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Comparative Study of Wastewater Parameters before and After Treatment of WWTP –A Case Study

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ABSTRACT
The current parameters such as pH, DO, TSS, BOD and COD before and after treatment of the wastewater treatment plant (WWTP) in the campus of Abhilashi University was analyzed in this study. A reduction in the values of Ph, TSS, BOD and COD were found to be 15.04%, 74.92%, 93.73% and 79.79% respectively. Increase in the value of DO after treatment was found to be 58.36. Also data has been collected and analyzed month wise and compared and trends show similar reduction in pH, TSS, BOD, COD and increased level of DO.

MAIN WORDS: *Waste Water, pH, TSS, DO, BOD, COD, Sewage Treatment Plant etc.*

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I. INTRODUCTION

Sewage is the waste water created by a population, domestic wastewater, raw or treated industrial wastewater discharged from bathrooms, toilets, kitchens, etc. into the sewerage system, and also rain-water and urban runoff. Domestic waste water, which is also taken as a synonym, is the principal component of sewage. Sewage elements are not known to be sand and coarse materials (paper, bottles, etc.).When they arrive at a treatment plant, they are carried by water but treated as solid waste. Depending on economic aspects, social activity, nature and number of industries in the region, climate conditions, water use, nature of sewer system, etc., the sewage flow rate and composition differ considerably from place to place.

Suspended solids, soluble organic compounds, and faecal pathogenic microorganisms are the major contaminants in waste, but waste isn't only made up of human excrement and water. Sewage can also detect a range of contaminants, such as heavy metals, trace elements, detergents, solvents, pesticides, and other rare substances such as pharmaceuticals, antibiotics, and hormones. Securities relating to water, food and energy are becoming an increasingly critical and crucial problem for India and the world. Most river basins are closed or closed in India and elsewhere, with moderate to extreme water shortages caused at the same time by the effects of agricultural development, industrialization and urbanization. Increased efficiency of water use and demand management could meet the existing and future demand for fresh water. Wastewater / low quality water is therefore emerging as powerful Sewage is a type of waste water produced by a community of people (or domestic waste water or municipal waste water). Flow rate or quantity, physical state, chemical and toxic components and bacteriological status (which species it contains and what quantities it contains) describe it. It consists mainly of grey water (from drains, tubs, showers, dishwashers, and clothes washing machines), black water (the water used to flush toilets, combined with the human waste from which it flushes).

Kumar Ravi et. Al (2010) identified two treatment plants with activated sludge processes in Bangalore City. Wastewater treatment plants are built to extract from wastewater the biological and inorganic constituents that pollute human and environmental health. The findings concluded that, relative to BOD, COD and TSS, the treatment plants were all incapable of handling total dissolved solids. The order for both plants to be cut was TDSS [1].

Prerna Sharma et. Al (2013) performed a comparative study of three existing sewage treatment plants in the city of Chandigarh operating on various technologies. Chandigarh has a well planned and developed sewerage network for the transport of domestic waste water generated by the treatment plants, as described by the author. The Moving Bed Biofilm Reactor (MBBR), Activated Sludge Process and Up flow Anaerobic Sludge Blanket (UASB) are the technologies compared. The results concluded that the effluent parameters of STP with MBBR technology were within permissible limits and that the effluent water used in various sector gardens in Chandigarh for irrigation purposes was used. Effluent parameters were not within permissible limits for the other two STPs. TDSUASB > ASP is the order of removal efficiency of STP with UASB. [2]

Prachi N. Wakode et. Al (2014) conducted a study on the Sequential Batch Reactor (SBR) technology of the 25MLD domestic wastewater treatment plant located in Kalyan, Thane. As effluent is released into Ulhas River, the analysis is conducted to monitor the effluent parameters. The STP was studied for a time interval of three months. An on-site questionnaire was performed to research the STP. Thirty six samples were examined in total. Test sample collections were obtained from the inlet, circulation chamber and outlet. The findings showed that BOD's removal efficiency is 96 percent, TSS is 92.74 percent and total nitrogen is 75.67 percent and 71.79 percent for phosphate. The author concluded that the higher elimination efficiency is due to the aeration equipment's regular maintenance. [3]

With ozonation, Marcucci and Tognotti demonstrated with activated carbon filter is more effective in reducing COD It is more effective at removing bacteria while using UF. Yellowish colour effluent removed by ozonation could, however, be removed Not to be deleted by UF. [4]

Zheng et al., in 2009 worked on the impact of slow sand philtre on treatment of municipal wastewater before treatment with UF. Direct filtration, according to their findings, the secondary effluent used for UF contributes to rapid effects of Fouling, because of a great deal of secondary fouling in the about effluent. In waste water, the foulant compounds might be removed with a sluggish sand philtre, UFF dramatically enhanced Efficiency.

