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Efficacy of Sewage Treatment Plant near Pokhribal Site of Nigeen Basin

Faizanul Mukhtar[a], Hamida Chisti[a], Nawaz Ahmad Mir[b] , Shabir Ahmad Bhat[b]

[a]*Department of Chemistry, National Institute of Technology, Srinagar, J&K, India,*
[b]*Department of Higher Education, Government of J&K, India*

Correspondence Author: Faizanul Mukhtar, *Department of Chemistry, National Institute of Technology, Srinagar, J&K, India*
E-mail: kufaizan78614@gmail.com

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Abstract

Water quality monitoring has been high priority to determine the current conditions of the water system. The present study has been undertaken to evaluate the performance of the Sewage Treatment Plant (STP) located near Pokhribal site of Nigeen basin. Sewage samples were collected and analyses were undertaken for raw sewage entering the STP and treated one discharged at the site. Various physico-chemical parameters were checked and the efficacy of the STP for many parameters was evaluated. . It was found that the efficiency of the STP in respect of turbidity was 63.52%, total hardness 7.10%, total alkalinity 22.81%, COD 71.98%, BOD 75.20%, Ca 17.64% etc.

Key words: Water quality, Sewage Treatment Plant, Pokhribal, Nigeen basin, Efficacy,

INTRODUCTION

Water is an essential component for the survival of life on earth, which contains minerals, important for humans as well as for earth and aquatic life. Waste water is a complex mixture of natural inorganic and organic materials mixed with man-made substances. It contains everything discharged to the sewer, including material washed from roads and roofs, and course where the sewer is damaged ground water will also gain entry. It is this complex mixture that ends up at the waste water treatment plant for purification. The main function of waste water treatment plants is to protect human health and the environment from excessive overloading of various pollutants. Sewage is the subset of waste water that is contaminated with feces and urine. The strength and composition of sewage changes on an hourly, daily and seasonal basis. Aims of waste water treatment are to convert the waste materials present in waste water into stable oxidizable end products that can be safely disposed off without any adverse ecological effects (Uzma and Rafiq 2102). Due to industrial development, domestic effluent and urban run-off contribute the bulk of waste water generated. Waste water can be splitted into domestic (sanitary) waste water also known as sewage, industrial (trade) waste waters and finally municipal waste water which is a mixture of the two (Metcalf et al. 1992). Municipal waste water is one of the largest sources of pollution. Municipal waste water normally receives treatment before being released into the environment. The higher the level of treatment provided by a waste water treatment plant, the cleaner the effluent and the smaller the impact on the environment. Despite treatment, some pollutants remain in treated waste water discharged into surface waters. Treated waste water may contain grit, debris, disease causing bacteria, nutrients and hundreds of chemicals such as those in drugs and in personal care products like shampoo and cosmetics. Nowadays, society demands that all processes, product and services must also be analyzed from the environmental point of view. Therefore it is necessary to analyze the system to determine the overall pollution associated to these activities (Tripathi et al. 1991). Rapid growth and urbanization of Srinagar city over past few years has given rise to innumerable problems. One of the major problems is the deterioration of water quality due to more or less unrestricted disposal of large volumes of domestic waste water.

Experimental

Sample collection and pre-treatment

The present work was carried on the sewage treatment plant near Pokhribal site of the Nigeen basin of Dal Lake situated between 34°9′N 74°87′E along geographical coordinates. The samples were collected from 8:00 A.M to 10:30 A.M both at the inlet and outlet components of the STP during the period from January 2017 to June 2017. In order to determine the water quality, samples were kept in plastic cans wrapped with carbon. All water samples were stored in insulated cooler containing ice and delivered on the same day to laboratory and all the samples were kept at 4^0C until processing and analysis.

Chemicals and reagents

Triple distilled water was used throughout the work. All chemicals and reagents were analytical grade, Merck (Darmstadt, Germany). Standard solutions of three elements (i.e. Ca, Mg and Na) were prepared by dilution of 1000 ppm certified standard solutions.

Analytical procedure

Turbidity

Turbidity of water samples were measured by two ways:

I) By making use of digital portable turbidity meters of WTW (Turb 430- IR) which gives the turbidity values directly after the scattering of light has taken place.
II) Nephelometric method:

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Principle:-
The turbidity of water samples was measured from the amount of light scattered by the sample taking a reference with standard turbidity suspension.

