



Assessment of Surface Water and Ground Water Quality of Industrial Areas in Medak, Andhra Pradesh, (India)

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ABSTRACT

A study was conducted for the analysis of pollution load in surface water and ground water at Kazipally IDA, Gaddapotheram IDA, and Bollaram IDA during the rainy season. Samples were analyzed for various physical and chemical parameters like pH, EC, TDS, Nitrates, Phosphates, Flourides, Sodium, Potassium, Calcium and magnesium. The heavy metals such as Fe, Mn, Ni, Zn and Cd were analysed. All the results were compared with US-EPA and WHO standands and it was found that surface water and ground water are highly polluted and they are neither fit for irrigation nor safe for drinking purposes.

Key words: Assessment, Industrial effluent, Medak, A.P., Physical and Chemical parameters.

INTRODUCTION

Medak District with an area of 9702 km² is located at 17°3'N Latitude and 78°15' longitude on the North-Eastern part of Andhra Pradesh state in India. It is located on the banks of river Manjera. This area was predominantly an agricultural land. . The Patancheru Industrial Estate was set up in 1975 as part of Govt's initiative to bring in more industries and to industrialize the backward areas in the State of Andhra Pradesh, India. As a result the Medak has been transformed into Industrial belt.

Subsequently numerous Industries were established at Kazipally, Gaddapotheram and Bolaram and other places in Medak District.

In Kazipally and Gaddapotheram Industrail areas there are Chemical and bulk drug manufacturing units. Industrial effluents are the major factor causing the pollution of the environment of these areas and also affecting the surface water as well as ground water. The pollution of surface water and ground water is arguably the most serious threat to human life.

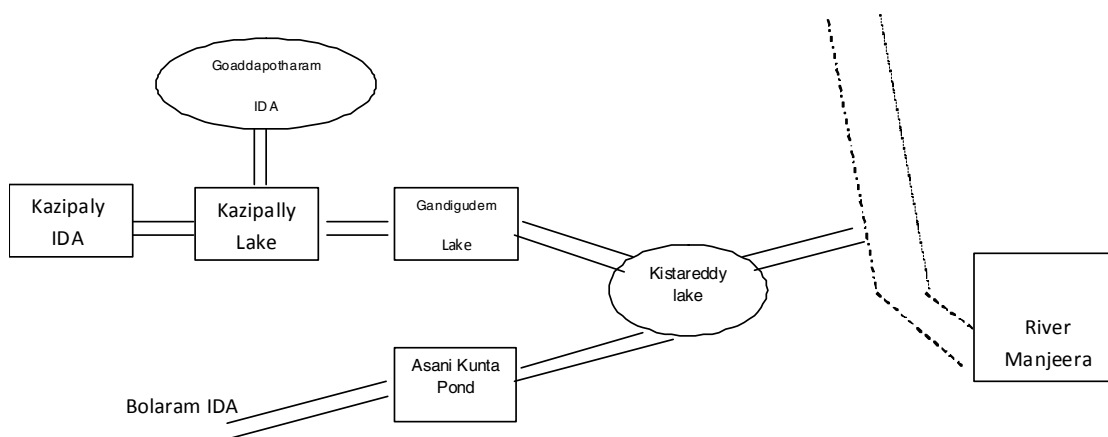
Industrial effluents are discharged into water bodies containing toxic chemicals (i.e., inorganic, organic and synthetic chemicals) from various industries. The toxicity of various pollutants contaminate the water bodies and they poison the aquatic life. Synthetic chemicals are released by industries, but they never produced in nature. Many of these chemicals are so stable that they cannot be break down by the existing common effluent treatment plants.

Ponds, Tanks, lakes, Streams and Rivers are the natural sources for all kinds of chemical reactions. In the presence of sunlight, wind, convection currents of water and the potential energy of the stream will mix and stir the water of the water bodies. It is also alarming that most of the industries discharging large quantities of industrial effluents directly into water bodies resulting in serious pollution. This loss of water quality is causing health hazards, death of aquatic lives and crop failures.

This problem is aggravated by lack of awareness, lack of wastewater treatment facilities, lack of financial resources and insufficient environmental laws.

The objective of this study was therefore to assess the extent of chemical pollution in receiving water bodies and ground water, which are affected by industrial effluent discharged therein.

