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Analysis Of Groundwater Samples of Gnanapuram Area of Visakhapatnam City in Andhra Pradesh, India for Sodium, Potassium And Chloride : The Potability Concern.

Dr. P. Sarada Lecturers in Chemistry, St. Joseph's College for Women(Autonomous), Visakhapatnam-530 004.

Dr. P. Bhushanavathi. Lecturers in Chemistry, St. Joseph's College for Women(Autonomous), Visakhapatnam-530 004.

ABSTRACT

A study on ground water potability was carried out in the first industrial-residential confluence area of Visakhapatnam city, Andhra Pradesh, India. The study area is at a 3Km distance from the sea coast and falls in a 2Km radius of Visakhapatnam Port Trust. Here ground water is extensively used for domestic and industrial purposes and occasionally for drinking. Twelve groundwater samples were collected from different locations in the pre and post monsoon months of 2014 from bore wells and open wells in the study area and analysed for Na, K and Cl-. The groundwater in this area is found to be moderately hard. This study reveals that geological formation and local environmental conditions control the groundwater quality in the area under study. Groundwater suitability for domestic and potability purposes was examined using WHO and Indian standards classification, which indicates that groundwater here is unfit for drinking purpose.

KEYWORDS : Water quality, Groundwater, Sodium, Potassium, Chloride, Potability

INTRODUCTION: Water is an essential component of the environment. It sustains life on the earth. All living creatures depend on water for their survival. It is available on the earth as surface and ground water. This study focuses on ascertaining the ground water quality with reference to the concentration levels of Na, K and Cl^- at the oldest industrial-residential confluence area of Visakhapatnam city in Andhra Pradesh, India. The study area is close to the Bay of Bengal and right behind the stock yard of Visakhapatnam Port . It is densely populated by BPL families. People here depend on ground water extensively for their domestic needs and occasionally for drinking purpose. As is the case in other industrial areas, ground water potential as well as quality is facing a downward trend here. This may be due to population explosion, rapid industrialisation, failure of monsoon and ineffective rain water harvesting [16]. Hence, it is felt necessary to undertake quality analysis of groundwater in order to assess its suitability for drinking as well as utilisation for domestic and industrial purposes. An appropriate assessment of the suitability of groundwater for potability and domestic purposes requires establishing the concentration of some important parameters like Na, K and Cl^-.

Groundwater chemistry depends on a number of factors, such as general geology, degree of chemical weathering of the various rock types, quality of recharge water and inputs from sources other than water-rock interaction. Such factors and their interactions result in a complex groundwater quality [7, 8,9]. The pollution of groundwater is of major concern because of its increasing use for human needs and industrial activity. Groundwater is believed to be comparatively much clean and free from pollution than surface water. But prolonged discharge of industrial effluents, domestic sewage , sea water intrusion and solid waste dump causes the groundwater to become polluted and creates health problems [1]. Sodium and chloride occur naturally in groundwater. However, sources such as road salt storage and application, industrial wastes, sewage, fertilizers, water softener discharge and proximity to saltwater generally cause elevation of their levels in ground water aquifers. This can be a concern for people on low-sodium diets. Elevated levels of sodium and chloride can also interfere with taste and increase the corrosivity of water, which in turn can affect the household plumbing. Studies on variations in major ions help to identify the chemical processes and interaction between soil and water that are responsible for the changes in groundwater quality with respect to space and time. Sodium in our diets results mainly from table salt used in preparing food products. Sodium in drinking water normally presents no health risks, as about 99 percent of the daily salt intake is from food and only about one percent is from water. However, elevated sodium in well water may be considered a health concern for those on a salt restricted diet. Individuals on a low sodium diet due to a high blood pressure or other medical problems are often restricted to water containing less than 20 mg/l of sodium. All ion exchange treatment systems using sodium chloride water softeners will increase the amount of sodium in water. Sodium chloride is a common constituent of some water sources, especially well water. Levels above 140 mg/l are considered to be toxic for plants [10]. However, a value of 600 mg/l has been set as the tolerance limit for irrigation water [11].

Study area: Visakhapatnam is a coastal city situated along Bay of Bengal. It is located between the latitude 83° 17′ and longitude 17° 65′. The city has a natural harbour which has been developed into a major port known as Visakhapatnam Port. The study area is located right behind the stockyard of the port and extends upto 5 Sq Km. (latitude 83°17′ and longitude 17°65′). It is about 2.5 Km away from the sea shore. Two large sewage drains (supposed to be storm water drains) perennially flow eastwards through it and join the Bay of Bengal.

