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Study of Physico-Chemical Parameters of effluents of Baidyanath Industry

M. S. Wagh, R. A. Tule, N. Thakur.
Department of Chemistry, Kamla Nehru Mahavidyalaya,
Dist. Nagpur (M. S.), India.

Abstract:
Physico-chemical analysis of Waste Water of Baidyanath of Nagpur Tehsil, District Nagpur has been studied, All the samples were analyzed to assess the water quality parameters like Temperature, Physical appearance, Odor, Turbidity, pH, Chloride, Total hardness, Permanent hardness, Total Dissolved Solids, Sulphate, Total alkanity, Dissolved Oxygen, B.O.D, C.O.D. It was found that most of the parameters are within the permissible limit as described by W.H.O. (1978) except Chloride content.
Keyword: Physico-chemical parameters, B.O.D, Total Dissolved Solids, Electrical conductivity, Total Alkalinity (TA), Total Hardness (TH)

Introduction

Natural resources are the important wealth of our country, water is one of them. Water is a wonder of the nature. “No life, without water” is a common saying depending upon the fact that water is one of the naturally occurring essential requirements of all life supporting activities.[1] Since it is a dynamic system, containing living as well as nonliving, organic, inorganic, soluble as well as insoluble substances. So its quality is likely to change day by day and from source to source. Any change in the natural quality may disturb the equilibrium system and would become unfit for designated uses. The availability of water through surface and groundwater resources has become critical day to day. Only 1% part is available on land for drinking, agriculture, domestic, power generation, industrial consummation, transportation and waste disposal.[2] In India, most of the population is dependent on surface water (damp water) as the only source of drinking water. The groundwater is believed to, be comparatively much clean and free from pollution than surface water. But prolonged discharge of industrial effluents, domestic sewage and solid waste dump causes the groundwater to become polluted and created health problems. [3] The rapid growth of urban areas has further affected groundwater quality due to over exploitation of resources and improper waste disposal practices. Hence, there is always a need for and concern over the protection and management of surface water and groundwater quality .[4] Heavy metals are priority toxic pollutants that severely limit the beneficial use of water for domestic and industrial application.[5] The lakes have complex and fragile, ecosystem, as they do not have self cleaning ability and therefore readily accumulate pollutants .[6]The physico-chemical parameters and trace metal contents of water samples from Delhi were assessed.[7] The consequence of urbanization and industrialization leads to spoil the water. For agricultural purposes ground water is explored in rural areas especially in those areas where other sources of water like dam and river or the canal is unavailable. During the last decade, this is observed that the surface water get polluted drastically because of increased human activities.[8-10] Nagpur city (district Nagpur) which is situated in the heart of the nation in Maharashtra (Vidharbha region) has become an important city because of the natural resources available around it. There are various existing industries and industrial estates. These industries use huge quantity of water for processing and release most of the water in the form of wastewater. The wastewater being generated is discharged into the nearby water resources. Similarly, the geo-chemical and morphological structural changes due to weathering may also leached out some chemicals/ minerals from the geostatic into surface and groundwater and may change the original characteristics of water which could be rather harmful to human health after consumption. The people are using open well water, tube well water, canal water, lake water as well as municipal water for their daily need. Hence, it is very essential to maintain the quality of surface water for human consumption, for the aquatic life and for other subsequent uses. Considering the above aspects of surface water contamination, the present study was

undertaken to investigate the impact of the surface water quality of some river and other bodies of surface water samples from effluents of Baidyanath industry. Thus, in this research work an attempt has been made to assess the physical and chemical parameters of surface water like, Temperature (T), pH, Electrical conductivity (EC), Total dissolved solids (TDS), Turbidity, dissolved oxygen (DO), Total Alkalinity (TA), Total Hardness (TH), Magnesium (Mg^{2+}), Sodium (Na^{+}), Potassium (K^{+}), chloride (Cl^{-}), Fluoride (F^{-}), Nitrate (NO^{-3}) Sulphate (SO_4^{2-}) and phosphate (PO_4^{3-}) was determined. The analyzed data were compared with standard values recommended by WHO. [11] Waste water from manufacturing or chemical processes in industries contributes to water pollution. Industrial waste water usually contains specific and readily identifiable chemical compounds. During the last fifty years, the number of industries in India has grown rapidly. But water pollution is concentrated within a few subsectors, mainly in the form of toxic wastes and organic pollutants. Out of this a large portion can be traced to the processing of industrial chemicals and to the food products industry. In fact, a number of large- and medium-sized industries in the region covered by the Ganga Action Plan do not have adequate effluent treatment facilities. Most of these defaulting industries are sugar mills, distilleries, leather processing industries, and thermal power stations. Most major industries have treatment facilities for industrial effluents. But this is not the case with small-scale industries, which cannot afford enormous investments in pollution control equipment as their profit margin is very slender.

