Research Article

Study of Ground Water Quality Analysis in Industrial Zone of Visakhapatnam

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Abstract: The Physicochemical characteristics of the groundwater in Visakhapatnam city and its surrounding area are analysed. There is a wide variation in the quality of water from point, which is reflected by the related parameters. Hydrogeochemical studies were carried out in industrial area to assess the groundwater quality groundwater samples from 10 bore wells. Industries consume large quantities to water for their process and then discharge their effluents on to the adjoining areas without pretreatment. This leads to the deterioration of groundwater quality significantly besides impoverishing the environment.

Keywords: Groundwater Quality, Physicochemical parameters, bore wells.

1. Introduction

Visakhapatnam has been home for a number of large and medium industries such as the Hindustan Petroleum Corporation, Visakhapatnam Steel plant, Bharat Heavy Plates and Vessels, Hindustan Polymers and Coromandel Fertilizers. Relatively more recently, the Visakhapatnam Export processing zone has come up and there are indications of the city emerging as a booming industrial metropolis. Commensurate with the growth of industrial and allied activities in and around the city, its area grew from 30 sq km in 1960 to over 80 sq km. presently. The city's population according to 2001 census is about 1.33 million.

The growing competition for water and declining freshwater resources, the utilization of marginal quality water for agriculture has posed a new challenge for environmental management. In water scarce areas there are competing demands from different sectors on the limited available water resources.

Groundwater makes up about twenty percent of the world's fresh water supply, which is about 0.61% of the entire world's water, including oceans and permanent ice. Groundwater is water located beneath the ground surface in soil pore spaces and in the fractures of lithologic formations. Groundwater is recharged from, and eventually flows to, the surface naturally; natural discharge often occurs at springs and seeps and can form oases or wetlands.

Over three-fourths of the freshwater drawn by the domestic and industrial sector, return as domestic sewage and industrial effluents which inevitably end up in surface water bodies or in the groundwater, affecting water quality. The "marginal quality water" could potentially be used for other uses like irrigation.

Hence, the reuse of wastewater for irrigation using domestic sewage or treated industrial effluents has been widely advocated by experts and is practiced in many parts of the world, particularly in water scarce regions. However, the environmental impact of reuse is not well documented, at least for industrial effluents, particularly in developing countries like India where the irrigation requirements are large. In this work an attempt has been made to study groundwater pollution in industrial areas in Visakhapatnam with the following objectives: To know the present groundwater quality after studying its physicochemical parameters; To draw conclusions based on the water quality analysis; To assess the potability of available water sources (bore wells, open wells) in and around the industrial zone of Visakhapatnam.

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2. Methodology

2.1 The Study Area

Visakhapatnam was Situated in between 170 40' 30" and 170 40' 45" North latitude and 830 16' 15" and 830 21' 30" East longitude. Visakhapatnam is an industrial area, because of its geographical location with a natural harbour attached nationwide attention, which led to the establishment of several industries.

Water facilities are provided by dipping the bore wells as the groundwater is the main source of drinking water in this area. Historically groundwater has been considered to be safe for drinking hence untreated ground waters supplied to the public. Since most of heavy industries are located, it leads to polluting the groundwater. Thus, in this present study industrial belts and its surrounding area has been selected and analysed the groundwater quality.

2.2 Sample Collection

The water samples were collected at selected points; great care was taken during collection of the sample. The samples were brought to the laboratory and analysed. Whenever delay was unavoidable, the samples were refrigerated. The clean plastic bottles of one-litre capacity were rinsed three times with the water before filling it after the samples was collected, the stopper was placed tightly.

In the present study, the groundwater quality in the industrial areas Scindia, Malkapuram, Sriharipuram, Old Gajuwaka, New Gajuwaka, Gajuwaka, Mindi, BHPV, Autonagar, Visaka dairy these areas of Visakhapatnam have been surveyed. The samples have been collected from digging wells and bore wells for physical-chemical analysis, which has been carried out, in the Environmental Monitoring Laboratory, GITAM Institute of sciences, GITAM University.

