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Efficiency of some sewage treatment plant of Srinagar city: A Brief study

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ABSTRACT

In present paper, we investigated the water samples taken from sewage treatment plant (STP) at Habak of famous Dal lake Srinagar (Jammu and Kashmir). Comparative analysis was carried out for inlet of the STP and outlet discharged into the Dal Lake. Some essential physico-chemical parameters like pH, electrical conductivity (EC), biochemical oxygen demand (BOD),chemical oxygen demand (COD),dissolved oxygen (DO),chloride (Cl^-),total alkalinity (TA),total hardness (TH),total solids (TS), total dissolved solids (TDS),total suspended solids (TSS) were studied. TS,TDS and TSS were determined by oven dry method, COD was determined by reflux digestion method, BOD was estimated by Azide modification of Winkler method, TA as $HCO3^-$,TH (Calcium, Ca^{2+}, Magnesium,Mg^{2+}) and Chloride (Cl^-), were estimated by standard titrimetry. For major and minor trace element (TE) determination, energy dispersive x-ray (EDAX) facilities attached to Scanning Electron Microscope (SEM) were employed. It was observed that the concentration of TS, TSS, TE, BOD and COD reduces but the Dissolved Oxygen (DO) increases after treatment at STP. It was found that the contents or proportions of most of the parameters (TS, TSS, TE, BOD and COD) decrease whereas the dissolved oxygen was found to increase after treatment. Various possibilities are explored vis a vis the current observed data.

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Introduction

The Geo-chemistry of water is due to the geology, weathering and erosional processes as well as anthropogenic inputs of catchment area or region. Generally, the chemical processes are chemical depletion of carbonate and silicate minerals by various mechanisms, such as dissociation, dissolution, hydrolysis, reduction and oxidation dynamics controlling world water chemistry (Gibbs RJ (1970). Directly most of the chemical reactions take place among silicates, carbonates and rainwater giving rise to different types of ions and clay minerals (Baudo *et al*1990). Therefore, the concentration of various chemical constituents in water depends on the availability of the parent mineral for a particular constituent and hence its dissolving capability.

Most of the world fresh water lakes are easy sites of agricultural, municipal and industrial waste- water discharges. As a result, they become deposits of various nutrients, sediments and associated heavy metals (Chakrapani GJ 2002). In addition, an unplanned rapid development in the lake surroundings with very narrow dispersion and high mobilization rates, the water quality of these lakes is decreasing throughout the globe and has become a direct threat to many life forms (Koussouris T et al,.1989 and Sujatha SD et al,. 2001)

Dal Lake is an urban type of lake and municipal and domestic effluents have directly polluted its surface-water composition, and have given rise to eutrophication. Also the excessive sedimentation rates, enhanced by extensive soil erosion due to deforestation and an encroachment by surrounding population have considerably reduced the lake area. This lake is a back bone resource for drinking water, irrigation, fisheries, recreation, tourism, etc. To preserve this beautiful fresh water lake, various remedial programs have been taken by the concerned authorities. One among them is the establishing of sewage treatment plants at various points of water entrances of the lake.

This research article examines the efficiency of one of the main Sewage treatment plants (STP's) located at Habak on the banks of Dal lake.

Materials and Methods

Dal Lake is one among the famous fresh water lakes of Asia, situated towards North-East of Srinagar city at an altitude of about 1,580 m above mean sea level. The lake lies between 34°6'N and 34°10'N latitude and 74°50'E and 74°54'E longitude and covers an area of about 11.50 km^2. This is a shallow lake with an average depth of around 6 meter. The present study was carried out on Sewage treatment plant, Habak, Srinagar situated between 34°8´N, 74°87´E geographical coordinates. Disposal site of treated sewage is Dal lake through open drainage system. This STP is mainly fed by two famous academic institutions (a) University of Kashmir (b) Unani Institute of Integrative Medicine and by other local residential areas like Habak, Zukura, Mallabagh, Naseem Bagh and Ilahibagh.

The samples were collected from inlet and outlet (receiving and discharging end) of STP. Water samples were collected for the month of March (maximum rainy month of the year) in plastic bottles between 10:00 a.m. and 12:00 p.m. The samples were then brought to the laboratory for various analysis.

The Standard methods as described by American public health association (APHA 1996) were adopted for the sample analysis.

Various important physico-chemical parameters analyzed for water samples included those of pH and EC (using Digital pH meter Systronic 130 model). TDS was determined by oven dry method and COD was determined by reflux digestion method. BOD was estimated by Azide modification of Winkler

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method. TA as $HCO3^-$, Calcium (Ca^{2+}), Magnesium (Mg^{2+}) i.e; TH and Chloride (Cl^-) were estimated by standard titrimetry.