2.1 MATERIALS AND METHODS

2.1.1 Sample area and sampling points:-

Wastewater samples were collected from the Baidyanath industry for the analysis of physicochemical parameters. Measurement points for the sampling were designated as A to D. Wastewater samples were collected from the industry designated as A i.e. Untreated wastewater (UW), another sample which was also from the industry designated as B i.e. Treated wastewater (TW), Wastewater collected from 500meters away from Baidyanath industry designated as C and Wastewater collected from 1000 meters away from Baidyanath industry designated as D.

2.1.2 Sample Collection

Wastewater samples were collected in plastics containers previously cleaned by washing in non-ionic detergent, rinsed with tap water and finally rinsed with de-ionised water prior to usage. During sampling, samples bottles were rinsed with sampled water three times and then filled to the brim at a depth of one meter below the waste water from each of the four designated sampling points (A to D).The samples were labeled and transported to the laboratory. Samples were collected in the month of February 2014.

2.2 EXPERIMENTAL METHODS

Physico-chemical parameters of these samples were determined by using standard procedures.[12]

2.2.1 pH: pH is termed as negative logarithm of the H ion concentration. The pH is determined by Eli co, digital pH meter which gives direct values of pH.

2.2.2. Conductivity: The conductivity is determined by using digital conductivity meter. The Electrical Conductivity (EC in µS/cm) of the water samples was obtained by immersing the electrodes in a well-mixed sample.

2.2.3. Temperature: The instrument was immersed in a thoroughly shaken water sample and the readings (in ^{0}C) were noted down. Air temperature was obtained using Mercury thermometer.

2.2.4. Turbidity: Turbidity can be determined by using turbidity meter. The results were expressed in term of Nephelometric turbidity units (NTU).

2.2.5. Total dissolved solids: Total dissolved solids were determined by evaporating the waste samples to dryness. In this method 50 ml of sample were transferred to the previously weighed china dish, and it is evaporated to dryness by heating for 1-2 hours at 180 °C to a constant weight.

2.2.6. Total Suspended Solids (Non-Filterable Solids): The total suspended solids were determined according to the method described.[37] Cleaned crucible with filter paper was ignited to constant weight in an oven ($W1$). Then 25 ml sample was taken and filtered through the crucible. Then the crucible was dried at constant temperature of 103 °C for 24 hours. Then it was cooled in a desicator and weight was noted ($W2$).

2.2.7. Hardness:

Total Hardness: 25 ml of the well-mixed sample was taken in a conical flask; 2 ml of buffer solution was added followed by 1 ml of inhibitor. A pinch of eriochrome black T was added and titrated immediately against 0.01 M EDTA till the wine red colour changes to blue.

Simultaneously a blank reagent was run in the similar manner.

Calcium Hardness: 25 ml of the well-mixed sample was taken in a conical flask, 1 ml of sodium hydroxide was added to raise the pH to 12.0 followed by addition of murexide indicator and titrated immediately with EDTA till the pink colour changes to purple. Simultaneously a blank reagent was run in the similar manner. The volume of EDTA consumed for total hardness and calcium hardness were noted down.

2.2.8. Alkalinity : The alkalinity of water sample is determined by titrating it against standard acid solution using indicators like phenolphthalein and methyl orange.

2.2.9. Density: The density of each sample was determined according to the method described by Eldardiri .Using density bottle of 25 ml volume. The density bottle was ignited in an oven at 115 °C for 10 min then transferred to desiccators and cooled and its Weight was recorded. After that the density bottle was filled by each samples and reweighed.

2.2.10. Dissolved Oxygen and Biochemical Oxygen Demand : Wrinkler's method was followed for the analysis of DO and BOD

2.2.11. Sulphate Content : Sulphate content in the water sample is determined by colorimetric method.

2.2.12.Chloride Content : The chloride content in the water sample is determined by titrating the water sample against 0.0141N silver nitrate solution using potassium chromate as an indicator.