Apparatus and Reagents:-
1) Nephelometer (Turbidimeter)
2) Sample tubes
3) Stock turbidity suspension: 1.0 g of hydrazine sulphate, $(NH_2)_2$.H2SO4 was dissolved in distilled water to prepare 100mL of solution. 10.0 g of hexamethylenetetramine $(CH_2)_6$ N_4 was dissolved in distilled water to prepare 100 mL of solution. 5 mL each of the solutions prepared were mixed together in a 100 mL volumetric flask and then allowed to stand for 24 hours at 25°C. Then the resultant solution was diluted upto 100 mL mark. This was 400 NTU (Nephelometric Turbidity Unit) suspension.
4) Standard turbidity suspension: 40 NTU solution was prepared by diluting 10 mL of stock solution to 100 mL.

Procedure:-
1) The instructions supplied by the manufacturer were followed.
2) The instrument was set at 100 with 40 NTU standard suspension. Each division on the scale equals to 0.4 NTU turbidity.
3) The sample was thoroughly shaken and kept for some time to eliminate the air bubbles.
4) The sample was put in the Nephelometer sample tube and the value was found on the scale.

Calculations:-
Turbidity, NTU = Nephelometer reading × 0.4× dilution factor

Total Alkalinity
Alkalinity of water is its acid neutralizing capacity. Alkalinity of surface water is primarily a function of carbonate and hydroxide content.

Reagents:-
1) .02N H_2SO_4
2) Methyl orange, 0.05%: 0.5 g of methyl orange was dissolved 100 mL of distilled water.
3) Phenolphthalein indicator: 0.5 g of phenolphthalein was dissolved in 50 mL of distilled water of 95% ethanol and 50 mL of distilled water was added to it. 0.05N solution of free NaOH was added dropwise, until the solution turns fainty pink.

Procedure:-
1) 50 mL of sample was taken in a conical flask and two drops of phenolphthalein indicator was added to it.
2) The solution remained colourless upon titration against sulphuric acid i.e. the phenolphthalein alkalinity is zero, and hence total alkalinity was determined.
3) Few drops (2 to 3) of methyl orange were added to the sample and the titration was continued further until yellow colour changes to pink at the end point. This is total alkalinity.

Calculations:-

$$\text{Total Alkalinity} = \frac{(\text{mL} \times \text{N})\text{of } H_2SO_4 \times 50 \times 1000}{\text{mL of sample taken}}$$

Total Hardness
The total hardness of water reflects the sum total of alkaline metal cations present in it. The metal cations react with the indicator Eriochrome Black T (EBT) to form a complex of wine red colour at pH of 10. Ethylenediaminetetraaceticacid (EDTA) has strong affinity for the metal ions and therefore it forms new complex by breaking the complexes of the indicator.

Metal + Indicator → Metal – Indicator (complex)

Metal – Indicator + EDTA → Metal – EDTA + Indicator

Reagents:-
1) EDTA solution, 0.01M: 3.723 g of disodium salt of EDTA was dissolved in distilled water to prepare 1L of solution.
2) Buffer solution: i) Dissolved 16.9 g of ammonium chloride (NH_4Cl) in 143 mL of concentrated ammonium hydroxide (NH_4OH). ii) Dissolved 1.179 g of disodium EDTA and 0.780 g of $MgSO_4.7H_2O$ IN 50mL of distilled water. Both the solutions prepared were mixed and diluted to 250 mL with distilled water.
3) Eriochrome Black T indicator: 0.40 g of EBT was mixed with100 g of NaCl and grinded.

Procedure:-
1) 50 mL of sample was taken in a conical flask.
2) 1 mL of buffer was added to it.
3) 100-200 mg of EBT indicator was added till the solution turns wine red.
4) Titration of the resultant solution was carried against EDTA, till the colour changes from wine red to blue.

Calculations:-

$$\text{Hardness as} \frac{\text{mg}}{\text{L}}, CaCO_3 = \frac{\text{mL of EDTA used} \times 1000}{\text{mL of the sample}}$$

Phosphate
Phosphate was determined by using paqualab photometer of ELE International. Water test tablets (photometer grade) of palin test® were used in its determination. The wavelength of the photometer was set at 490nm.