Biological Nutrient Removal Nowadays (BNR), is a very well-known approach and is typically accomplished by sludge processes that are enabled Anaerobic, anoxic and aerobic with selected the [5] circumstances. A number of improvements have been made in the past decade. Phosphorus Biological Removal (EBPR) Processes have been identified [6]. EBPR is an altered phase of activated sludge in that is followed by an initial anaerobic unit, followed by the effects of the aerobic cycling of activated sludge in biomass production, higher than that of biomass the natural content of phosphorus. [6,7,8].

Because of more stringent laws for Municipal secondary wastewater treatment, Municipalities are starting to incorporate in their wastewater processing, tertiary treatment its plants [9]. Tertiary therapy requires the elimination of Phosphorous or nitrogen, or both of them from until discharging the waste water in a Body of Water. In Romania nowadays, biological Therapy has become an increasingly popular therapy. The method used to generate the nutrients Wastewater removal [10].

II. MATERIALS AND METHODS

The treatment plant for wastewater under analysis is situated in the Campus of Abhilashi University, Himachal Pradesh, India. The warehouse Domestic and commercial sewage is stored. Description of main components waste water treatment plant is given in the table1.

Table1. Description of WWTP

Description	**No. of Units**	**Size/Specifications**
Treatment process		Tertiary Treatment
Total area covered by STP		11.95m x 9.351m
Capacity	1	150 KLD
Collection Tank	1	5.2m x 4m
Collection Tank for Laundry	1	1.2m x 3m
Coagulation Chamber	1	2.8m x 0.6m
Flocculation Chamber	1	2.8m x 0.9m
Clarifier	1	2.8m x 2.8m
BIO Reactor 1	1	1m x2.25m
BIO Reactor 2	1	1m x2.25m
Open able Checker Plate	1	1m x 1m
Chlorine Contact Tank	1	2.8m x 1.175m
Treated Water Tank	1	3.95m x1.175m

2.1 Treatment Methods at STP

2.1.1 pH:

The solution's pH refers to its behavior as a hydrogen ion. The reciprocal logarithm of conc. is also known as conc. of the ions in hydrogen.

$$PH = -\log [H] -\log [H] \qquad - (1)$$

The pH of the sample at STP is calculated using a digital pH meter. The selection is tested using pH paper or using different indicators such as Methyl orange, Phenol red, Methyl violet, Methyl red, etc. by colour comparison.

2.1.2 Methods of determination of solids in a waste water sample

The term solid refers to the material left out after the sample has been evaporated and subsequently dried at a given temperature (103-105 ° C) in an oven. No-filterable, filterable, non-volatile (inorganic) and volatile (organic) matters are included in the term.

• Total Solids Dissolved solids are obtained before evaporation by filtering the given sample. Through filtration, suspended residue is collected. The fixed residue reflects the remainder of the evaporated sample (total solids) after combustion for one hour at a time. Drying the oven and evaporating dishes such as glass, silica and porcelain can do this.

$$\text{Total solids mg/l} = \frac{\text{increase in weight in mg}}{\text{ml of sample taken}}$$

2.1.2.1 Suspended and dissolved solids (SS & DS)

Whatmann paper no 42 determines suspended and dissolved solids (SS & DS). The known volume of sample is taken in a dry dish and evaporated to a constant weight at 103 ° C (± 2) in an oven for dryness. It is permissible to cool and measure the dry dish after that.

$$\textit{Total dissolved solids mg/l} = \frac{mg\ of\ residue\ x\ 1000}{ml\ of\ sample\ taken}$$

Suspended solids mg/l = total solids (TS) **–** *total dissolved solids (TDS)*

Volatile and fixed solids are calculated by the desiccators and muffle furnace. The muffle furnace works at a temperature of 750±50 ° C. In this the residue obtained in total solids is ignited and weighted in desicator nod in the muffle furnace and cooled in dish.

$$\textit{Volatile solids} = \frac{loss\ on\ ignition\ \ (in\ mg) * 1000}{volume\ \ (ml) of\ sample\ evaporated}$$

$$\textit{Fixed solids} = \frac{residue\ \ (mg) on\ ignition\ * 1000}{volume\ \ (ml) of\ sample\ evaporated}$$

2.1.2.2 Determination of dissolved oxygen in liquid sample

For the determination of dissolved oxygen, Winkler's method is used in the laboratory. The sample is treated with manganese sulphate, sodium hydroxide, sodium iodide and sulfuric acid, respectively.

