A report
on
project work

Water quality survey of different local water sources of Pattamundai block

MARCH 2021

DEPARTMENT OF CHEMISTRY
PATTAMUNDAI COLLEGE
PATTAMUNDAI

Project on

WATER QUALITY SURVEY OF DIFFERENT LOCAL WATER SOURCES OF PATTAMUNDAI BLOCK

BACHELOR OF SCIENCE

In

CHEMISTRY

2020-21

DEPARTMENT OF CHEMISTRY

PATTAMUNDAI COLLEGE

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REPORT

A project on **"Water quality survey of different local water sources of Pattamundai block"** was undertaken by students of chemistry department during the month January to February 2021. Nine numbers of students participated in the project work. They collected five waste water samples from the different area of Pattamundai locality and estimated various parameters like total Iron, pH, total hardness and analysed the values to assess the quantity of these parameters and eutrophication level in the collected samples. The experimental part was done in the laboratory of the chemistry department. The project work was guided by all the departmental teachers which were highly satisfactory.

21/03/2021

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Contents

Introduction:

For the existence of life, water is the most important constituent. So it's the responsibility for scientific society to find out optimized values for various parameters for better quality of water. Water quality is determined by variables like temperature, transparency, turbidity, water colour, carbon dioxide, pH, alkalinity, hardness, unionized ammonia, nitrite, nitrate, primary productivity, BOD, plankton population etc. Dissolved iron in water, causes the water to taste metallic". Even though the environmental protection agency (EPA) says that the iron in the drinking water is safe to drink, the iron sediments, other trace impurities may support bacteria that are harmful. An easy, efficient and safe method was developed to determine iron in water samples.[1]

Water quality is determined by various physico-chemical and biological factors as they may directly or indirectly affect its quality and consequently its suitability for the distribution and production of fish and other aquatic animals. Many workers have reported the status of water bodies (lentic and lotic) after receiving various kinds of pollutants altering water quality characteristics (physical, chemical and biological). All living organisms have tolerable limits of water quality parameters in which they perform optimally. A sharp drop or an increase above these limits has adverse effects on their biological functions. The role of various factors like temperature, transparency, turbidity, water colour, carbon dioxide, pH, alkalinity, hardness, ammonia, nitrite, nitrate, primary productivity, biochemical oxygen demand (BOD), plankton population etc. can't be overlooked for maintaining a healthy aquatic environment. [2-5]

Fast population growth, urbanization and industrialization have imposed pressure on the natural resources. The disposal of industrial effluent into the water bodies without adequate treatment is the major cause of the environmental pollution (Mc Laughlinet al., 1999). Apart from the metal manufacturing industries, metal waste recycling is being carried out on the banks of river Brahmani at Angul. The waste is being dumped into the ground and in the drains without any treatment. Considering the non-judicious disposal of wastes, the environmental monitoring of this region becomes very necessary for both quality and quantity of water limits and its usage. Polluted water can be a serious threat to human health (Rawatand Arora, 1986). Urbanization and conventional landfills leads to deterioration of the groundwater quality and poor drainage system impairs the surface water quality. (Sinha and Kumar 2006) have carried out trace metal monitoring in Gangan river water system. The river water was found to be excessively contaminated with copper, lead and iron.

In the drinking water supply, iron (II) salts are unstable and are precipitated as insoluble iron (III) hydroxide which forms as a rust coloured sediment". When water is directly pumped from the well, the water may contain iron (II) at concentrations of up to several milligrams per liter without any colour or turbidity. When the iron levels are more than 0.05-0.1 mg/L turbidity and colour develops in the pipe system. If the concentration is more than 0.3 mg/L staining of laundry and water systems may be damaged. Iron also promotes undesirable bacteria growth within a water works and distribution system because of large deposition of iron minerals on piping. [6-11]

Iron is the fourth most abundant element making up 5.6% of earth's crust. Iron contamination of water can either be geogenic or via industrial effluents and domestic wastes. Iron containing water after reacting with tea and coffee appears inky black (Colter and Mahler, 2006). Iron is an essential element for haemoglobin, myoglobin and a number of enzymes and its deficiency lead to anaemia and loss of well-being. However, its overload causes severe health problems in human beings such as liver cancer, diabetes, cirrhosis of liver, heart diseases and infertility etc. The presence of higher concentrations of iron changes colour, taste, odour of water, leaving stains on clothes and corrodes water pipelines (Behera et al., 2012). [12, 13]

In the present study, the water quality has been assessed with respect to iron contamination by real time profiling and also by interaction with local population. Before starting the water sample collection for real time profiling and interaction with local population, the location of industries, drainage system and river bodies were thoroughly studied. The objective behind carrying out both the quantitative estimation of water in the laboratory and qualitative assessment of water quality through interaction with local population is to have data from nine sources of Pattamundai block which complement each other in highlighting the same problem of poor water quality with respect to iron contamination.