Present studies were carried out at Kazipally IDA, Gaddapotheram IDA, Bolaram IDA. The industries of Kazipally IDA, Gaddapotheram IDA are discharging their effluents into Kazipally lake. From Kazipally lake, the water drained into Gandigudem lake and polluting the water in the down stream natural bodies such as Kistareddy pet lake, Asanikunta pond, , palma vagu, Peddavagu Stream all the way upto river Manjeera.



MATERIAL AND METHODS

Samples were collected from Kazipally Lake, Gandigudem Lake, Asanikunta Pond, kistareddypet Lake, palma vagu stream, Pedda Vagu stream and ground water samples from the areas surrounding. Samples were collected in clean and dry plastic bottles in such a way that no bubbles were formed in bottles. After collection, the samples were analyzed for all physical and chemical parameters. All the analytical work was carried out in Geo-chemistry Lab National Geo-physical Research Institute (Ngri), Hyderabad.

Chemical Analysis

pH was measured using a Systronics pH digital meter, Electrical conductivity by conductivity meter and TDS by TDS meter 308. Na and K were determined by using flame photometer. Chlorides, Sulphates, nitrates, Phosphates, Flourides were determined by using Ion-Chromatograph. Ca, Mg and total hardness by titri-metric method. Zn, Fe, Cd, Ni, Mn were analysed by F-AAS (Flame- Atomic absorption spectrophotometer) by using specific cathode lamp.

F–AAS was calibrated for each element using standard solution of known concentration, before sample injection (APHA 1992).

RESULTS AND DISCUSSION

The pH of the surface water of water bodies and ground water found to be in the range of 6.98 to 7.89. The pH of all the of surface water and ground water are with in the permissible limits of US-EPA and WHO standards (6.0-8.5).

Electrical conductivity of water is a measure of total dissolved solids, is one of the most important water quality parameters, which effects the water intake of the crops. The electrical conductivity of water is less than 1.5 mS/cm then water is considered to be safe and more than 1.5 mS/cm is not safe for crops it may create salinity/ alkalinity problems in the soil in due course. However, the conductivity is more than 2.25 mS/cm the water is considered to be dangerous for crops.

The EC is found to be in the range of 5.0 – 10.6 mS/cm for lakes. The EC of Kazipally lake is found to be 7.0 mS/cm. The high value of EC for Kazipally lake may be due to direct discharging of effluents from industries of Kazipally IDA and Gaddapotharam IDA into lake. The EC of Gandigudam lake is 5.0 mS/cm. The low value for Gandigudam lake is due to fact that it is not receiving effluents directly from the industries. EC is found to be highest in Asanikunta i.e 10.1ms/cm. This is due to the inflow of effluents from Gandigudam lake and also from Bolaram Industries. The EC for Kistareddy pet lake , Pedda Vagu Stream, palma Vagu Stream was found to be 5.8 ms/cm,10.6 ms/cm , 8.2 ms/cm respectively.

Na is found to be in the range of 563-931 mg/L for lakes and 287-834 mg/L for ground water. Upto moderate concentration of Na there is no adverse impact, but high concentration may effect the soil structure as well as permeability resulting in alkaline salts and becomes toxic to plants. For both surface and ground water having Na concentration above permissible limit of 20 mg/L (US-EPA).

K is found to in the range from 26-170 mg/

L for lakes and 32-76.1 mg/L for ground water. Potassium is not known for harmful or toxic effect on human health but it helps in plant growth as an essential nutrient.

Ca is found to be in the range from 205-487mg/L for lakes and 122-230 mg/L for ground water. Ca has no hazardous effect on human health, infact; it is one of the most important nutrients required by the organism. Calcium can also aid in maintaining the structure of plant cells and soils.

Magnesium is found to be in the range of 87-201 mg/L for lakes and 87-134 mg/L for ground water. Magnesium is regarded as non-toxic to human health.

Chloride is found to have range from 350-1500 mg/L for lakes, which is above the permissible limit of 250mg/L as per US-EPA. The lowest value found in chinna vagu stream (350 mg/L) and the highest value in Asanikunta Pond (1500 mg/L). If chloride is more than 250 mg/L in water it is unfit for both irrigation and drinking purposes. Chloride increases the electrical conductivity of water and thus increases its corrosivity. In metal pipes, chloride reacts with metal ions to form soluble salts thus increasing levels of metals in water. In Pb pipes, a protective oxide layer is built up, but chloride enhances the galvanic corrosion. It can also increase the rate of pitting corrosion of metal pipes.