The initial manganese hydroxide precipitate, combined with the dissolved oxygen in the sample, forms a brown manganese oxide precipitate. Manganese oxide forms manganese sulphate upon acidification, which serves as an oxidizing agent to release iodine from NaI.

2.1.2.3 Determination of Biochemical Oxygen Demand (B.O.D)

BOD is the amount of oxygen that bacteria need for decomposable organic matter to be stabilized under aerobic conditions. The waste sample is incubated at 27 ° C in the dark for 3 days. The decrease in the concentration of DO during the incubation period gives a measure of the demand for biochemical oxygen. The test is carried out with the aid of the aerator and the incubator of the BOD.

In order to be saturated with dissolved oxygen, the test begins by preparing diluted water by aerating distilled water with a supply of clean compressed air. After that, as micro nutrients for bacteria, add 1 ml of each of the phosphate buffers, ferric chloride, calcium chloride and magnesium sulphate solution to one liter of distilled water. You should change the sample pH to 7. There are suggested dilutions of the following:

1) 0.1-1.0% for strong trade waste.
2) 1-5% for raw and settled sewage
3) 5-25% for oxidized effluent
4) 25-100% for polluted river water

By adding samples to the diluted water, the desired mixture is prepared. One bottle is held blank, and 300ml is filled with another. Hold one set at 27 ° C for 3 days in the BOD incubator. After that, the DO will automatically find out about the blank bottle. After incubation for 72 hours or 3 days, find the DO in both bottles.

BOD mg/l **=** $(D_1\text{-}D_2) – (B_1\text{-}B_2)$ x dilution factor

Where,
D_1 = DO of blank before incubation (1st day)
D_2 = DO of blank after incubation (3rd day)
B_1 = DO of diluted sample before incubation (1st)
B_2 = DO diluted sample after incubate (3rd)

2.1.2.4 Determination of chemical oxygen demand (C.O.D.)

Most kinds of organic matter are destroyed by a boiling mixture of chromic and sulphuric acids. A sample is refluxed with known concentrations of potassium dichromate and sulfuric acid and the remaining dichromate with ferrous ammonium sulphate is titrated. The amount of oxidizable organic matter, measured as oxygen-equivalent, is proportional to the amount of potassium dichromate ingested. The reflux device consists of a round bottom flask of 300 ml and condensers from Liebig.

Table.2 Quantity of Chemicals Required according to the Sample Size

Sample size	0.25N standard dichromate	Conc. H_2SO_4	$HgSO_4$	Normality of $Fe(NH_4)^2(SO_4)^2$	Dilution quantity after reflux
Ml	MI	N	g	N	ml
10	5	15	0.2	0.05	70
20	10	30	0.4	0.10	140
30	15	45	0.6	0.15	210
40	20	60	0.8	0.20	280
50	25	75	1.0	0.25	350

$$\text{COD in mg/l} = \frac{(B-S)*8000*N}{ml\ of\ sample\ taken}$$

Where,
B = ml of FAS used for blank
S = ml of FAS used for sample
N = Normality of FAS

III. RESULTS AND DISCUSSION

3.1 Characteristics of effluents and efficiency of Treatment Scheme

The parameters such as pH, DO, TSS, BOD and COD before and after treatment of the wastewater treatment plant (WWTP) in the campus of Abhilashi University was analyzed in this study. A reduction in the average values of pH, TSS, BOD and COD before and after treatment were found to be 15.04%, 74.92%, 93.73% and 79.79% respectively. Increase in the value of DO after treatment was found to be 58.36%. Average values of parameters before and after treatment was calculated and given in the table3.

Table 3. Characteristics of effluents and efficiency of treatment scheme

Parameters	Avg. Value before treatment	Avg. Value after treatment	Reduction of pollutant level [%]	Permissible limits as per HPPCB
pH	7.71	6.55	15.04	6.5-8.5
DO	3.04	7.3	58.36	4.8 mg/l
TSS	152.54	38.25	74.92	<30 mg/l
BOD	189.33	11.88	93.73	<250 mg/l
COD	370.33	74.83	79.79	<100 mg/l