RESULTS AND DISCUSSION

All the physico-chemical parameter was carried out on the Baidyanath wastewater samples. Four samples of wastewater were collected in the month of February 2014 as follow.

Sample A Untreated wastewater (UW),

Sample B treated wastewater (TW),

Sample C Wastewater collected from 500meters away from Baidyanath industry and

Sample D Wastewater collected from 1000 meters away from Baidyanath industry.

In this study, water quality of the Baidyanath industry was investigated with respect to standard parameters. The results are presented in the following tables.

Table 1. Physical Parameters of Effluents

Sr.no	PARAMETERS	SAMPLE A	SAMPLE B	SAMPLE C	SAMPLE D
1	Temperature	30^{o}C	25 ^{o}C	25^{o}C	24^{o}C
2	Turbidity	162.8 NTU	125.6 NTU	16.9 NTU	14.1 NTU
3	Conductivity	1.4792 m/□	3.4056 m/□	0.3956 m/□	0.3784m/□
4	Colour	Blackish brown	Yellowish	grayish	grayish

Table 2: WHO Standard for Discharge of Industrial Effluent

Sr.no	Parameters	Desirable limits
1	Temperature	43.3^{o}C
2	pH	06-10
3	Turbidity	-
4	Conductivity	-
5	Total Alkalinity	-
6	Total Hardness	-
7	Calcium Hardness	-
8	Magnesium Hardness	-
9	D.O	-
10	COD	125mg/L
11	BOD	25mg/L
12	Total solids	-
13	TDS	1500mg/L
14	TSS	150mg/L

15	Chloride	-
16	Sulphate	1mg/L

Table 3 **Indian Standard for Discharge of Industrial Effluents**

Sr.no	Parameters	Desirable limits
1	Temperature	-
2	pH	6.8-7.1
3	Turbidity	-
4	Conductivity	-
5	Total Alkalinity	-
6	Total Hardness	-
7	Calcium Hardness	-
8	Magnesium Hardness	-
9	D.O	-
10	COD	799-1002mg/L
11	BOD	176-210mg/L
12	Total solids	-
13	TDS	1043-1293mg/L
14	TSS	1160-1380mg/L
15	Chloride	250mg/L
16	Sulphate	-

1. Temperature:-
Temperature is basically important as it affects many chemical and biological reactions taking place in water and aquatic organism. In the present study, Temperature of sample A i.e. Untreated wastewater was found to be 30 ^{o}C. Temperature of sample B i.e. treated wastewater was found to be 25 ^{o}C. Temperature of sample C which is from 500 m away from the Baidyanath industry was found to be 25 ^{o}C. Temperature of sample D which is from 1000 m away from Baidyanath industry was found to be 24 ^{o}C.

2. pH: - The higher range of pH indicates higher productivity of water.[39] .pH of sample A i.e.untreated wastewater of Baidyanath was found to be 4.53. pH of sample B i.e. the treated wastewater of Baidyanath was found to be 6.16. pH of sample C which 500 m away from Baidyanath was found to be 7.36. pH of sample D which is 1000 m away from Baidyanath was found to be 7.53.

3. Dissolved Oxygen:- Dissolved oxygen is one of the important parameter in eater quality assessment. Its presence is essential to maintain variety of forms biological life in water and the effects of waste discharge in the water body largely determine by the oxygen balance of the system. In the present study, dissolved oxygen in all samples was found to be absent.

4. Conductivity: - Electrical conductivity (EC) is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salts [40]. In the presence study, Conductivity of sample A i.e. the untreated wastewater of Baidyanath was found to be 3.4056 m/Ω. Conductivity of sample B i.e. the treated waste water of Baidyanath was found to be 1.4792 m/Ω. Conductivity of sample C which is 500 m away from Baidyanath was found to be 0.3956 m/Ω. Conductivity of sample D which is 1000 m away from Baidyanath was found to be 0.3784 m/Ω.

5. Total Dissolved Solids: - Total dissolved solids indicate the salinity behavior of groundwater. Water containing more than 500 mg / L of TDS is not considered desirable for drinking water supplies, but in unavoidable cases 1500 mg / L is also allowed [41]. In the present study, Total dissolved solids of sample A i.e. the untreated wastewater of Baidyanath was found to be mg / L. total dissolved solids of sample B i.e. the treated wastewater of Baidyanath was found to be mg / L. Total dissolved solid of sample C which is 500 m

away from Baidyanath was found to be mg / L. Total dissolved solid of sample D which is 1000 m away from Baidyanath was found to be mg / L.