The chloride is found to be in the range of 300 - 500 mg/L for ground water, which is above the permissible limits. Sulphate ranged from 100-250 mg/L for lakes and in the range of 300 - 500 mg/L for ground water. Both surface water and ground water are having sulphate concentration above the permissible limit of 150 mg/L as per US-EPA.

Nitrates and phosphates are always present in natural water and they are important nutrients for plant growth, but too much of nutrients encourages the over abundance of plant life and can result in environmental damage called as eutrophication. Thus nitrates and phosphates are the key factors for eutrophication of lakes. Excessive concentration of nitrates also causes severe health problems, like blood disorders and conc of nitrate

Table 1: Results of the physico-chemical characterisation of surface water and ground water

Parameters	Kazipallylake			Gandigudam Lake			Asani		Kistareddypet Lake			Peddavagu		Chinnavagu	
	Inlet	Outlet	Ground water	Inlet	Outlet	Ground water	Pond	Kunta	Inlet	Outlet	Ground water	stream	stream	stream	stream
pH	7.34	7.76	7.78	6.7	7.5	7.76	6.89	7.55	7.10	7.34	7.12	7.5	7.12	7.12	7.12
EC ms/cm	3.2	3.3	1.8	2.1	1.8	1.3	4.0	1.9	1.8	1.2	1.4	1.2	1.4	1.4	1.4
TDS mg/l	2100	2150	1200	1400	1200	850	2600	1300	1200	800	900	800	900	900	900
Sodium mg/l	260	260	190	160	140	110	420	150	140	100	120	70	120	120	120
Potassium mg/l	36	38	07	20	16	25	22	14	14	30	14	06	14	14	14
Calcium mg/l	275	225	125	145	100	95	215	200	140	90	100	75	100	100	100
Magnesium mg/l	15.9	158.6	54.9	86.6	67.1	49.5	161.05	69.25	75.6	40.5	51.2	73.2	51.2	51.2	51.2
Chloride mg/l	1050	1100	500	650	550	320	1300	630	550	300	350	350	350	350	350
Sulphate mg/l	200	180	150	150	100	170	250	175	140	60	180	100	180	180	180
Nitrate mg/l	20.8	10.8	18.4	35.6	6.4	13.0	60.0	19.6	20.6	12.0	15	10.8	15	15	15
Phosphate mg/l	15.6	14.3	BDL	9.12	5.5	BDL	1.4	4.8	3.4	BDL	2.4	1.1	2.4	2.4	2.4
Fluoride mg/l	0.84	0.75	0.76	0.61	0.58	0.14	2.46	1.28	0.56	0.13	0.2	0.54	0.2	0.2	0.2
Fe mg /l	0.05	0.07	0.03	0.08	0.04	0.048	0.03	0.05	0.025	0.08	0.01	BDL	0.01	0.01	0.01
Mn mg /l	2.25	2.95	0.002	0.982	0.170	0.095	0.16	0.008	0.021	0.025	0.006	BDL	0.006	0.006	0.006
Ni mg /l	0.135	0.189	0.004	0.062	0.044	0.020	0.138	0.020	0.057	BDL	0.054	BDL	0.054	0.054	0.054
Zn mg /l	0.054	0.045	0.015	0.039	0.025	0.012	0.023	0.012	0.012	0.007	0.013	0.004	0.013	0.013	0.013
Cd mg /l	0.015	0.013	0.003	0.009	0.006	0.008	0.018	0.007	0.006	0.002	0.012	BDL	0.012	0.012	0.012

Metals in lakes

Metal	Max Limit US-EPA mg/L	Kazipally lake		Gandigudam lake		Asani kunta	Kistareddy lake		Chinna Vagu stream	Pedda Vagu stream
		Inlet	Outlet	Inlet	Outlet		Inlet	outlet		
Fe (mg/L)	0.1	0.05	0.07	0.08	0.04	0.03	0.05	0.025	BDL	0.01
Mn (mg/L)	0.05	2.25	2.95	0.982	0.170	0.16	0.008	0.021	BDL	0.006
Ni (mg/L)	1	0.135	0.189	0.062	0.044	0.138	0.02	0.057	0.007	0.054
Zn (mg/L)	5.0	0.054	0.045	0.039	0.025	0.023	0.012	0.012	0.004	0.0134
Cd (mg/L)	0.01	0.015	0.013	0.009	0.006	0.018	0.007	0.006	BDL	0.012

