended solids from the wastewater using primary clarifiers. This process is helpful in reduction of total suspended solids (TSS) and associated biochemical oxygen demand (BOD) levels and prepares the waste for the next step in the wastewater treatment process. The objective of primary treatment is to remove of settle able organic and inorganic solids by sedimentation and removal of materials that float (scum) by skimming. Secondary treatment process involves decomposition of suspended and dissolved organic matter in waste water using microbes. The mainly used biological treatment processes are activated sludge process or the biological filtration methods. Tertiary treatment can also involve physical-chemical separation techniques such as activated carbon adsorption, flocculation/precipitation, membranes filtration, ion exchange, de-chlorination and reverse osmosis [14]. Chemical treatability study is the method by which study of different chemical characteristics of treated sample can be carried out to get the brief idea about the different treatment process. Sewage water is a complex matrix with many different chemical characteristics. Due to high dissolved solid there is increase in concentration of COD, BOD, and high conductivity with pH ranging from 6 to 9.The characteristics determine the operating condition and the process carried out in the sewage treatment plant [14].

II. OBJECTIVES

- To study the disposal characteristics of wastewater.
- To reduce the water pollution load by means of proper treatment of disposed wastewater.
- Prior to disposal neutralization; dissolved solid removal; organic matter removal and other required process must be done as untreated waste water will also create ground water pollution.
- So proper treatment of wastewater is necessary and various parameters like pH; BOD; COD; TDS; Suspended solids; Conductivity etc. should be in prescribed limit at the time of disposal.

III. MATERIALS AND METHODS

3.1 Collection of sample: Treated wastewater collected from one of the sewage treatment plant (STP) located at Ahmedabad. There are 3 units of STP having different capacities. One unit is of UASB type having 126 MLD capacities. 2 units are of ASP type having capacity of 35 MLD and 240 MLD respectively. Treated wastewater disposed to the Sabarmati river. There were total 3 outlets for disposal. Total 30 samples, each outlet 10 samples collected to check the treatability study of the sewage sample. Out of which 15 samples collected at morning and 15 samples collected at evening to check the time effect on the disposal of treated wastewater. According to the authority of treatment plant they are doing physical, chemical and biological process before they disposed the wastewater to the river.

3.2 Experiments: Various experiments i.e., pH, BOD_5, COD, TDS, Conductivity, Suspended solids etc. pH of the sample helps to determine the acidic or basic characteristics. Generally the pH scale varies from 0 to 14. 0 to 7 is acidic, 7 is neutral and 7-14 is alkali in nature. The BOD (Biochemical oxygen demand) is an empirical biological test. This test gives the idea about the presence of biodegradable organic matter in wastewater. The prescribed limit according to central pollution board for disposal of treated wastewater in freshwater is 30 mg/L. Generally BOD is a 5 day experiment and mostly deals with biodegradable organic matter [11].

The chemical oxygen demand (COD), determines the amount of oxygen required for chemical oxidation of organic matter using strong chemical oxidant, such as potassium dichromate under reflux condition. The refluxing generally done at 150 º C for 2 hrs. Sample is titrated with ferrous ammonium sulphate. The disposal limit for COD is 250 mg/L.

Total dissolved solids in the sample are due to bicarbonates, carbonates, sulphates of calcium, magnesium, sodium and potassium. The amount of TDS in the fresh water increases, if the disposed wastewater contains more amounts of TDS. When the value of TDS increases in the electrical conductivity of the sample also going to increase.

Disposal of sewage and industrial effluents contributes suspended matter to river or streams. The Indian standards have specified a maximum limit of 100 mg/L for wastewater dischargeable into water bodies

IV. RESULTS AND DISCUSSION

According to BIS standard, pH discharge of sewage and industrial effluents in surface water sources and public sewer is around 5.5 to 9.0. For all the collected samples, 30 samples the value of pH varies in between 6.5 – 9.3 (Figure1).