For major and minor TE determination, inlet and outlet water samples were taken separately in a crucible dish and dried to ash in hot air oven, the obtained residue was analyzed by employing EDAX facilities attached to scanning electron microscope (SEM: Hitachi Japan Model 3000).

Results and Discussion

Fig.1a show the SEM micrograph and Fig.1b shows the EDAX spectrum of the TE's of inlet water sample of the understudy STP. The elements detected in it were Carbon potassium, calcium, magnesium, chloride, oxygen, sulphur and silicon. Fig.1c shows the percentage wise distribution of elements in the inlet water sample.

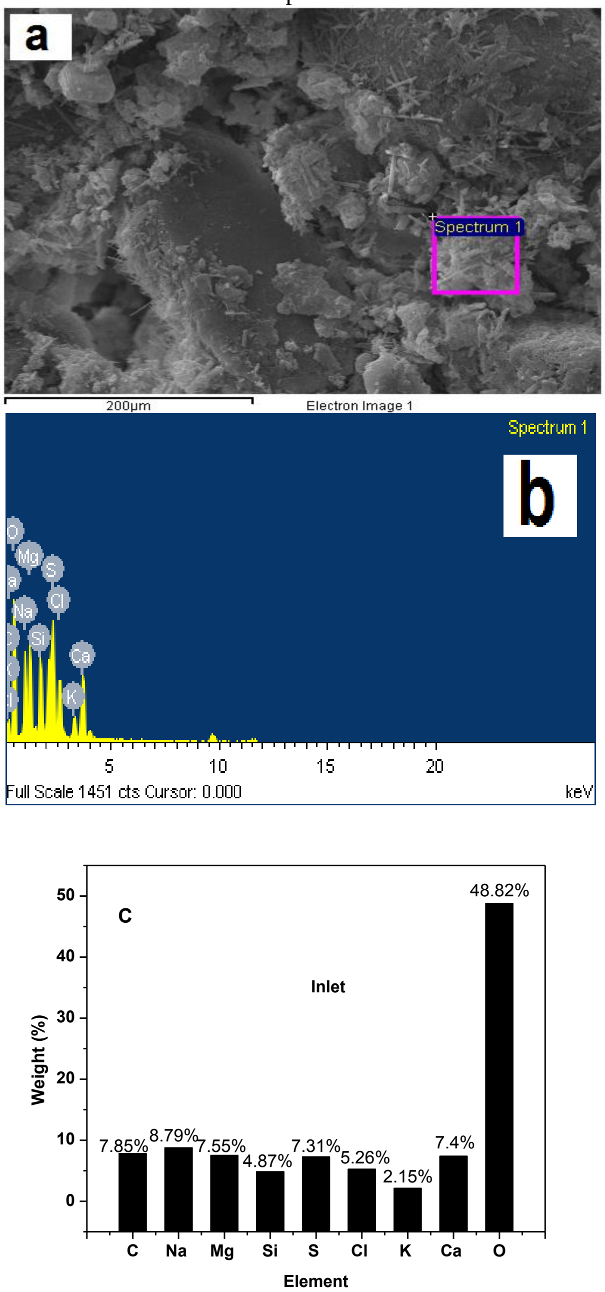

Fig.1 ***SEM, EDAX and ion distribution of inlet water***

Similarly, Fig.2a, Fig.2b and Fig.2c show the SEM micrograph, EDAX spectrum and percentage wise distribution of these elements in the outlet water sample respectively. By comparing the data of inlet and outlet water samples of the STP, a significant decrease is observed in most of the TE's (See Fig.1c and Fig.2c).