US-EPA and WHO standards for drinking water

Contaminants	U.S.EPA (mg/L)	WHO (mg/L)
Color	Colorless	Colorless
Odor	Odorless	Odorless
Taste	Tasteless	Tasteless
Temperature	-	12°C
PH	6.0 - 8.5	6.5 - 9.2
DO	4 - 6	3
TDS	500	500
TSS	0 - 5	5
Cl-	250	200-500
Sulphates	250	200-400
Nitrate/Nitrite	100	45
Calcium	100	100
Magnesium	30	150
COD	4.0	10
Sodium	20	200
Potassium	--12	
E.C	300	400
Arsenic	0.05	0.05
Cadmium	0.01	0.05
Fluoride	2.2	1.5
Mercury	0.002	0.001
Iron	0.3	0.3

above 45 ppm may cause methamoglobinaemia in children. The toxicity of nitrate to human beings is mainly due to its reduction to nitrite. The major biological effect of nitrate in human beings is its involvement in the oxidation of normal Hb to met-Hb, which is unable to transport oxygen to the tissue. When met-Hb concentration reaches 10%

and above normal-Hb concentration, the condition is called methamoglobinaemia. The nitrate was found to be in the range from 10.89 - 60 Mg/L for lakes. It is above the permissible limits of 45 mg/L in Asanikunta (60 mg/L) and it ranges from 12 - 18.4 mg/L for ground water, which is within the permissible limits. Phosphate is found to be between 1.1. mg/L - 15.6 mg/L. It is found to be lowest in Peddavagu stream (1.1. mg/L) and highest in Kazipally lake (15.6 mg/L). The phosphate concentration is below detectable level in ground water.

Fluoride was found to be in the range of 0.2 - 2.46 mg/L for lakes and It ranges from 0.13 to 0.76 mg/L for ground water. Except asanikunta lake (2.46mg/L), all other lakes are having fluoride concentration within permissible limit of 1.5mg/L (WHO), but flouride is within limits for ground water. Fluoride can have adverse effect on tooth enamel and may give rise to mild dental flourosis at a concentration between 0.9 to 1.2 mg/Litre (Dean, 1942)

The concentration range of individual heavy metals found to be Fe (0.1 - 0.8 mg/L) Mn (0.006 - 2.95), Ni (0.007 - 0.189) Zn (0.004 - 0.054 mg/L) Cd (0.006 - 6.015 Mg/L). The concentration of heavy metal found to be high In Kazipally lake. The low concentration levels of metals determined in other lakes could be ascribed to dilution, sedimentation and depuration. Slow flow conditions enhance sedimentation, especially in the presence of high levels of iron and manganese in the system as observed from the analysis of sediments (Okoye

etal, 1989). This sedimentation would likely become the more important mechanism for removing heavy metals and other pollutants from the water thus the cumulative impact is that heavy metal levels are kept low in spite of high fluxes from industrial wastes.

The study has shown that the effluents from the industries have a huge impact on the water quality of receiving lakes. Although, the values in some cases were lower than the allowable limits, the continued discharge of the effluents in the lakes may result in severe accumulation of the contaminants, which in turn affects the lives of the people. The following conclusions may be arrived at, based on the study.

- The industrial effluents had severely polluted the lakes especially Kazipally lake, Asanikunta pond.
- The ground water is not fit for drinking in many areas around the lakes.

- The surface and ground water is not safe for irrigation.

- The lakes are degraded in its quality due to excessive input of industrial effluent from the industries.

- The lakes had turned to Eutrophic.

The following steps should be taken for proper treatment of industrial effluents before discharging into water bodies

- Govt. has to take necessary steps to monitor the treatment of industrial effluents periodically by industries.
- Kazipally lake, Asanikunta pond, Kistareddy pet lake, which are identified as highly affected by toxic industrial discharges and for which remedial steps should be taken immediately.
- All the contaminated lakes must be treated immediately.

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