A Case Study of Water Quality in Groundwater of Industrial Area, Eluru, West Godavari District, A.P

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Abstract
The present paper is aimed to study the quality of water samples from bore wells as well as canal in and around the industrial zones of Eluru, Andhra Pradesh. The present study was made for assessing impact of industrial activities on the ground water as well as canal water. Eight Water samples were collected to carry out the analysis. The physical parameters like pH, EC, TDS, Total hardness were analyzed using standard techniques in the laboratory. The ions studied include, chloride and sulphate. The trace metals like pb, Fe, Zn, Mn, Cd were analyzed using Atomic Absorption Spectrophotometer. The results were compared with W.H.O and ICMR Standards.

Keywords
Trace Elements, water quality, physical parameters

I. Introduction

Water is a vital element for life. Fresh water resources like ground water, surface water, and sub surface water are limited. Fresh water is essential for all living organisms including human beings1. There has been great demand for fresh water due to rapid growth of population as well as industrialization. The quantity and quality of the ground water is highly related with the local geological, hydro geological and environmental conditions 2. Generally higher amount of dissolved constituents are found in ground water than surface water. Ground water is the main source of irrigation in addition to domestic needs. In most of the industrial cities the disposal of industrial wastes on to the land is resulting in the deterioration of ground water quality 3. Heavy metals are usually present as trace amounts in natural water but many of them are toxic even at very low concentrations. Over one billion people each year are exposed to unsafe drinking water due to contamination. According to WHO organization, about 80% of all the diseases in human beigings are waterborne. Industrial disposal of chemicals by surface and sub surface runoff finally reach the ground water level. The main objective of this paper is to examine pollution threats for ground water and surface water around industrial areas in Eluru of West Godavari district, Andhra Pradesh.

II. Study Area

Eluru is located on the west Godavari district of Andhra Pradesh, India. It is located at 16.7°N 81.1°E.The average elevation is 22 metres (72 feet) above sea level. Krishna-Godavari Canal slicing the town into two parts, One Town and Two Town. The city is situated on the border of the Kolleru Lake. The Tammileru River passes through the city. The Eastern part of Tammileru borders the entire North of the city, while the Western Tammileru flows to the West of the city. The Krishna – Eluru canal passes through the heart of the city from South – West towards North – East. The Godavari - Eluru canal, The Krishna – Eluru canal and the Tammileru River and join together on their way to Kolleru Lake. Eluru city falls in the hot humid region of the country and it is less than 40 miles (64 km) from Bay of Bengal. The climate of the city is very hot in the summers and it is pleasant during the winter. The hottest day falls in the month of May with shift to June during some years. The maximum temperature observed is 51.7 C and the minimum temperature observed is 12.9 C. The present study was carried in and around industrial zones located in between Krishna canal, Godavari canal.

III. Hydrogeology

Geologically the area is underlain by the Eastern Ghats of super group of Precambrian age and sediments of recent age. This area is underlain by Archaean crystallines, Gondwans, Deccan traps, Tertiaries and alluvial sediments. The groundwater occurs under unconfined, semi to confined conditions in different formations of the area.

IV. Materials and Methods

In the present work water samples are collected from 8 different locations in and around Industrial zones of Eluru. The locations are (S1) Vidyuath Nagar, (S2) Ambica temple in the Industrial Estate, (S3) Ice plant in the Industrial Estate, (S4) Satrampadu, (S5) sir CR R Autonomous College, (S6) kothuru jute mill, (S7) canal water near jute mill, (S8) jute mill on high way.
The samples were collected in cleaned and well-dried bottles with necessary precautions. These bottles were labeled with respect to collecting points, date and time in order to avoid any error between collection and analysis .Water samples were collected on Nov 26, & 27 of 2016 for determining both physiochemical analyses as well as for identifying heavy metals. All the chemicals used were AR grade of pure quality. Double distilled water was used for the preparation of all the reagents and solutions. Glassware were cleaned with commercial HCl followed by distilled water. The pH and Electrical Conductivity were measured by using Systronics digital pH meter (model 802) with an accuracy of ± 0.01 and Systronics digital Conductivity meter (model 304) with an accuracy of ± 0.01 respectively. TDS was determined by using TDS meter (TDS-3). Total Hardness were measured by EDTA titration method. Na, K, were measured using flame photometer(model-130).Trace elements like Fe, Zn, Mn, Cd, Pb were analyzed by using Atomic absorption spectrophotometer (model SYS-813). In general, the standard methods recommended by APHA, and NEERI (1986) were adopted for determination of various physico-chemical parameters. For the determination of Hardness, 50ml of sample was buffered at pH 8-10 (NH4Cl and NH4OH) and titrated against standard EDTA using Erichrome Black T as indicator. Calcium was measured by titration of the water sample against standard EDTA using muroxide indicator. Sulphates were determined by systronocs uv-vis spectrophotometer (model-108).