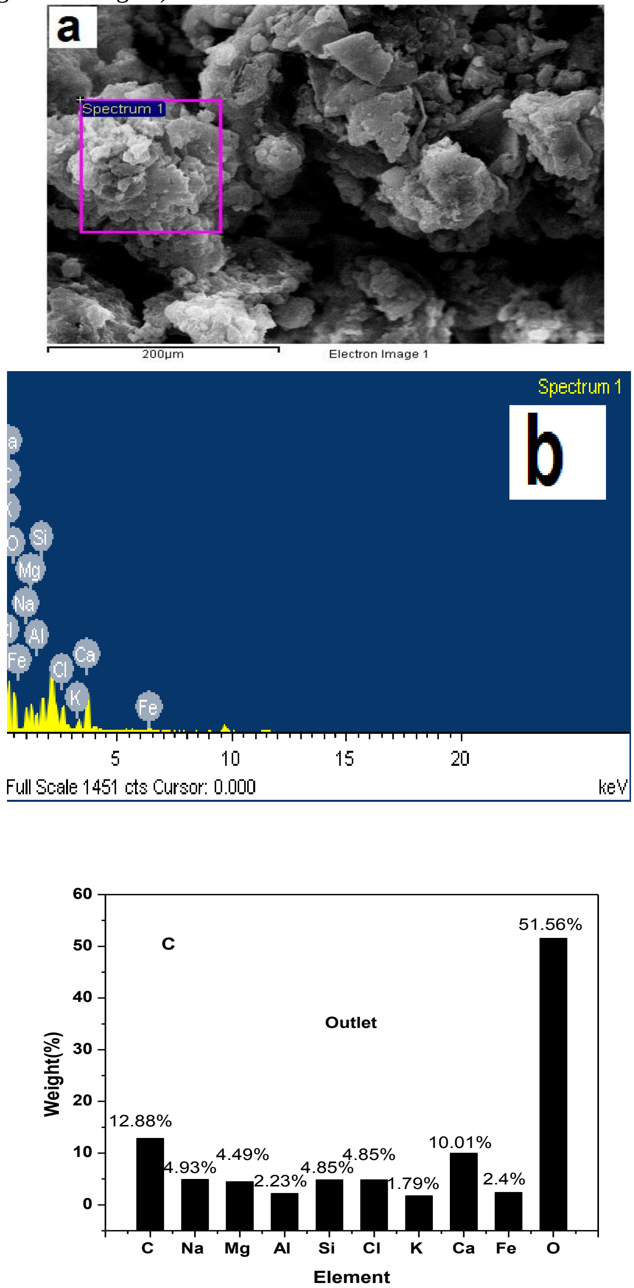

Fig.2 ***SEM, EDAX and ion distribution of outlet water***

Generally groundwater acquires its minerals mostly from the reactions between rainwater and host rocks (when it flows through them) with the passage of time (which may be days, months and years). This water-rock interaction is controlled by the residence time of the water and the mineralogy of the aquifer matrix. The modification or rectification of water chemistry in groundwater can occur through various processes (physical, chemical and biological). Anthropogenic activities including excessive use of agrochemicals, release of septic tank effluents and domestic wastes also have a significant impact on groundwater quality.

In our present study we observed that the pH of this STP enhances from inlet to outlet (Table I). Usually, sewage is acidic but this factor depends on the condition of the sewage floated by the area (Metcalf et al,. 1991, Gray, N.F., 2004). In addition, pH of water also depends upon numerous factors like aeration and biological activities. In maximum cases, natural water is alkaline due to large concentration of carbonates dissolved in it. In the present study,the observed alkaline range of pH is due to the geological features of the catchment, comprising a karewa bed, composed of calcium carbonate rocks and some other salts in high proportions. The visible enhancement of pH value in limestone regions is due to dissolved carbonates (Shapiro et al,. 1962).

The observed electrical conductivity increases from inlet to outlet. It should be noted that conductivity is a measure of total dissolved solids in the water. Therefore, increase in conductivity in the present study may be due to the increase in concentration of various electrolytes or levels of various anions and cations in the treated water. Also, there is a sudden rise in electrical conductivity during the summer season because electrical conductivity increases with increase in temperature. Electrolytic conductivity increases with temperature at a rate of 1.9 percent per ^{o}C (see Table I).

The DO in present study enhances after treatment (see table I). The DO in surface water is generated by photosynthetic organisms like plants and algae or directly due to exposure to air. However, in few cases the organic substances tend to reduce the DO in water. The measurement of DO is one of the basic parameters in water pollution studies as it represents the aerobic or anaerobic nature of biological activities in water bodies (Jamie et al. 1996). The enhancement in DO in the present case may be due to the biological treatment of STP (comprising of fluidized aerobic bioreactors).Also, DO is found to decrease in summer season which may adversely affect the biological degradation of organic waste by aerobic micro-organisms. The DO concentration depends on numerous parameters like chemical, physical and biochemical activities in the water body and its measurement is an indication of water quality. Therefore, its change predicts the varying conditions in the water bodies (Jamie et al. 1996).

A reduction in COD was also observed after treatment (see table I). This one of the essential parameters gives the amount of oxygen utilized by organic matter. Its measure indicates the oxygen content corresponding to that portion of the organic matter in water that is prone to oxidation under the test conditions. COD is one among the flag parameters which is an indicator of both biodegradable and non- biodegradable waste present in the water bodies. It is described by the demand of oxygen by organic substances and chemical oxidizing agents (Jamie et al. 1996).