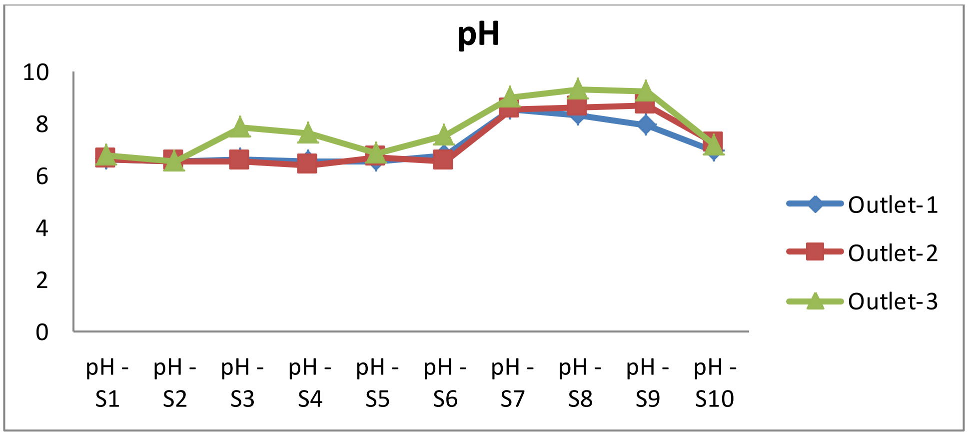

Figure-1: pH data of 3 outlets

According to disposal point of view, out of 30 samples, 11 samples showing the result under the permissible limit. 19 samples results varying from 35 to 100 mg/L, which is the above the permissible limit. From the sample collected area there are total 3 outlets were there. Out of 3 outlet, outlet no 2, showing all the 10 collected samples were result more than the prescribed limit (Figure2).

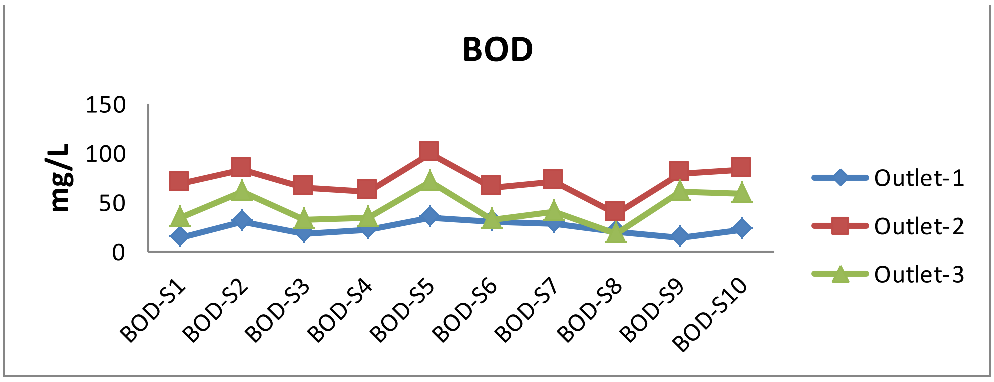

Figure-2: BOD data of 3 outlets

COD plays an important role according to disposal point of view. Out of 30 samples, 10 samples under the permissible limit i.e., 250 mg/L. There is a similar tendency of result with respect to BOD result. The outlet no 2 showing excess COD for all the 10 samples. The excess value of COD varies from 265-1390 mg/L (Figure3).

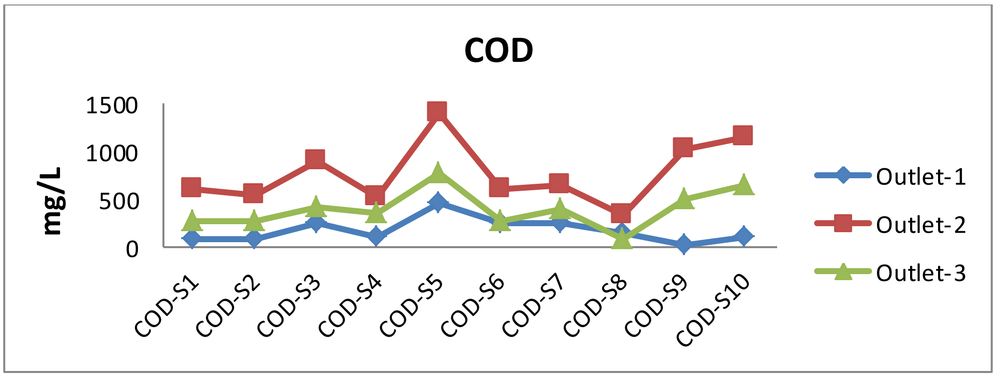

Figure-3: COD data of 3 outlets

Total dissolved solids limit for disposal is 600 mg/L. All the 30 samples showing the result more than the prescribed limit for TDS. The result varies from 1035 ppm to 6500 ppm, which is 2 to 10 times more than the prescribed limit. Out of 3 outlets, outlet no 2 showing the highest result for collected samples (Figure4).