The Physicochemical Parameters of the water samples were analyzed in triplicate by adopting standard procedures from manual of the American Public Health Association (APHA, 1998). The water samples were analyzed for the following Physicochemical Parameters.

3. Results and Discussion

The population in the area has increased more than threefold within a span of two decades, because of the rapid growth in industrial activity. Groundwater is the prime source of drinking water and its quality is getting degraded due to increasing industrialization (1). The present communication is focused on the study of temporal changes in the groundwater quality to assess the intensity of pollution activity on it in the different industrial surrounding areas.

3.1 pH

The observed pH value ranging from 6.4 to 8.5 shows that the present water samples are slightly alkaline. These values are maximum permissible limit prescribes WHO standards. If pH increases the permissible level it may promote corrosion of plumbing systems and fixtures.
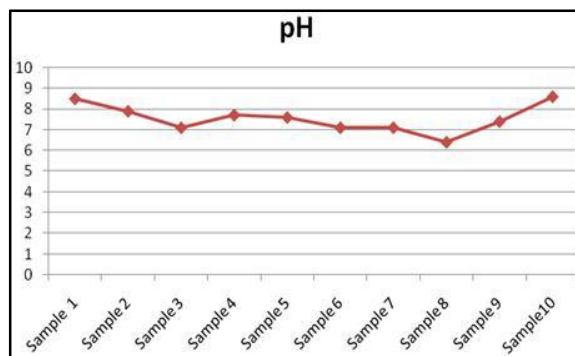

3.2 Chloride

From study area, it is observed that the chloride content exceeds than the permissible limit. The site point exceeds are Hindustan zinc area (290), old Gajuwaka area (399.9), Malkapuram area (319.9), new Gajuwaka area (309.9), Srinagar area (319.9).

When the chloride concentration of 250mg/l is present along with sodium ions, a salty taste can observe. The salty taste may be absent in waters in the absence of sodium ions, even concentration of chlorides is high as 1000mg/l.

Chloride is present in all natural water at greatly varying concentrations depending on the geochemical conditions. Chlorides in natural waters can be attributed to leaching of chloride containing rock and soil, discharges of effluents from chemical industries, ice creams plant effluents, edible oil mill operations, sewage disposal, irrigation drainage, contamination, from refuse leachates and seawater intrusion in coastal regions.
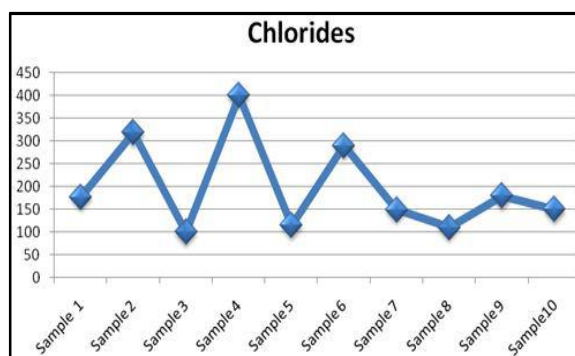
3.3 Hardness

As per the analysis report, it is observed that hardness is exceeding the limits. Such areas are Hindustan Zinc area (234). Old Gajuwaka area (191), New Malkapuram (188), Mindi (290), BHPV (193), Sheela Nagar (292).

Hardness is a measure of the ability of water to cause precipitation of insoluble calcium and magnesium salts of higher fatty acids from soap solutions, the principle hardness causing cations are calcium, magnesium, strontium, ferrous ion, manganese ion associated with bicarbonates, carbonates, chlorides, and sulphates.