Iron is one of the most important constituent of blood in human and other living organism. Iron is an essential element for human nutrition and metabolism, but in excess quantities results in toxic effect like hemochromatosis in tissues. The maximum permissible limit of iron in drinking water is 0.3 ppm. (P.Tambekar 2013)[14-17]

Water hardness is the traditional measure of the capacity of water to react with soap, hard water requiring considerably amount of soap to produce lather. Hardness is one of the very important properties of ground water from utility point of view for different purposes. In the present study water was very hard and crossed the permissible limits. It is well known that hardness is not caused by a single substance but by a variety of dissolved polyvalent metallic ions, predominantly calcium and magnesium cation, although other cation likes barium, iron, manganese, strontium and zinc also contribute. The high concentration of total hardness in water samples may be due to dissolution of polyvalent metallic ions from sedimentary rocks, seepage and run off from soil. As we know calcium and magnesium, are the two principal ions causing hardness. The concentration of total hardness in drinking water sources ranged between 75 and 1110 mg/L (Nawlakhe; 1995)7, (Sastry *et al*) also reported water samples from ponds, wells and hand pumps were very hard ranging from 222.8-1094.4 mg/L. In old Anaj Mandi Area tube well and well water showed high concentration of total hardness. [18]

Total Hardness: Total hardness is defined as the sum of calcium and magnesium hardness in mg/L as $CaCO_3$.TotaL hardness in fresh water is usually in the range of 15 to 375mg/L as $CaCO_3$. Calcium hardness in freshwater is in the range of 10 to 250 mg/L often double that of magnesium hardness (5 to 125 mg/L) and total hardness of 6630 mg/L as $CaCO_3$. A high concentration of hardness may be due to leaching from of the soils or due to the high background concentration of the waters. WHO permissible limit for total hardness of water is 150 mg L^{-1} and ISI desirable limit was 300 mg L^{-1}. Suggested that the values between 150 and 300 mg L^{-1} of total hardness means the water was hard, and total hardness greater than 300 mg L^{-1} means the water is very hard. High concentration of hardness may cause the problem of heart disease and kidney stones. [19,24-39]

Objective of the work: The water samples of different locality of Pattamundai block around the periphery of Pattamundai College were collected. A total of nine samples were collected and the iron content, total hardness and pH was determined and analyzed to know the pollution level of water.

Materials and Method:

The pH of the water samples was measured by using a pH meter (model ECI 98130) The pH meter was calibrated, with three standard solutions (pH 4.0, 7.0, and 9.2), before taking the measurements. The value of each sample was taken after submerging the pH probe in the water sample and holding for a couple of minutes to achieve a stabilized reading. After the measurement of each sample, the probe was rinsed with deionized water to avoid cross contamination among different samples.

Total hardness is due to the presence of bicarbonates,chlorides and sulphates of calcium and magnesium ions.

The total hardness of water is estimated by titrating the water sample against EDTA using Eriochrome Black –T (EBT) indicator. Initially EBT forms a weak EBT- Ca^{2+} /Mg^{2+} wine red coloured complex with Ca^{2+} /Mg^{2+} ions present in the hard water. On addition of EDTA solution, Ca^{2+} /Mg^{2+} ions preferably forms a stable EDTA- Ca^{2+} /Mg^{2+} complex with EDTA leaving the free EBT indicator in solution which is steel blue in colour in the presence of ammonia buffer(pH =10)

Eriochrome Black –T + Ca^{2+} /Mg^{2+} ⟶ Eriochrome Black –T - Ca^{2+} /Mg^{2+}
(Wine Red)

Eriochrome Black –T - Ca^{2+} /Mg^{2+} + EDTA ⟶ EDTA- Ca^{2+} /Mg^{2+} + EBT
(Wine Red) (Steel blue)

As an oxidant, dichromate has some advantages over permanganate, but, as it is less powerful, its use is much more limited. It is obtainable in a state of high purity and can be used as a primary standard. Solutions of dichromate in water are stable indefinitely. The half reaction for the dichromate system is:

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O \qquad E^0 = 1.33V$$

The most important application of dichromate is in its reaction with iron (II) in which it is often preferred over permanganate ion. The relevant half reaction is

$$Fe^{2+} \rightarrow Fe^{3+} + e^- \qquad E^0 = -0.77V$$

And the total reaction is

$$Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O \qquad E^0 = 0.56V$$

Unlike permanganate, dichromate titrations require an indicator. There are three indicators that may be used for the titration of Fe^{2+} with $K_2Cr_2O_7$. These are diphenylamine, diphenyl benzidine and diphenylamine sulfonate. The colour change for all three indicators is green to violet and the standard electrode potentials are all 0.78 V. According to Kolthoff and Sandell, this should lie between the electrode potentials of the two reduction reactions. This not being the case, phosphoric acid is added to reduce the electrode potential for the $Fe^{3+} \rightarrow Fe^{2+}$ reaction by stabilising the ferric ion. [20,21]
A standard dichromate solution was prepared by dissolving an accurately weighed sample of about 0.4 g in water and makes up to 100 cm^3 in a volumetric flask. Into beakers accurately weighed duplicate portions of about 0.7 g of the iron (II) solid `M' provided. 30 $cm^3$ of dil. $H_2SO_4$, 100 $cm^3$ of water, 7 $cm^3$ of 85% phosphoric acid and 5 drops of diphenylamine sulfonate indicator was added to the solution. Titrate with dichromate to a purple colour. Calculate the percentage of iron in the solid `M'. [22]

Results and Discussion:

Sample	Location	Total Hardness (mg/L)	pH	Total iron (mg/L)
S-1	Tube well-1 (At/Po-Jigaran)	83.4	7.24	0.5
S-2	Tube well-2 (At-Baipada)	87.3	8.01	0.75
S-3	Tube well-3 (At-Kharianta)	85.6	7.72	0.8
S-4	Tap-1 (At-Jigaran)	79.5	7.43	0.9
S-5	Tap-2 (At-Gogua)	75.3	7.32	1.2
S-6	Pond-1 (At/po-Jigaran)	58.2	8.21	0.25
S-7	Pond-2 (At-Baipada)	65.4	8.23	0.21
S-8	River-1 (Brahmani) (At-Kasananta)	73.2	8.11	0.57
S-9	River-2 (Gobari) (At-Gandakia)	64.3	7.81	0.62

Table:1 Data of total hardness, total iron, pH of water samples collected.

The total hardness of the collected samples ranges from 64.3 -87.3mg/L. The tube well water samples show maximum hardness but within the admissible limit. The hardness of tube well at Baipada is found to be maximum. The pond water samples collected from different locality show minimum hardness. The lowest hardness is found for sample of river Gobari.

The range of pH of water collected from different spots is from 7.24-8.23.The tube well at Baipada having pH of 8.01 is highest value among the samples of different tube well and unfit for drinking. The total iron content of the water sample was estimated using traditional potassium dichromate method. The value of total iron ranges from 0.21 to 1.2 mg/L. The tap water at Gogua shows maximum value. The minimum value of iron content is found to be for pond at Baipada. In the drinking water sources the value is within permissible limit.

Conclusion:

According to US EPA (United States Environmental Protection Agency), the recommended limit for dissolved iron in drinking water is 0.30 ppm.[23] As per our result, all the samples concentrations in set 1 are much lower than the maximum limit of iron in drinking water except few samples. In addition, our analysis indicates that water containing suspended solids may result in high dissolved iron concentrations. Finally the water samples that we tested were found to have dissolved iron concentration below the limit of 1.2 mg/L for the samples collected from various tubes well. Whereas the results for analysis of samples collected from pond and river are deviating from recommend range. Similarly the P^H value and analysis for few metals causing hardness of water shows acceptable values in recommended range whereas the values for samples collected from pond and rivers are deviating with a significant value. The project work was done after collection of water samples from Pattamundai locality. The experimental part was done at chemistry laboratory. The results were analyzed and recorded.