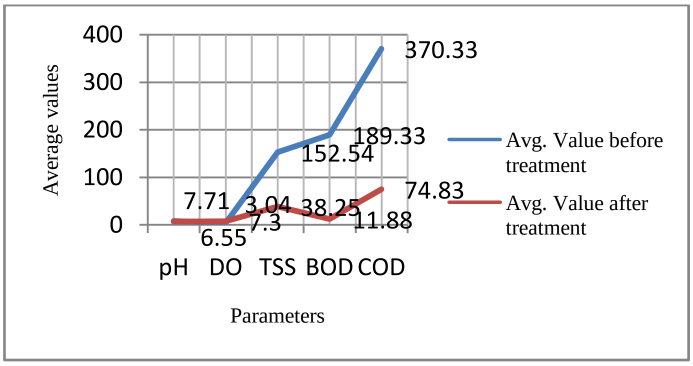

Figure1.Comparsion b/w values of parameters before & after treatment

3.2 Month Wise Analysis of Parameters of WWPT

Samples of Waste water from the treatment plant was collected month wise and analyzed and compared & trends show reduction in pH, TSS, BOD, COD and increased level of DO as shown in table2 and figure2.enhancement in the value of DO level is

Table4. Showing Avg. Value of various Parameter before and after Treatment

	Avg. Values Before Treatment					Avg. Values After Treatment				
Parameter / Month	pH	DO (mg/l)	TSS (ppm)	BOD (mg/l)	COD (mg/l)	pH	DO (mg/l)	TSS (ppm)	BOD (mg/l)	COD (mg/l)
Jan	7.89	3.27	153	177.5	357	6.95	7.15	35	11.5	69
Feb	7.84	2.95	151.5	188	316	6.54	7.32	39	11.75	79
March	7.88	2.9	154.75	193	386	6.41	7.20	41	11.75	79
April	7.71	3.07	153.5	195	383	6.5	7.42	43.5	12.25	71
May	7.7	2.85	145.5	192.5	366	6.64	7.37	36.5	11.75	73.5
June	7.23	3.17	151	190	354	6.56	7.23	34.5	12.25	80

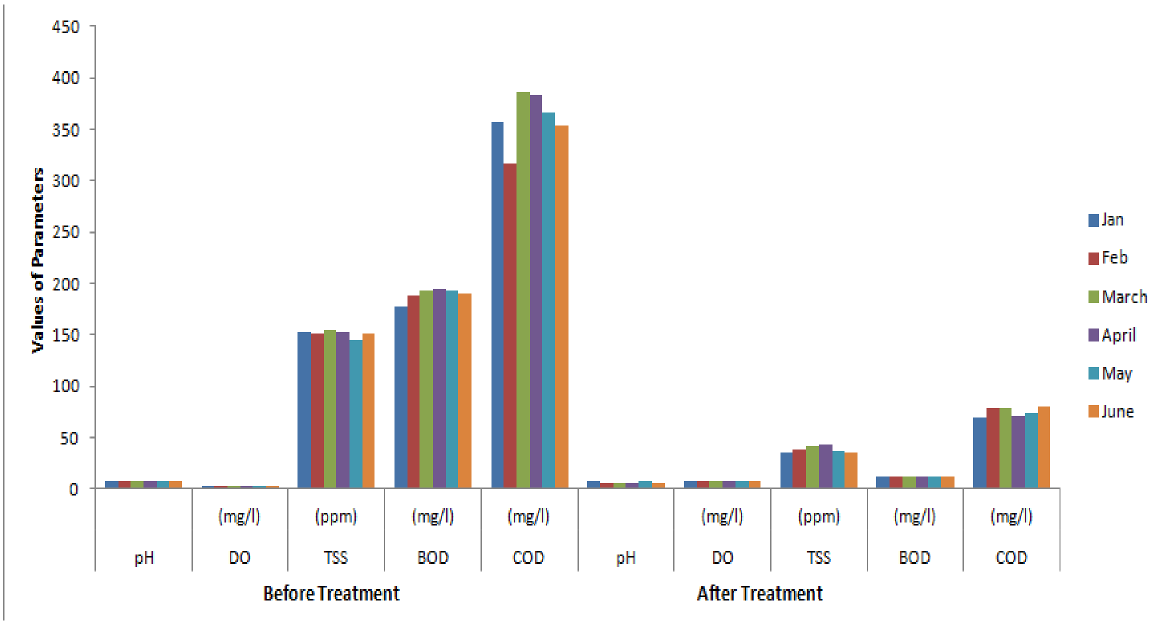

Figure 2.Avg. Value of various parameters per month before and after treatment

IV. CONCLUSIONS:

1. A reduction in the average values of pH, TSS, BOD and COD before and after treatment were found to be 15.04%, 74.92%, 93.73% and 79.79% respectively.
2. Increase in the value of DO after treatment was found to be 58.36%.
3. Trends show reduction in pH, TSS, BOD, COD and increased level of DO when waste water samples from WWTP were collected month wise from January to June

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