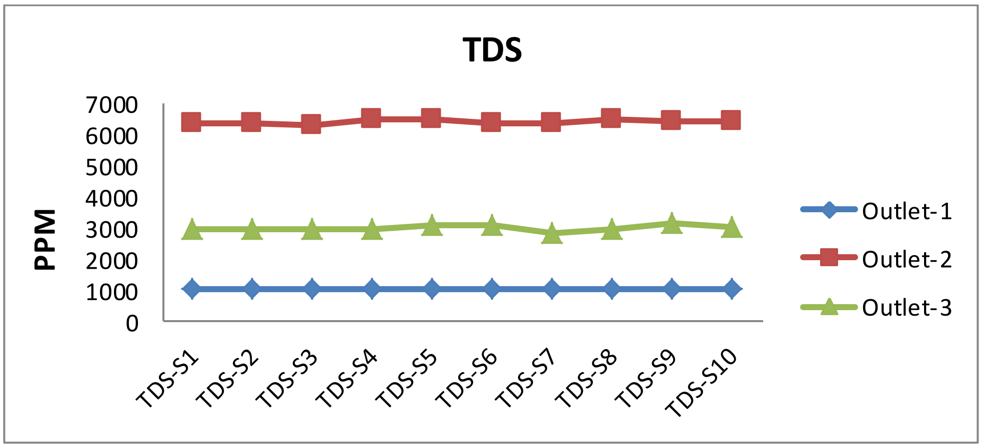

Figure-4: TDS data of 3 outlets

Out of 30 collected samples, except 1 other sample showing the result more than the prescribed limit i.e. 2mS. The result of conductivity varies from 2. 4 – 30mS. In outlet no 2 there is much more variation in the result (Figure5).

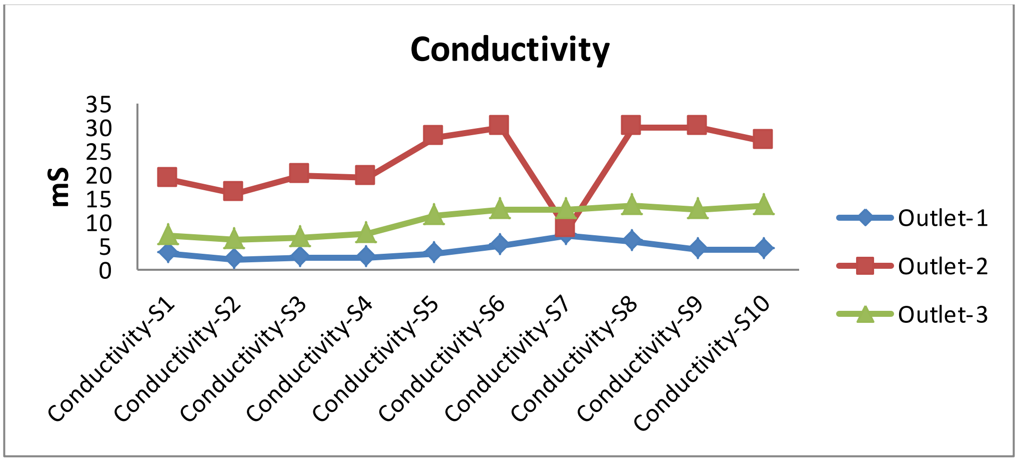

Figure-5: Conductivity data of 3 outlets

Suspended solids play an important role according to disposal point of view. The recommended value for suspended solids is 100 mg/L. The collected sample showing the result more than the prescribed limit. The result varies from 280 – 1290 mg/L. Among the entire outlet, outlet no 2 showing the result with high values (Figure 6).