Total hardness

Calcium Hardness

Magnesium Hardness
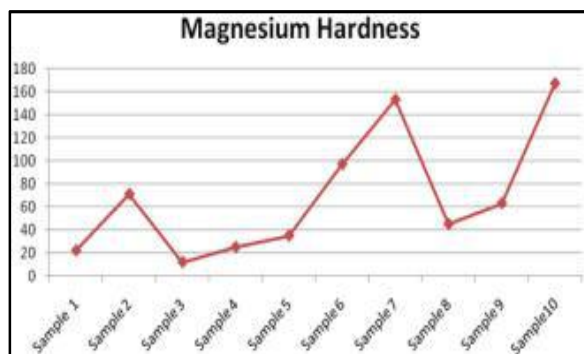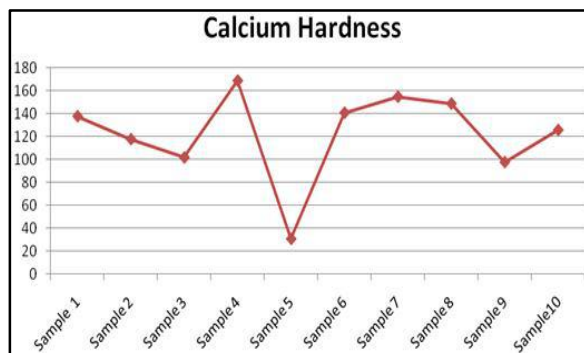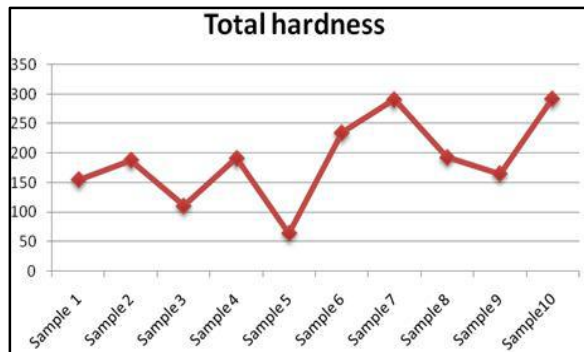
3.4 Suspended solids

Suspended solids or matter in surface water may consist of the inorganic or organic matter. These materials are after natural contaminants resulting from the erosive action of water flowing over the land surface. Groundwater contains a negligible quantity of suspended solids and these being filtered out by soil start a through mechanical straining action.

The amount of suspended solids in surface water increases with input of natural and man-made contamination. As per the analysis report, it is observed that suspended solids are exceeding the limits. Such areas are Mindi (1200), Hindustan zinc area (1200), Old Gajuwaka (800), Malkapuram (1150).

Total Solids

Total Dissolved Solids

Total Suspended Solids
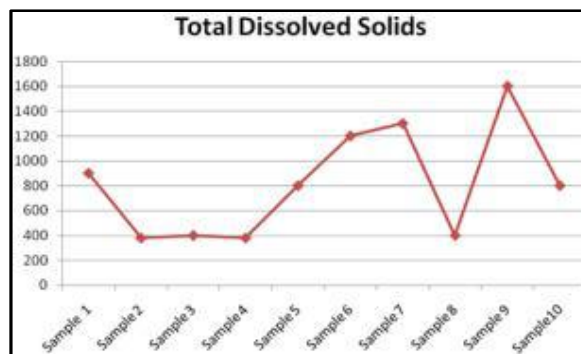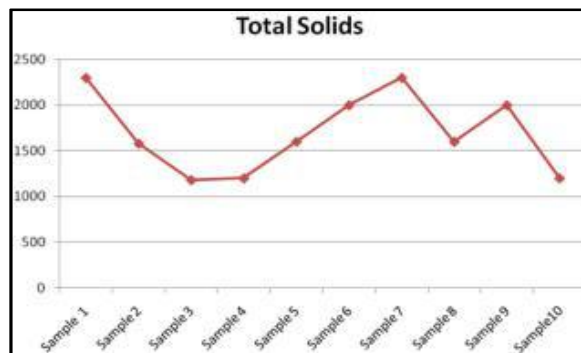
3.5 Nitrates

As per the analysis report, it is observed that Nitrates is exceeding the limits. Such areas are Scindia (4.6), Sriharipuram (7.9), Hindustan Zinc area (4.02), Old Gajuwaka area (3.5), Malkapuram (5.1).