Procedure:-
1) 10 mL of water sample was filled in a test tube.
2) To it one phosphate HR tablet was added after crushing properly.
3) The sample was vigorously shaken and allowed to stand for 10 minutes.
4) After that reading was taken from the photometer which gives percentage transmittance and corresponds to a particular concentration of phosphate in mg/L.

Biochemical Oxygen Demand
BOD is the measure of the degradable organic material present in a water sample.

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Principle:-
The method involves measuring the difference of the oxygen concentration of the sample and after incubating it for five days at 20°C.

Calculations:-
BOD, mg/L. = (D_o – D_5) × dilution factor

where,
D_o = Initial DO in the sample
D_5 = DO after five days

Chemical Oxygen Demand
COD is the measure of oxygen consumed during the oxidation of the oxidizable organic matter by a strong oxidizing agent. The instruments used for COD measurement are spectroquant NOVA-60 and spectroquant TR-320 of Merck. COD voils of Merck containing mercury(II)sulphate and sulphuric acid (3 mL total) were used and to it 3 mL of the sample water to be tested was put in it.

Procedure:-
1) 3 mL of the sample water was poured in the COD voils of Merck containing mercury(II)sulphate and sulphuric acid.
2) The contents in the cell were mixed vigorously.
3) The cell was heated at 148°C for 2 hours in spectroquant – TR 320.
4) After 2 hours the cell was removed and allowed to cool for 30 minutes.
5) Now the measurement of COD was carried in spectroquant- NOVA 60.

Calcium, Magnesium and Sodium
Calcium, magnesium and sodium were determined by Atomic Absorption Spectrophotometer (AAS) of Perkin Elmer Precisely, AAnalyst 800.
Atomic absorption utilizes the principle that each atom absorbs light at a specific wavelength. Therefore, at a specific wavelength the quantity of the absorbing element can be measured and is proportional to its concentration. A sample is aspirated into an air-acetylene (C_2H_2) or nitrous oxide (N_2O)-C_2H_2 flame. The molecules are atomized in the flame having a specific wavelength of light diverted through it. The atoms absorb light. The amount of light absorbed quantifies the amount of element present by use of Beer's law.

A=abc.

Where, A=absorbance
A=absorption coefficient for the absorbing species
b =length of light path
c=concentration

STATICAL ANALYSIS
RESULTS AND DISCUSSION

Table 1. Influent and effluent average concentrations of various water quality parameters of the STP

Parameter	Influent	Effluent
pH	7.24	7.69
EC (μScm^{-1})	638	654
Turbidity (NTU)	85	31
TDS (ppm)	321	359
Total Hardness (ppm)	352	327
Total Alkalinity (ppm)	355	274
DO (ppm)	0.6	2.4
COD (ppm)	282	79
BOD (ppm)	125	31
Total Phosphate (ppm)	4.7	0.8
Chloride (ppm)	42	48
Calcium (ppm)	34	28
Magnesium (ppm)	24	18
Sodium (ppm)	26	09

Table 2. Efficiency of the STP for various water quality parameters

Parameter	Efficiency (%)
Turbidity	63.52
T. Hardness	7.10
T. Alkalinity	22.81
COD	71.98
BOD	75.20
Phosphate	82.97
Calcium	17.64
Magnesium	25
Sodium	65.38