6. Chloride:- Chloride concentration in water indicates the presence of organic waste in water, primary of animal origin. It increases with ammonia cal nitrogen which also owes itself mostly on animal excreta. In the present study, chloride of sample A i.e. untreated waste water of Baidyanath was found to be 1004.68 mg / L. Chloride of Sample B i.e. the treated waste water was found o be 729.77 mg / L. Chloride of sample C which is 500 m away from Baidyanath was found to be 9.9969 mg / L. Chloride o sample D which is 1000 m away from Baidyanath was found to be 34.9891 mg / L.

7. Turbidity:- Turbid water is undesirable from aesthetic point of view in drinking water supplies and also may affects product in industries. Turbid water also pores a number of problems in water treatment plants. Therefore at water works, the turbidity measurement is useful in monitoring in proper filtrations and to determine the effectiveness of treatment processes with different dosage of chemical. In the present study, Turbidity of sample A i.e. the untreated waste water of Baidyanath was found to be 125.6 NTU. Turbidity of sample B i.e. the treated waste water o Baidyanath was found 162.8 NTU, Turbidity of sample C which is 500 m away from Baidyanath was found to be 16.9 NTU. Turbidity of sample D which is 1000 m away from Baidyanath was found to be 14.1 NTU.

8. Total Hardness: - Hardness is the property of water which prevents the lather formation with soap and increases the boiling points of water [42]. Hardness of water mainly depends upon the amount of calcium or magnesium salts or both. Water hardness is an important property, which determines its utility for domestic and industrial activities. The range of hardness is 300 mg / L according to the WHO standard permissible limit for drinking water. Hardness may vary over a wide range. The disposal sewage and industrial wastes are also important source of calcium usually prevalent (up to 70%); although in some cases magnesium hardness can reach 50-60%. In the present study, Total hardness of sample A i.e. the untreated wastewater of Baidyanath was found to be 2832 as CaCO3 mg / L. Total hardness of sample B i.e. the treated waste water of Baidyanath was found to be 1628 as $CaCO_3$ mg / L.Total hardness of sample C which is 500 m away from Baidyanath was found to be 76 as $CaCO_3$ mg / L. Total hardness of sample D which is 1000 m away from Baidyanath was found to be 52 mg / L.

9. Sulphate:- Sulphate ions usually occur in natural water. Many sulphate compounds are readily soluble in water ingestion of water containing high concentration of sulphate can have laxative effect which is enhanced when sulphate is consumed in combination with magnesium. Taste-threshold concentration for the most prevalent sulphate salt are 200-500 mg / L for sodium sulphate, 250-900 mg / L for calcium sulphate ,and 400-600 mg / L for magnesium sulphate. Essentially on the basis of above values, a guideline value of 400 mg / L is proposed. In the present study, sulphate of sample A i.e. the untreated wastewater was found to be 122 mg / L. Sulphate of sample B i.e. the treated wastewater was found to be 311 mg / L. Sulphate of sample C which is 500 m away from Baidyanath was found to be 161 mg / L. Sulphate o sample D which is1000 m away from Baidyanath was found to be 133 mg / L.

10. Chemical Oxygen Demand (COD):- COD is measure o the oxygen required for chemical oxidation of organic matter. This also provides a direct measure state of pollution in water bodies. It is an important, rapidly measured parameter as a means of measuring organic strength for streams and polluted water bodies. The COD values in the present study, COD of sample A i.e. the untreated wastewater of Baidyanath was found to be 148 mg / L. COD of sample B i.e. the treated wastewater of Baidyanath was found to be 200 mg / L, COD of sample C which is 500 m away from Baidyanath was found to be 40 mg / L. COD of sample D which is 1000 m away from Baidyanath was found to be 32 mg / L.

11. Biological Oxygen Demand (BOD):- BOD of sample A i.e. the untreated wastewater of Baidyanath was found to be 49.38 mg / L. BOD of sample B i.e. the treated wastewater of Baidyanath was found to be 66.69 mg / L. BOD of sample C which is 500 m away from Baidyanath was found to be 13.33 mg / L. BOD of sample D which is 1000 m away From Baidyanath was found to be 10.66 mg / L.

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