If the nitrates increase than the permissible level water may get poisoned to a pregnant woman or nursing woman. It has also been known to cause infant cyanosis (blue-baby) in children under the age of six months.

Nitrates
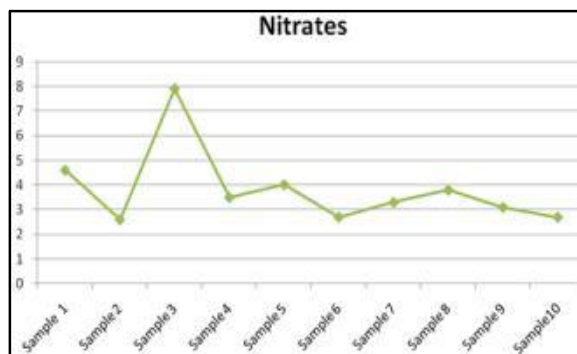
3.6 Sulphates

As per the analysis report, it is observed that a sulphate is exceeding the limits. Such areas are Scindia (3.6), Autonagar (3.5), Sheela Nagar area (3.1), New Gajuwaka (3.6). High level of sulphates in water can cause dehydration and diarrhoea and may also cause corrosion effect on plumbing.

3.7 Iron
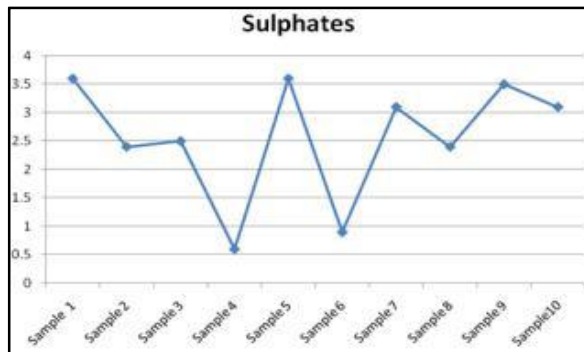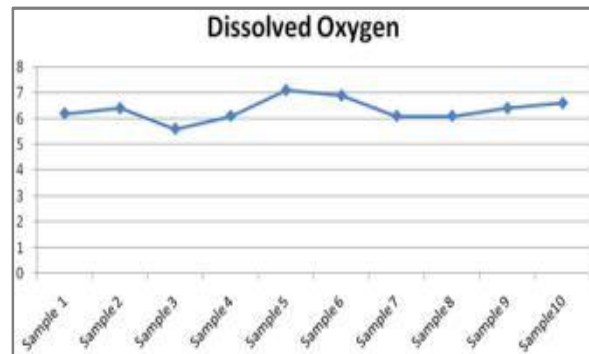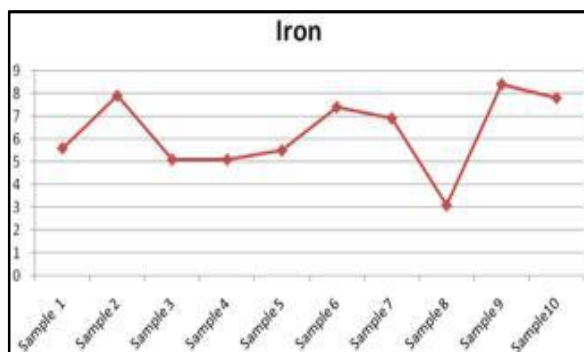
As per the analysis report, it is observed that Iron is exceeding the limits. Such areas are Scindia (7.9), Hindustan zinc area (5.5), Old Gajuwaka area (5.5), Malkapuram (5.1), Sheela Nagar (7.8).

Iron is mostly a naturally derived metallic pollutant which areas its origin in waters mainly to the sources derived from the soil and crocks. The corrosion of pipes, pumps and other such structures can also raise the concentration of iron in the distribution systems.

Large quantities of iron can leach out from the soil by run-off especially in acidic conditions such and associated with acid mine drainage and degradation of excessive organic matter accumulated in the soil.