The BOD was found to decrease after treatment (Table I). The value of BOD represents concentration of biological waste in the biodegradable organic waste in the water body. More the organic matter in the water, lesser is the oxygen concentration. The BOD represents the degree of biodegradable waste in the water bodies. Mostly the raw domestic sewage ranges between 320- 480mg/lt (Jamie et al. 1996).

The TH was found to decrease with treatment (see table I). The major cause of TH in water is due to some cations present there in. Calcium and Magnesium are the main cations responsible for TH of water. Carbonates and bicarbonates of calcium and magnesium also cause TH because due to hydrolysis they naturally change into these principle cations. One of the main reasons for natural hardness of water depends on geological nature of drainage basin of the region (Dessert et al, 2001).

The TA also decreases with treatment (see Table I). It is seen that the alkalinity of some water bodies is because of bicarbonates of calcium and magnesium. The natural as well as polluted water contains various kinds of salts such as carbonates, silicates, phosphates and borates which are inturn responsible for degrading the quality of water. As per our TE data, we got reduction in percentage of the ions in the treated water, so could be one of the essential reasons for reduction in alkalinity (Dessert et al, 2001).

It is observed that the chloride decreases from Inlet to outlet. Chloride is one of the important parts of human diet and is indigestible, hence becomes one of the major sources of raw sewage.

In addition, Chloride anions are mostly present in natural waters. Its raised level in water is due to the geological activities going on in the region. Its high level in water can cause corrosion in metals and is equally harmful to most trees and plants. However, a reduction in this parameter after treatment is a good gesture for aquatic ecosystem of the lake (Dessert et al, 2001).

A reduction in the TS was also observed after treatment (see Table I). Usually, TS give a measure of the suspended and dissolved solids in water. This parameter is also very essential for the water quality assessment. In present case, the decrease in TS could be due to the sedimentation process taking place during the treatment.

The TSS were found to reduce from Inlet to outlet after treatment (see Table I). These TSS include silt, clay, plankton, organic wastes and inorganic precipitates such as those from acid mine drainage. The best cause for reduction in TSS is due to sedimentation during the treatment.

Also it was observed that the TDS increase from Inlet to outlet (see Table I). Generally TDS consist of that substituents that penetrate through the water filter. They include some salts, organic materials, inorganic nutrients and toxins. Slight variation in TDS could be related to the change in concentration of ions during the treatment processes (Dessert et al, 2001).

Conclusion

The present study was taken to see the efficiency of sewage treatment plant (STP) Habak, Srinagar located on the banks of Dal lake. Various essential parameters like pH, electrical conductance, major and minor trace elements, biological oxygen demand ,chemical oxygen demand , Chloride (Cl^{-}), total alkalinity, total dissolved solids, total suspended solids, total hardness and total solids were studied. It was found that the concentrations or proportions of most of the parameters (TS, TSS, TE, BOD and COD) decrease whereas the Dissolved Oxygen was found to increase after treatment. The present water contamination of these catchment areas is due to the intensive agricultural cultivation and relatively high concentration of nutrients in the soil or water. These areas fall under the high-density residential areas and farming communities. The elevated nutrient levels can, therefore, be attributed to the use of chemical fertilizers and other agro-products. For Trace elements, the geo-chemistry of the region is one of the essential factors causing nutrient bloom.

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Table I. Various parameters of influent and effluent water samples of the STP

Parameters	Winter(Dec-Jan 2012-13)		Summer(july 2012)	
Sample specification	Influent	Effluent	Influent	Effluent
Air temperature(^{o}C)	10		31	
Water temperature(^{o}C)	5	6	18	19
pH	7.5	7.8	7.3	7.6
Turbidity(NTU)	97	34	112	53
Electrical conductivity(μS/cm)	555.71	558.57	630	642.85
BOD(mg/l)	101	18	198	34
COD(mg/l)	364	80	388	91.5
Chloride(mg/l)	48.28	32.66	68	42
Residual Chlorine	0	0.1	0	0.5
Total Phosphate(PO_4-P)	2.0	0.91	2.88	1.41
Ammonical Nitrogen	10.6	8.1	14.55	9.98
Dissolved oxygen(mg/l)	0.8	2.5	0.5	1.9
Total alkalinity(mg/l)	330	275	380	355
Total hardness(mg/l)	235	233	310	300
Total solids(mg/l)	800	600	927	751
Total dissolved solids(mg/l)	389	391	441	450
Total suspended solids(mg/l)	411	209	486	301

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