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Assessment of Ground Water Quality in Different Areas of Hyderabad

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Abstract: *The Quality of groundwater is assessed through statistical analysis of the data with respect to BIS: 10500-1991standards. The study was undertaken during 2016-2017. The samples are collected from the bore wells of different areas. The study area comprises of three different pharma industry influenced areas namely: Pragathi Nagar (ALEAP), Sanath nagar (Natco, Hetero Etc), Chintal (Hetero, Sipra Etc) and compared it to purely residential area like Kondapur lying in the semi-arid Telangana region. As per water quality index (WQI) values, the groundwater in the study area during post monsoon ranging from "Good" to "Unfit for drinking" and no where it was found "excellent." Correlation amongst all the parameters was found to be positive. Only total dissolved solids and oxidizable substances are more in few selected areas when compared it to Kondapur area. This indicates that there is no regionally extensive factor governing the water quality and it is varying with local conditions only.*

Keywords:*Quality, groundwater, water quality index (WQI), total dissolved solids and oxidizable substances.*

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I. Introduction

Hyderabad is one of the metropolitan cities, which has many pharmaceutical industries, so ground water is being polluted by various chemicals. As the demand of water is increasing due to rapid growth of population quality of water plays a major role as it effect health of individuals[1].We have selected three different pharma industry influenced areas namely: Pragathi Nagar (ALEAP), Sanath nagar (Natco, Hetero Etc), Chintal (Hetero, Sipra Etc) and compared it to purely residential area like Kondapur i.e, without influencing any industrial contaminationAccording to WHO organization, about 80% of all the diseases in human beings are caused by water. Water quality index is one of the most effective tools to communicate information on the quality of water to the concerned citizens and policy makers. Thus, it becomes an important parameter for the assessment and management of groundwater. The more common soluble constituents include calcium, sodium, bicarbonate and sulfate ions. Another common constituent is chloride ion derived from intruded sea water, connate water, and evapotranspiration concentrating salts, and sewage wastes[1].

Groundwater is used for a variety of purposes, including irrigation, drinking, and manufacturing. Groundwater is also the source of a large percentage of surface water. To verify that groundwater is suited for its purpose, its quality can be evaluated (i.e., monitored) by collecting samples and analyzing them. In simplest terms, the purpose of groundwater monitoring is to define the physical, chemical, and biological characteristics of groundwater.

II. Experimental

Sample collection and analysis:

All samples were collected using the clean sampling procedures specified by the USGS National Water-Quality Assessment (NAWQA) program (Shelton , 1994).the groundwater analysis of different areas in Hyderabad are performed. Samples are collected from the groundwater of Chintal, Sanath nagar, Pragathinagar, and Kondapur. Several parameters were discussed for the assessment of ground water quality in the selected areas.

Turbidity: The turbidity of the sample is measured from the amount of light scattered by the sample taking a reference with standard turbidity suspension. The higher the intensity of scattered light the higher is the turbidity. Formazin is polymer used as the primary standard reference suspension[2, 8].

Test procedure:

i. Calibrate the instrument.
ii. To the sample cell add sample water up to the mark, wipe gently soft tissue. Place it in the turbidity meter such that the vertical mark in the sample cell should coincide with the mark in the turbidity meter and cover the sample cell.
iii. Check the reading in turbidity meter. Wait until you get stable reading.

Acidity: It isa measure of the capacity of water to neutralise bases. Usually dissolved carbon dioxide is the major acidic component present in the unpolluted surface waters. The volume of standard alkali required to titrate a specific volume of the water sample to pH 3.7 is called methyl orange acidity.Hydrogen ions present in the sample result in dissociation or hydrolysis of solutes reacts with additions of standard alkali. Acidity thus depends on end point of the indicator used[5].

i. Boil 10ml of the sample and cool it.
ii. Add 0.05ml methyl red solution.
iii. If the sample solution turns to red it indicates that the sample acidic**.**

Calcium: Waterhardness is an expression for the sum of the calcium and magnesium cations concentration in a water sample. The presence of calcium in water results from deposits of lime stone, gypsum etc., calcium is one of the principal cations involved in the water hardness. These cations format insoluble salts with soap and decreases the cleaning effectiveness of soap. They also format hard water deposits in hot water heaters. The calcium content may range from zero to several hundred ppm.The quantity of calcium will be determined by titrating the water sample with standard EDTA of known volume and concentration. The indicator imparts a pink colour to the solution while there is calcium and magnesium ions have not complexed with EDTA. No hint of pink colour will be left[6].