The present investigation reveals that mean value of pH increased from influent (7.24) to effluent (7.69). Usually sewage is acidic to a certain degree but this factor depends on the conditions of the sewage floated by the area (Grey 2004).The increase in pH depicts the geological features of the catchment area which can be attributed to the dissolved carbonate. The EC increases from 638 to 654 μScm^{-1}. The increase in conductivity may be attributed to the increase in TDS and some ions like chloride. The present investigation also revealed that the mean value of TDS increased from 321 to 359 ppm. Increased value of TDS could be related with the increased concentration of ions during the treatment process (Dessert et al 2001).Calcium and magnesium can be reduced by the addition of detergent phosphates. Major portion of the phosphate in sewage is derived from the detergents used, which contributes to lake eutrophication. Decrease in concentration could be attributed to the grit separation, sedimentation process and active uptake of Ca and Mg by microorganisms during treatment (Nathanson 2003).As the main contributors of the total hardness are Ca and Mg, so as their concentration decreases it leads to a corresponding decrease in its level from influent 352 ppm to effluent 327 ppm. Also the natural hardness of water depends on the geological nature of the drainage basin. One of the essential components in human diet is chloride which passes through the digestive system unchanged, thereby becoming one of the major components of raw sewage. It was revealed that the mean value of chloride increased from influent 42 ppm to effluent 48 ppm. Increase in the mean value could be attributed to the addition of chlorine compounds during treatment (Nageswara and Shruti 2002). The decrease in the sodium level concentration from influent to effluent (26 to 09 ppm) occurs during the treatment from raw to treated sewage due to the biological treatment that results in the active uptake of the respective ions from sewage. Dissolved Oxygen in the surface water is generated by photosynthetic organisms. The DO in the present study increases from 0.6 to 2.4 ppm which may be due to the biological treatment in the STP. DO is one of the important water quality parameters meant to ascertain the pollution level of a water body. Hence its fluctuations predicts the varying conditions in the water bodies (Jamie and Richard 1996). Biochemical Oxygen Demand represents the degree of biodegradable waste in water bodies. The study reveals that the mean value of BOD decreased from influent (125 ppm) to effluent (31 ppm). One of the important indicators of the water pollution is the Chemical Oxygen Demand. In the present study it was found that a reduction from influent (282 ppm) to effluent (31 ppm) occurs. It is described as the demand of oxygen by organic substances and chemical oxidizing agents .Phosphorous is often the limiting nutrient for plant growth, meaning it is in short supply relative to nitrogen. Phosphate that is bound to plant or animal tissue is known as organic phosphate. Phosphate that is not associated with organic matter is known as inorganic phosphate. Inorganic phosphate is often referred to as orthophosphate or reactive phosphate. This form of phosphate is most accessible to plants (Wanzel and Ekama 1997). In the present study it was found that the mean value of total phosphate decreased from 4.7 to 0.8 ppm.

CONCLUSION

The present study was under taken to check the efficacy of STP near Pokhribal site of Nigeen Basin of Dal Lake. Several water quality parameters like pH, EC, DO, BOD, COD, Chloride, Ca, Mg, Na, total alkalinity, total dissolved solids and total hardness were studied. Both the influents and effluents were analyzed and the efficacy of the STP for many physico-chemical parameters was checked. It was found that the efficiency of the STP in respect of turbidity was 63.52%, total hardness 7.10%, total alkalinity 22.81%, COD 71.98%, BOD 75.20%, Ca 17.64% etc. The study reveals that the STP has considerable efficiency and works as per standard established procedures.

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REFERENCES

American Public Health Association (APHA), 1998. Standard methods for the examination of water and waste water, 20th edition. Washington D.C.

Clesceri, L.S., A.E. Greenberg and A.B. Eaton. 1998. American Public Health Association (APHA), American Water Works Association (AWWA) and World Environment Federation (WEF), Washington D.C.

Dessert, C., B. Dupre, L. M. Francois, J. Schott, J. Gaillardet, G. Chakrapani, S. Bajpai. (2001). Erosion of Deccan traps determined by river geochemistry. *Earth Planet Science Letters* 188: 459-474.

Grey, N.F. 2004. Biology of waste water treatment, 2nd edition. Imperial College Press London.

Jamie, B. and B. Richard.1996. Water Quality Monitoring – A practical guide to the design and implementation of fresh water quality studies and monitoring programmes. UNEP/WHO.

Metcalf, Leonard, Eddy, Harrison. 1992. Sewerage and sewage disposal: A text book. New York: McGraw-Hill.

Nageswara, V.V. and D. Shruti. 2002. Performance of sewage treatment plants in Hyderabad-A case study. *Pollution Research* 21: 191-193.

Nathanson, J.A. 2003. Basic environmental technology: Water supply, waste management and pollution control. 4th edition, Prentice –Hall, New Jersey, USA.

Tripathi, B.D., M. Sikandar and C. Shulka. 1991. Physico-chemical characterization of city sewage discharged into river Ganga at Varanasi, India. *International Journal of Environment* 17:469-478.

Uzma, J. and S.K. Rafiq. 2102. Efficiency of sewage treatment plant, Hazratbal, Srinagar, Jammu and Kashmir, India. *Nature and Science* 11: 195-198.

Wenzel, M.C. and G.A. Ekama.1997. Principles in the design of single sludge activated sludge systems for biological removal of carbon, nitrogen and phosphorous Belgium. 4: 13-26.