V. Results and Discussion

The physico-Chemical analysis result of water samples for PH, EC, TDS, TH, Chloride, Sulphate were represented in Table-1. Observed values for Na, K, Cd, Zn, Mn,Fe and Pb has been shown

in Table 2. Stastical data like mean, minimum, maximum & STD is shown in Table-3. Correlation coefficient matrix of water samples is shown in Table 4.

Table 1: Physico-Chemical analysis of water samples from industrial zone

S.No	PH	Ec	TDS	TH	Chloride	Sulphate
S1	8.3	900	576	292	157.62	11.35
S2	7.1	1400	896	402	244.24	12.95
S3	7.3	1000	640	302	150.52	11.9
S4	7.44	900	576	312	122.12	10.75
S5	7.35	1200	768	312	103.66	12.85
S6	7.83	400	256	268	391.92	34.7
S7	7.2	2700	1728	110	29.82	9.5
S8	7.11	2000	1280	352	214.42	22.75

Table 2: Analysis of water samples for Trace Elements from Industrial zone

S.No	Na	K(mg/l)	Cd(mg/l)	Zn(mg/l)	Mn(mg/l)	Fe(mg/l)	Pb(mg/l)
S1	13	2	ND	0.007	0.15	ND	ND
S2	19	2	ND	0.006	0.1	0.11	ND
S3	13	2	ND	0.009	0.15	ND	ND
S4	11	1	ND	0.011	0.13	0.059	ND
S5	20	1	ND	0.002	0.15	ND	ND
S6	53	1	ND	0.011	0.12	ND	ND
S7	4	1	ND	0.021	0.15	ND	ND
S8	39	6	ND	0.006	0.15	ND	ND

Table 3: Stastical data of water samples from industrial zone

Parameters	MIN	MAX	MEDIAN	STD
PH	7.1	8.3	7.325	0.414
Ec	400	2700	1100	725.923
TDS	256	1728	885	148.995
TH	110	402	307	84.748
Chloride	29.82	391.92	154.07	109.048
Sulphate	9.5	34.7	12.375	8.640
Na	4	53	16	16.336
K(mg/l)	1	6	1.5	1.690
Cd(mg/l)	0	0	0	0.000
Zn(mg/l)	0.002	0.021	0.008	0.006
Mn(mg/l)	0.1	0.15	0.15	0.019
Fe(mg/l)	0.059	0.11	0.0845	0.036
Pb(mg/l)	0	0	0	0.000

A correlation coefficient is a number that quantifies some type of correlation and dependence, meaning statistical relationships between two or more random variables or observed data values. Degree of linear association between any two values are measured by the simple correlation coefficient(r) or Pearson's r. It is a measure of the strength and direction of the linear relationship between two variables that is defined as the (sample) covariance of the variables divided by the product of their (sample) standard deviations value is ranging from +1,to -1,If r value is 0 indicates positive linear parameters.

Table 4: Correlation coefficient matrix of water samples from industrial zonec

	pH	EC	TDS	TH	Cl	Na	K	Fe	Zn	Mn
pH	1									
EC	-0.5924	1								
TDS	-0.2629	0.65134	1							
TH	-0.1062	-0.4315	-0.68533	1						
Cl	0.24552	-0.5803	-0.01804	0.45832	1					
Na	0.11775	-0.368	0.189551	0.31996	0.87479	1				
K	-0.2817	0.32599	0.045946	0.42645	0.16288	0.35181	1			
Fe	-0.3309	-0.0699	-0.29873	0.49945	0.13264	-0.1888	-0	1		
Zn	-0.073	0.46342	0.718494	-0.864	-0.2804	-0.2875	-0	-0.1425	1	
Mn	0.12067	0.32221	0.081005	-0.4304	-0.5994	-0.2795	0.2	-0.8253	0.0829	1