i. Pipette 20ml of the water sample and transfer it to a clean 250mL conical flask.
ii. Measure 2ml of 1N sodium hydroxide solution using measuring cylinder. Add it to the water sample in conical flask so that the pH will be maintained between 12 and 13.
iii. Add few amount of ammonium purpurate indicator to the water sample. Now the sample turns to pink colour. The colour change is due to the calcium and magnesium ions present in water.
iv. Before starting the titration rinse the burette with few mL of EDTA solution and discard it. Fill the burette with 0.02M EDTA solution. Adjust the reading to zero, and then fix it in burette stand. Ensure that, there is no air bubble inside the burette.
v. Titrate the water sample against the EDTA solution in the burette till all calcium and magnesium ions present in the sample reacts with EDTA complex by changing the colour of the sample to purple.
vi. Note down the burette readings and repeat the titration for concordance values.

Total Dissolved Solids:A total dissolved solid (TDS) is the term used to describe the inorganic salts and small amounts of organic matter present in solution in water. The principal constituents are usually calcium, magnesium, sodium, and potassium cations and carbonate, hydrogen carbonate, Chloride, sulfates, and nitrate anions.The presence of dissolved solids in water may affect its taste[7].

- To measure total dissolved solid. Take a clean porcelain dish which has been washed and dried in a hot air oven at 180°c for 1hr
- Now weigh the empty evaporating dish in analytical balance. Let's denote the weight measured as W1=35.43
- Mix sample well and pour into funnel with filter paper. Filter approximately 80-100ml of sample
- Using pipette transfer 75ml of un filtered sample in the porcelain dish
- Switch on the oven and allowed to reach 105°c.Place it in the hot air oven and care should be taken to prevent splattering of sample during evaporation or boiling
- Dry the sample to get constant mass. Drying for a long duration usually 1to2hrs is done to eliminate necessity of checking for constant mass
- Cool the container in a desiccator. Don't leave the lid off for prolonged periods or the desiccant will soon be exhausted.
- We should weigh the dish as soon as it has cooled to avoid absorption of moisture due to its hygroscopic nature. Samples need to be measured accurately weighed carefully and dried and cooled completely.
- Note the weight with residue as W2=35.449.

Sulphates:Sulfates occur naturally in numerous minerals, including barite ($BaSO_4$), epsomite ($MgSO_4 \cdot 7H_2O$) and gypsum ($CaSO_4 \cdot 2H_2O$). These dissolved minerals contribute to the mineral content of many drinking-waters. Copper sulfate has been used for the control of algae in raw and public water supplies[2].

i. Take 10 ml of sample add 0.1mlof 2M hydrochloric acid.
ii. Then add 0.1ml barium chloride solution.
iii. The appearance of the solution does not change for at least one hour.
iv. Done the same procedure for all the samples and compare with the reference sample.

P^H: $P^H$is an indicator of the acid or alkalinecondition of water. The P^H scale ranges from0-14; 7 indicates the theoretical neutral point. Water with a P^H value less than 7 indicatesacidity and tends to be corrosive, while waterwith a value greater than 7 indicates alkalinityand tends to affect the taste of the water[2].
Testing of sample:

i. Calibrate the instrument.
ii. In a clean dry 100ml beaker take the water sample and place it in a magnetic stirrer, insert the coated stirring bar and stir well
iii. Now place the electrode in the beaker containing the water sample and check for the reading in the pH meter. Wait until you get a stable reading.

Total Hardness: Water that has high mineral content is known as hard water. Hardness of water is a measure of the total concentration of the calcium and magnesium ions expressed as calcium carbonate. There are two types of hardness[3].

1) **Temporary hardness –** It is due to the presence of bicarbonates of calcium and magnesium. It can be easily removed by boiling.
2) **Permanent hardness –** It is due to the presence of chlorides and sulphates of calcium and magnesium. This type of hardness cannot be removed by boiling.