Iron in groundwater remains mostly as a predominate from due to general lack of oxygen, but such iron-rich ground waters when brought to the surface, the ferrous is quickly converted I to ferric resulting in the formation of ferric in the presence of iron is substantial quantities render the water unsuitable for food processing making beverages, dying bleaching, manufacturing ice and many other items, the limit of iron in drinking water (0.1mg/l) is not because of the health consideration but due to its aesthetic and taste significance.

3.8 Sodium

As per the analysis report, it is observed that Sodium is exceeding the limits. Such areas are Sriharipuram area (50), Autonagar (40), Malkapuram (51.5). The High level of sodium in water may affect possibly increases blood pressure in susceptible individuals.
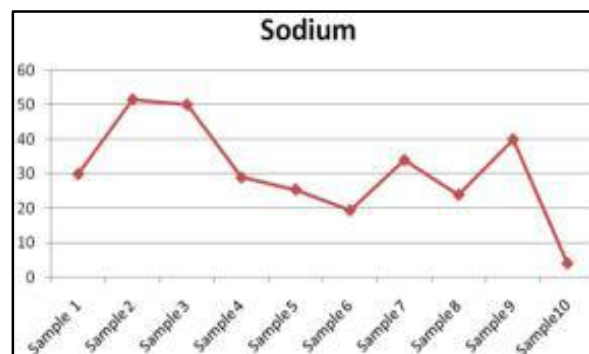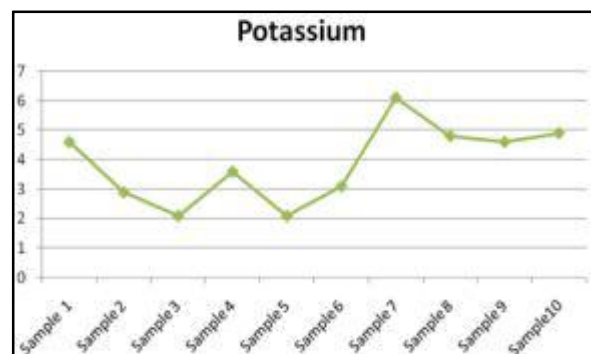

3.9 Potassium

As per the analysis report, it is observed that Potassium is exceeding the limits. Such areas are Scindia (4.6), Autonagar (4.6), BHPV (4.8), Sheela Nagar (4.9) High level of potassium in water may cause laxative effect.

WATER QUALITY ANALYSIS IN INDUSTRIAL AREAS OF VISAKHAPATNAM

S. No.	Parameter	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
1	pH	8.5	7.9	7.1	7.71	7.6	7.1	7.1	6.4	7.4	8.4
2	Chlorides	177	318	99.6	400	115	290	149	110	180	150
3	Total hardness	155	188	111	191	64	234	290	193	165	292
4	Calcium hardness	138	118	102	169	31	141	155	149	98	126
5	Magnesium hardness	22	71	12	25	35	97	153	45	63	167
6	Total solids	2300	1580	1180	1200	1600	2000	2300	1600	2000	1200
7	Total dissolved solids	900	380	400	380	800	1200	1300	400	1600	800
8	Total suspended solids	930	1150	800	800	790	800	1200	1200	400	400
9	Nitrates	4.6	2.6	7.9	3.5	4.02	2.7	3.3	3.8	3.1	2.7
10	Sulphates	3.6	2.4	2.5	0.6	3.6	0.9	3.1	2.4	3.5	3.1
11	Dissolved Oxygen	6.2	6.4	5.6	6.1	7.1	6.9	6.1	6.1	6.4	6.6
12	Iron	5.6	7.9	5.1	5.1	5.5	7.4	6.9	3.1	8.4	7.8
13	Sodium	30	51.5	50	29	25.5	19.5	34	24	40	4.2
14	Potassium	4.6	2.9	2.1	3.6	2.1	3.1	6.1	4.8	4.6	4.9

SAMPLE LOCATIONS:- S1 = SCINDIA; S2 = MALKAPURAM; S3 = SRIHARIPURAM; S4 = OLD GAJUWAKA; S5 = NEW GAJUWAKA; S6 =HINDUSTAN ZINC AREA; S7 = MINDI; S8= BHPV; S9= AUTONAGAR; S10= SHEELA NAGAR.