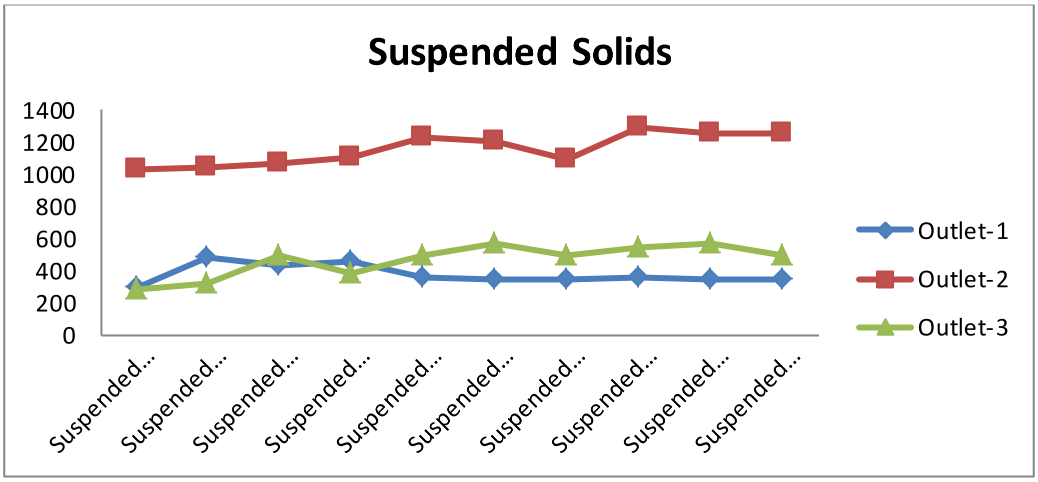

Figure-6: Suspended solids data of 3 outlets

Table-1: Summary of collected sample

Sr. No.	Sample No and Outlet	pH	Conductivity	COD	TDS	Suspended Solid	$BOD_{(5)}$
Recommended value	-	7	2 mS	250 mg/L	600 mg/L	100 mg/L	30 mg/L
	Sample-1						
1	Outlet – 1	6.6	**3.4**	80	**1061**	**300**	15
	Outlet – 2	6.59	**19**	**615**	**6360**	**1030**	**68**
	Outlet – 3	6.79	**2.4**	**265**	**2980**	**280**	35
	Sample-2						
2	Outlet – 1	6.59	**2.4**	250	**1050**	**485**	30
	Outlet – 2	6.5	**20**	**900**	**6350**	**1038**	**83**
	Outlet – 3	7.82	**6.6**	**425**	**2990**	**321**	**60**
	Sample-3						
3	Outlet – 1	6.56	2	85	**1050**	**435**	18
	Outlet – 2	6.54	**16**	**540**	**6300**	**1067**	**65**
	Outlet – 3	6.55	**6.5**	**275**	**3000**	**498**	**32**
	Sample-4						
4	Outlet – 1	6.55	**2.5**	100	**1080**	**457**	22
	Outlet – 2	6.4	**19**	**525**	**6500**	**1109**	**60**
	Outlet – 3	7.37	**7.5**	**350**	**2985**	**380**	**35**
	Sample-5						
5	Outlet – 1	6.53	**3.5**	**450**	**1035**	**357**	**35**
	Outlet – 2	6.72	**28**	**1390**	**6480**	**1230**	**100**
	Outlet – 3	6.83	**11.5**	**770**	**3100**	**489**	**70**
	Sample-6						
6	Outlet – 1	6.77	**5.3**	250	**1070**	**350**	30
	Outlet – 2	6.53	**30**	**595**	**6345**	**1200**	**65**
	Outlet – 3	7.55	**12.6**	**280**	**3080**	**570**	**32**
	Sample-7						
7	Outlet – 1	8.53	**7**	250	**1035**	**350**	28
	Outlet – 2	8.5	**8.5**	**650**	**6360**	**1090**	**70**
	Outlet – 3	9	**12.7**	**400**	**2850**	**495**	**40**
	Sample-8						
8	Outlet – 1	8.32	**5.8**	150	**1060**	**360**	20
	Outlet – 2	8.6	**30**	**325**	**6490**	**1290**	**38**
	Outlet – 3	9.33	**13.7**	**75**	**2990**	**547**	18
	Sample-9						
	Outlet – 1	7.9	**4.2**	25	**1055**	**340**	15

9	**Outlet – 2**	8.7	**30**	**1025**	**6435**	**1256**	**80**
	Outlet – 3	9.2	**12.7**	**500**	**3150**	**567**	**60**
	Sample-10						
10	Outlet – 1	6.92	**4.2**	110	**1065**	**350**	22
	Outlet – 2	7.22	**27**	**1150**	**6400**	**1250**	**83**
	Outlet – 3	7.16	**13.5**	**650**	**3035**	**500**	**58**

(* results in bold having limits exceeds the prescribed limit)

V. CONCLUSION

In this research, the main thing which comes out as the conclusion is that the wastewater which comes to the sewage treatment plant in Ahmedabad city is not treated properly at all. As per the recommendations of GPCB many parameters have to be kept in mind while treating the wastewater. 6 basic parameters which were selected by us for checking showed a variety of results. Very few samples were under permissible limit as per the norms.

Following things thus, can be concluded from the results of the experiments conducted.

- pH result of all 30 samples is within the prescribed limit. Thus it can be concluded that neutralization is carried out.
- Conductivity more than 2 mS for 29 samples. Thus it can be concluded that no dissolved solids removal has been done in the STP which is very necessary.
- COD is high in 20 samples. In that outlet no. 2 for all sampling shows the highest result among all the outlets. Thus it can be concluded that samples contain more amount of organic matter in wastewater. This of course, as discussed earlier can result in bio-accumulation.
- TDS for all the 30 samples is more than prescribed limit. As TDS is directly proportional to conductivity, the effect of high TDS is due to non-removal of dissolved solids.
- Suspended solids for all 30 samples have been found more than prescribed limit. Thus it can be concluded that no sedimentation and precipitation for removal of suspended solids.
- BOD $_{(5)}$ for 20 samples is found above prescribed limit. It indicates the presence of biodegradable organic material in disposed water.

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