Testing of water sample:

i. Pipette 20ml of water sample and transfer it to a clean conical flask. Add 2mL of ammonium buffer solution to the water sample so that the p^H will be maintained between 9 and 10.
ii. Add few drops of EBT indicator to the conical flask and the sample turns to wine red in color. Before starting the titration rinse the burette with few mL of EDTA. Fill the burette with 0.02M EDTA solution and adjust to zero then fix it in burette stand.
iii. Titrate the sample against the EDTA solution in the burette till all calcium and magnesium ions present in the sample reacts with the EDTA. The appearance of blue color indicates that all calcium and magnesium ions are complexed with EDTA and forms a metal EDTA complex that is the end point of the titration. Note down the burette reading and repeat the titration for concordant values.

Chlorides: Chlorides are widely distributed in nature as salts of sodium (NaCl), potassium (KCl). Chlorides commonly found in streams and waste water. Sodium chloride is widely used in the production of industrial chemical such as caustic soda, chlorine, sodium chlorite, and sodium hypochlorite sodium chloride. Calcium chloride and magnesium chloride are extensively used in snow and ice control. Potassium chloride is used in production of fertilizers[3].

Testing of sample:

i. Take 10 ml of sample in attest tube add 1 ml of 2M nitric acid
ii. Add o.2 ml of 0.1 M silvernitrate, the appearance of the solution does not change for at least 15 minutes.

Electrical Conductivity: Conductivity of a substance is defined as the ability or power to conduct transmits heat, electricity or sound. The conductivity of a solution is proportional to its ion concentration. A voltage is applied between the electrodes in the probe immersed in the sample water[11].
Testing the water sample:

1. Calibrate the instrument.
2. Rinse the electrode thoroughly with deionized water and carefully wipe with a tissue paper.
3. Measure 200 ml of water sample and transfer to it a beaker and place it on the magnetic stirrer.
4. Dip the electrode into the sample solution taken in a beaker and wait for steady reading. Make sure that the instrument is giving stable reading.
5. Note down the reading in the display directly, which is expressed in ms.

Nitrates: Nitrogen exists in the environment in many forms. Although there are many sources of nitrate (both natural and anthropogenic) that could potentially lead to the pollution of the ground water with nitrates, waste materials are one of the anthropogenic sources of nitrate contamination of ground water.A water test for nitrates is highly recommended for households with infants, pregnant women's and elderly people. These groups are most susceptible to nitrate or nitrate contamination[4].

1. Take 5 ml of sample in a test tube immersed in ice.
2. Add 0.4 ml of 10%w/v solution of KCl , 0.1 ml of diphenylamine solution and drop wise with shaking 5 ml of sulphuric acid.
3. Transfer the tube to a water bath at 50º c to allow standing for 15 minutes.

4. Any blue color in the solution is not more than in a solution is not more intense than that in a solution prepared at the same time and in the same manner using a mixture of 5.5 ml of nitrate free water and 0.5 ml of nitrate standard solution.

Microbiological Assay:The microbiological assay is based upon the inhibition of the growth of microorganisms of the test compared with the inhibition of growth of the standard. The rate of growth is then proportional to the amount of this nutrient added in the test substance[4].
Pour plate method:Pour plate method is usually the method of choice for counting the number of colony-forming bacteria present in a liquid specimen. In this method, fixed amount of inoculums (generally 1 ml) from a broth/sample is placed in the center of sterile Petri dish using a sterile pipette. Molten cooled agar (approx. 15mL) is then poured into the Petri dish containing the inoculums and mixed well. After the solidification of the agar, the plate is inverted and incubated at 37°C for 24-48 hours.Microorganisms will grow both on the surface and within the medium. Colonies that grow within the medium generally are small in size and may be confluent.Streak Plate: The lid of the agar plate has to be opened just sufficiently enough to streak the plate with the inoculation loop. Minimize the amount of agar and the length of time the agar is exposed to the environment during the streak process.

Total Alkalinity:Alkalinity is primarily a way of measuring the acid neutralizing capacity of water. The possibility to maintain constant p^H is due to the hydroxyl, carbonate and bicarbonate ions present in water[10].
Testing of water sample:
1. Rinse the burette with 0.02N sulphuric acid and discard the solution.
2. Fill the burette with 0.02N sulphuric acid and adjust it to zero.
3. Measure 100mL of sample and transfer to conical flask. Add few drops of indicator. Pink colour appears due to alkalinity of water sample.
4. Titrate with 0.02N sulphuric acid till pink colour disappears. The volume consumed is noted as (V_1).
5. Repeat the titration for concordant values.