DRINKING WATER QUALITY STANDARDS

		Indian Standards		ICMR		WHO	
		P	E	P	E	P	E
PHISICAL							
1	Colour	10	50	5	25	5	20
2	Taste & Odour	Unobjectionable		Unobjectionable		Unobjectionable	
3	Turbidity	10	25	5	25	5	25
4	PH	6.5-8.5	6.5-9.2	7-8.5	6.5-9.2	7-8.5	6.5-9.2
CHEMICAL (Mg/L or PPM)							
5	Total Solids	-	-	-	-	500	1500
6	Total Hardness	300	600	300	600	-	-
7	Calcium	75	200	75	200	75	200
8	Magnesium	30	100	50	150	50	150
9	Copper	0.05	1.5	1.0	3.0	1.0	1.5
10	Iron	0.3	1.0	0.3	1.0	0.3	1.0
11	Manganese	0.1	0.5	0.1	0.5	0.1	0.5
12	Chlorides	250	1000	250	1000	200	600
13	Sulphates	150	400	200	400	200	400
14	Nitrate	45	-	20	50	-	50-100
15	Fluoride	0.6-1.2	-	1.0	2.0	0.5	1.0-1.5
16	Phenolic Substances	0.001	0.002	0.001	0.002	0.001	0.002
TOXIC							
17	Arsenic	0.05	-	-	0.2	-	0.2
18	Cadmium	0.05	-	-	0.05	-	0.05
19	Cyanide	0.05	-	-	0.01	-	0.01
20	Lead	0.1	-	-	0.1	-	0.1
21	Selenium	0.01	-	-	0.05	-	0.01
22	Zinc	5.0	10	-	-	-	-
23	Mercury	0.01	-	-	-	-	-
24	Bacteriological	100ml/ Coli form	100ml/ Coli form	100ml/ Coli form	100ml/ Coli form	100ml/ Coli form	100ml/ Coli form
RADIOACTIVITY							
25	Alpha emitters	10^{-8}			10^{-9}		10^{-9}
26	Beta Emitters	10^{-7}			10^{-8}		10^{-8}

4. Conclusion

This study emphasizes the need for regular groundwater quality monitoring to assess pollution activity from time to time for taking appropriate management measures in time to mitigate the intensity of pollution activity.

1. The quantity of water in around the industrial belt reached already alarming stage causing health effects as per the analysis report.
2. Regular monitoring should be done in various seasons to identify the pollution source.
3. The major industries nearby sampling point should supply protected drinking water to the people

surrounded by industries or they have to rehabilitate people from that point since they are mainly responsible for creation of pollution.

4. Improvement of sanitation facilities would minimize contamination of septic effluents into groundwater.

5. The groundwater quality problems are mainly due to:
   i) contamination by geogenic and man-made sources; and
   ii) Seawater intrusion due to over-abstraction of groundwater along the coasts.

6. The geogenic contamination can be attributed to over-abstraction causing lowering of the water table and disturbing the contaminated geological structures.

7. The man-made contamination is mainly due to large-scale urbanization, industrialization and agricultural activities.

8. Groundwater quality is being increasingly threatened by agricultural, urban & industrial wastes, which leach or are injected into underlying aquifers.

9. The fast industrial growth also results in the generation of large quantity of wastes (solid, liquid and gaseous). Many times these wastes also do not get collected, treated and disposed of. They also have the same fate as domestic wastes in the city.

10. A large number of industrial activities are taking place in urban areas, especially in congested, populated areas. The wastes generated by industrial activities in urban areas get mixed with domestic wastes and pollute the groundwater.

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