Table 5: Comparison of Drinking Water Standards

Sl. No.	Parameter	BIS	ICMR	WHO
1	Colour	5	2.5	-
2	Odour	Agreeable	Unobjectionable	Unobjectionable
3	pH	6.5-8.5	7.0-85	7.0-8.5
4	TDS	500 mg/l	500 mg/l	500 mg/l
5	Hardness	300 mg/l	300 mg/l	200 mg/l
6	Ca	75 mg/l	75 mg/l	75 mg/l
7	CL	250 mg/l	200 mg/l	200 mg/l
8	Sulphate	200 mg/l	200 mg/l	200 mg/l
9	Fe	0.3 mg/l	0.1 mg/l	0.1 mg/l
10	Cd,	0.01 mg/l	-	0.01 mg/l
11	Pb	0.1 mg/l	-	0.01 mg/l

BIS- Beaurau of Indian Standards,ICMR- Indian Council for Medical Research.WHO- Health Organization.

A. PH

The observed PH value ranging from 7.1 to 8.3 in the collected 8 samples PH value is observed as within the allowed range of 6.5 to 9.2 according to WHO.

B. Total Dissolved Solids (TDS)

The mineral constituents dissolved in water gives total dissolved solids (TDS). TDS is the general indication of overall suitability of water for various uses. In the study area range of TDS is from 100 to 515. According to WHO the permissible limit is 500. .

Sodium (Na):

The sodium ion is ubiquitous in water. Saline intrusion, mineral deposits, seawater spray, sewage effluents, contributes significant quantities of sodium to water. In the study area sodium in the water observed range is 4 to 53. It is far below the normal range.

C. Potassium (k):

Concentrations of potassium normally found in drinking-water are generally low and do not pose health concerns, the high solubility of potassium chloride and its use in treatment devices such as water softeners can lead to significantly increased exposure. In the samples potassium observed between 1 to 6. The observed values are within permissible limit.

D. Chloride

The permissible limit of chloride is 250mg/l, High chloride content may harm metallic pipes and structures as well as growing plants. Chloride in excess imparts the salty taste water. People are not accustomed for high chloride in water. In the present study it is observed that a low range of 29.82 mg/l is observed in canal water, where as 391.92 mg/l is detected in the s6 sample. Permissible range is upto 250 mg/l as per ICMR.

E. Sulphates

The major physiological effects in excess quantities of sulphates are dehydration, gastro intestinal irritation. Sulphates also contribute to corrosion of distribution systems. Sulphate in the samples range between 9.5 to 34.7 mg/l, which is below the BIS range 250 mg/l

VI. Heavy Metals

Collected 8 samples were labeled and analyzed for the metal content using AAS. The observed values in different locations in and around industrial area have been presented in the table2.

A. Iron (Fe):

Consumption of excess amount of iron leads to hemochromatosis, a severe disease that may damage organs of the body. Early symptoms are fatigue, weight loss, and joint pains. It may also cause liver problem, Diabetes. Irons in the samples were between ranges of 0.059 to 0.11. According to BIS permissible limit is 0.3.

B. Zinc (Zn)

According to WHO In natural surface waters, the concentration of zinc is usually below 10 µg/litre, and in ground waters, 10– 40 µg/litre .In the study area except in sample 7 zinc level is below the normal range.

C. Manganese (Mn):

Manganese is considered as one of the least toxic element but excess amount consumption may cause growth retardation, fever, fatigue and eye blindness. In the samples Manganese level range between 0.1 to 0.15, it is below the desirable limit.

D. Lead (Pb):

Lead is toxic to the central and peripheral nervous system causing neurological and behavioral effects. The consumption of lead in higher quantities leads to hearing loss, blood pressure and hypertension. No trace of Lead is found in the collected samples.

E. Cadmium (Cd):

It is a cumulative environmental pollutant and its exposure to the body damages the kidney and causes renal disinfection, even cancer also. No traces of cadmium are found in the collected samples.

VII. Conclusion

In the study area the physico chemical parameters of water indicates considerable variation. Sodium, Potassium, chlorides, Sulphates ranges are within the limit of ICMR standards. No traces of lead and cadmium are observed even though the samples were collected within industrial zone area. Hence the water quality in the study area is suitable for drinking purpose.

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