Oxidisable Substances:Testing of sample
- To 100ml sample add 10ml of 1M sulphuric acid.
- To this mixture add 0.02ml of 0.1M of potassium permanganate solution.
- Boil the solution and leave it for 5min
- Observe the color.

III. Results And Discussion

S.NO	PARAMETERS	KONDAPUR WATER	CHINTAL WATER	PRAGATHINAGAR WATER	SANATHNAGAR WATER	RANGE	
1	Turbidity	2.3NTU	5NTU	3.5NTU	3.8NTU	5NTU	10NTU
2	Acidity	Pale orange	Dark orange	Pale orange	Orange	Colorless	Orange
3	Calcium	75mg/L	150mg/L	90mg/L	100mg/L	75mg/L	200mg/L
4	Total dissolved solids	500mg/ml	2000mg/ml	550mg/ml	1550mg/ml	500mg/L	2000mg/ L
5	Sulfates	No change in color	No change in color	No change in color	No change in color	No change in color	-
6	p^H	7.01	5.6	6.58	6.98	6.5	8.5
7	Total hardness	300mg/L	1000 mg/L	500 mg/L	700 mg/L	300mg/L	1000mg/L
8	Chlorides	No change in appearance	No change in appearance	No change in appearance	No change in appearance	No change in color	-
9	Electrical conductivity	95.3µmho	102.5µmho	98.3µmho	97.9µmho	50 µmho	100 µmho
10	Nitrates	2 mg/L	4 mg/L	3.1 mg/L	3.5mg/L	1 mg/L	3 mg/L
11	Microbiological test	Colony count is low	Colony count is more	Colony count is medium	Colony count is more	-	-
12	Total alkalinity	Pale blue	No color change	Pale blue	Pale blue	colorless	Pale blue
13	Oxidisable substances	No color	Pink color	Slight pink color	Pink color is remained same	Colorless	Pink

Turbidity of all the water samples is within limits as per ISO. Kondapur water is having less turbidity when compared with the other samples. Disinfection of turbid water is difficult because of the adsorptive

characteristics of some colloids and because the solids may partially shield organisms from disinfectant.Acidity of water affects aquatic lives. The organisms present are prone to death with low p^H of water. Water containing mineral acidity is not fit for drinking purposes. All the samples from different areas contain acidic nature. Chintal water sample is more acidic in nature when compared with others. Calcium content in all the water samples is within the limits as per ISO. Total dissolved solids concentrations in drinking water and the incidence of cancer, coronary heart disease, arteriosclerotic heart disease, and cardiovascular disease. Kondapur and Pragathinagar water samples are within the limits as per ISO. Remaining two samples are exceeding the limits. Sulfates are absent in all the water samples. Dehydration is reported as a common side-effect following the ingestion of large amounts of magnesium or sodium sulfate.P^H of all the water samples is slightly acidic in nature. The pH of drinking water is not a health concern however; acidic water (low pH) can leach metals from plumbing systems, which can cause health problems. Total hardness of all the water samples are within limits as per ISO. Hard water is useful to growth of children due to the presence of calcium. Chlorides are absent in all the water samples. Electrical conductivity of all the water samples is within limits as per ISO. It is useful to access the source of pollution. Nitrates of all the water samples are within limits as per ISO. Nitrate in drinking water, at high levels, causes "blue baby syndrome". In adults, long-term exposure to high nitrate levels in drinking water is potentially also associated with thyroid dysfunction and cancer. Appearance of colonies in all the water samples. Many microorganisms are found natural water. These include bacteria, cyanobacteria, protozoa, viruses, algae, and tiny animals such as rotifers. Samples other than Chintal show pale blue indicating slightly alkaline nature. Chintal water sample doesn't show any color change. Large amount of alkalinity imparts bitter taste in water.Oxidisable substances are more in Sanath nagar comparing with other water samples.

IV. Conclusion

Rapid urbanization and industrialization has led to unchecked proliferation of hazardous industries in and around Hyderabad. The selected areas surrounding Hyderabad has ample possibilities of organic pollution, laboratory waste from pharmaceutical laboratories and industries. As the selected areas are closer to the city, protecting it from pollution is of utmost importance as the water can be a precious resource in case of emergency.

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