MATERIALS AND METHODS: The groundwater samples were collected from 12 bore and open wells in selected stations of Gnanapuram region. The samples were collected as per the standard methods recommended by APHA [2]. Before water sampling, all the double-stoppered polythene containers were cleaned and rinsed thoroughly with water samples to be analyzed. The chemical analysis was done using the standard methods.

Sample collection and analysis: The groundwater samples are collected in the pre and post monsoon periods in the year 2014. Sampling was done thrice in the pre monsoon period and twice in the post monsoon time. Twelve ground water samples have been collected from the study area each time. The samples were then analyzed for different parameters such as Na, K and Cl^- by following standard methods of APHA [2]. All reagents used were of analytical grade. Samples were unfiltered and the concentration of the different parameters could correspond to their total concentration if the groundwater is used for drinking purpose. Sodium and Potassium were determined by flame photometerand Chloride was determined titrimetrically using standard $AgNO_3$ solution.

RESULTS AND DISCUSSION: The average of concentration values for sodium, potassium and chloride(mg/l) in the pre and post monsoon periods are separately presented in table-1. All the samples showed higher concentrations for the three ions in the post monsoon period than during the pre monsoon time.

Permissible limit of Na in the groundwater as per WHO as well as BIS

standards is 100mg/l [5,6,13,14]. All the samples showed high concentrations of Na but within the permissible limit except three (Sample No. 4,8 and 10). Several scientists have attributed excessive levels of Na (>150 mg/l)to sea water intrusion in the coastal belt [3,4]. But none of the samples showed such high values for Na. As the study area is urban and close to 2 storm water drain carrying sewage it can be assumed that the composition of water in this study area may be influenced by wastewater flowing through it from local households [12] .

The likely sources of potassium in ground water are silicate minerals-orthoclase, microcline, hornblende, muscovite and biotite in igneous and metamorphic rocks. Permissible limit of K concentration in the groundwater as per WHO as well as BIS standards is 10mg/l. All the samples showed K in excess of the permissible limit except two (Sample No. 2and 5). Main cause for increase in potassium levels in groundwater is agricultural activities. But since the study area is urban and is nowhere near an agricultural field that reason can be ruled out. Water softeners that regenerate using potassium chloride can also raise the level of potassium in water significantly. The research by DURKOWSKI (2005) [15] demonstrated that such high potassium concentrations occur in ground water of urban areas due to sewage infiltration. Excessive K levels in the present case can also be attributed to the same factor. Excess amount of potassium present in the water sample may lead to nervous and digestive disorders [17]. It is recommended that people with kidney disease or other conditions such as heart disease, coronary artery disease, hypertension, diabetes and those who take medication that interferes with how the body handles potassium should not drink ground water in this area.

Chloride in ground water originates from both natural and anthropogenic sources. High chloride content indicates heavy pollution. It can be due to the uses of inorganic fertilizer, landfills, lechates, septic tank effluent and industrial and irrigation drainage . Permissible limit of Cl^- in the groundwater as per WHO standards is 200 and as per BIS standards it is 250mg/l. All the samples showed Cl^- within the permissible limit.

CONCLUSION: In conclusion, among the major ions investigated the concentrations of sodium and chloride in the ground water samples from Gnanapuram of Visakhapatnam city are within the permissible limits. Excessive concentration of potassium and higher values of sodium may be indicative of contamination of the waters in this area owing to an influx of sewage from households nearby [12, 15]. Above cited results shows that the overall water quality in the study area is unfit for drinking purpose but can be used for domestic chores.
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Table-1: Pre Post Monsoon concentration levels(mg/l) of Sodium, Potassium and Chloride of ground water samples in the study area.

Sample No	Depth in feet	Sodium		Potassium		Chloride	
		Pre Mon	Post Mon	Pre Mon	Post Mon	Pre Mon	Post Mon
1	65	104.1	117.2	13.7	14.9	85.7	98.3
2	69	29.1	38.0	3.3	3.6	68.6	80.1
3	70	46.2	54.1	35.7	39.1	62.9	75.2
4	62	150.3	167.5	27.0	31.2	91.4	100.9
5	30	18.3	22.1	10.8	12.5	34.3	39.6
6	27	41.7	51.3	23.0	25.2	62.9	75.3
7	28	66.9	80.2	30.0	33.9	97.1	110.5
8	30	115.2	129.2	44.4	46.0	154.3	171.2
9	30	62.1	75.0	30.1	33.5	102.9	115.3
10	25	199.5	214.2	78.9	85.2	97.1	109.1
11	28	54.0	62.1	22.5	24.1	68.6	80.0
12	28	47.1	56.4	11.7	12.5	68.6	81.4

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