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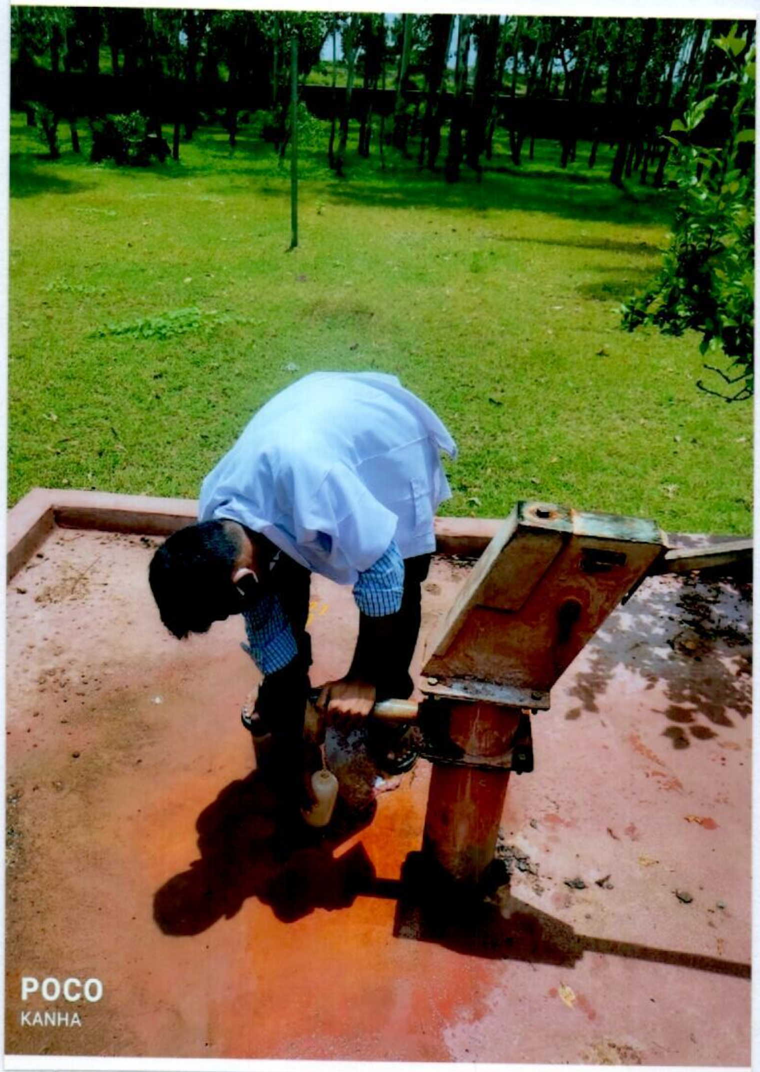
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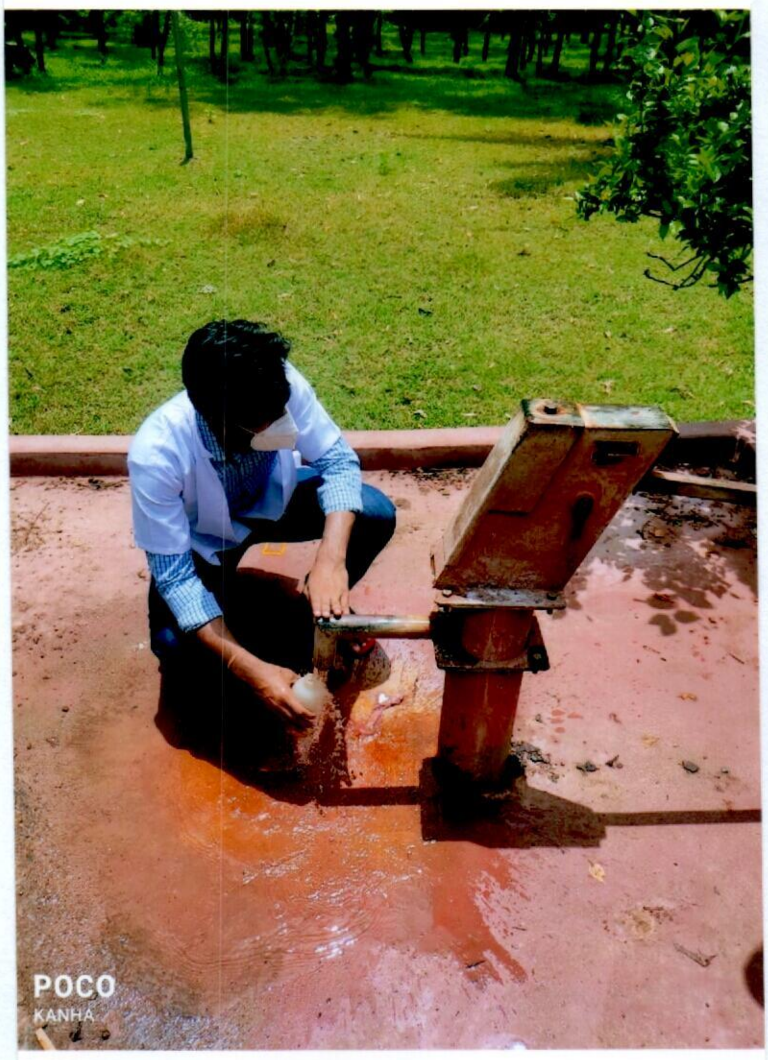
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