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Physico - Chemical Analysis of water in and around IISCO Mining area of Kiriburu

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ABSTRACT

The present paper deals with qualitative analysis of water during 1997 – 1999 in Kiriburu mining area, located in Chaibasa district of Jharkhand, to assess actual and potential changes in water quality of ground as well as surface water due to mining activities. Water is one of the most important natural resources and availability of safe drinking water is necessary both for aquatic and terrestrial habitat. But due to irregular and unsafe mining activities, ground as well as surface water gets contaminated by adding heavy metals and harmful chemicals. The holistic approach of this work includes all the aspects of physico-chemical analysis using standard methods and analysis of different kinds of minerals, salts and contaminants.

Keywords : Physico-chemical, qualitative, contaminants, water, Kiriburu.

INTRODUCTION

Water is a vital factor for the existence for all life forms and is essential for all activities of human beings (Dhar*et al.*,1986).The effect of water pollution on human health is of serious nature (Rawat and Arora,1986).Drinking water plays an important role in the bodily intake of true element by human. Even though some trace elements are essential to man, at elevated levels essential as well as non-essential element can cause morphological abnormalities reduce growth, increase mortality and mutagenic effects. Ground water is about 20% of the world resources of fresh water and used in large amount for industry, irrigation and domestic activity.

Water is one of the abundantly available substances in nature which man has exploited more than any other resources for the sustenance of life. The chemistry of water is influenced by the input of material containing minerals, their solubility and chemical equilibrium prevailing in the aqueous solution. Any water is capable of assimilating certain amount of pollution without serious effect due to dilution and self-purification factors. The physico-chemical characteristics of any aquatic ecosystem and the nature and distribution of its biota are directly related to and influenced by each other and controlled by a multiplicity of natural regulatory mechanisms. However, because of man's exploitation of the water resources, the normal dynamic balance in the aquatic ecosystem is continuously disturbed, and often results in each dramatic response as depletion of fauna and flora, fish kill, change in physico- chemical character etc. (Sakhre& Joshi, 2003).

Artificial changes which lead to such ecological responses are referred to as pollution and pollutional stage may reach a stage when these valuable aquatic resources are no longer safe for human use. Water is significant source of habitat for plants, animals, and is found in every section of ecosphere. Source of water are atmospheric, with surface water, stored water and ground water. Due to rapid population growth, urbanization, industrialization and indiscriminate development it reduces the catchments area, which ultimately leads to gradual deterioration of water bodies.

Numerous anthropogenic activities like disposal of sewage and industrial water, recreational activities, mining activities, excess use of fertilizers and pesticides has threatened environmental health of both surface and ground water.

Water pollution is now a day is considered not only in the term of public health but alsoin terms of its conservation, aesthetics and preservation of natural beauty and resources.Water pollution has however threatened to reduce the quantity in ponds, lakes and rivers and reservoirs due to disposal of sewage, industrial water and due to other human activities (Trivedi &Chandrasekhar, 1999). Sinha *et al,.* (1990) carried out the assessment of drinking water quality of Santhal Pargana Bihar. The water quality of reservoirs and temple tanks at Tirupati and Tirumala was studied by Naidu *et al.,* (1990). According to different surveys, 70 to 80 present of Indian water sources are polluted and different enteric diseases affect millions of the peoples every year.

The natural water regime is affected by the mining and allied activities which require redistribution and pulverization of rock materials. By opening up fractures in the rock and the grain size the reaction rate between the water and materials increases or decreases. The surface and ground water can get contaminated if any harmful materials like chromium, lead, Arsenic etc. are present. There are certain other elements which can be present in water in larger quality of aquifers, streams etc. is as a result of contaminated water moving along the water cycle.

MATERIALS & METHODS

Water quality analysis was conducted at Kiriburu mining area of Chaibasa district during 1997 – 1999 to assess the quality of surface and ground water and to assess actual and potential changes in water quality brought about by mining activities.

Collection of water samples was done from different points along the stream, form slime dam area, tube well & springs. Sterilized plastic container of 205ml capacity was taken where the sample was collected. They were rinsed with sample water prior to collection of samples. The following parameters were analyzed either at the Laboratory.

(1) pH

(2) Temperature

(3) Dissolved Oxygen (Do)

(4) Free CO2

(5) Conductivity

The following parameters relating to water quality were analyzed at R& D SAIL, Ranchi, SQ118 Photometer (MARK) & Inductively Coupled Plasma, etc., were used for the above purpose. Physical parameters were measured using instruments like conductivity bridge, pH meter (Systronic mark) turbidity meter etc. The samples brought to the station were acidified with HNO3.

It is an important step in investigation of water and soil quality in such a way so that the sample collected corresponds to the composition of the entire water body or field area.

For estimation of Do

50 ml water sample was taken and preserved by adding 1.0 ml manganese chloride and 0.0 ml of alkaline solution of potassium iodide. The glass bottle was tightly closed with a cork and carefully shaken 25 to 30 tines. Then it was placed in a dark cool place. The Sample analysis was conducted after 24 hours.

Estimation of suspended matter

(Nitrites, nitrates & phosphates)

2 liters of the sample was taken and preserved with HNO_3 and mixed thoroughly.

Estimation of heavy metals

The collected sample was kept in a white glass and preserved 1.5 ml. HNO_3 (nitric acid).

1. Al as Al
2. BOD
3. COD
4. Cobalt as Co

5. Chromium as Cr
6. Copper as Cu
7. Cacium as Ca
8. Arsenic as As
9. Free NH_3
10. Iron as Fe
11. Lead as Pb
12. Cadmium as Cd
13. Sodium as Na
14. Nitrates
15. TDS
16. Potassium as K
17. Magnesium as Mg
18. Phosphorus as P
19. Nickel as Ni
20. Zine as Zn
21. Manganese as Mn

Chemical Analysis was done using ICP. The methodology applied is given below:

(1) Preparation of Reference Solutions for (Standard and stock solution) standards (Al, Ca, Mg, Na, Cr, Fe, Co, Ni, Zn, As, Pb, Cd, Cu, Mn, P). Required quantities of pure elements (metal or oxides) were taken in 1 litre flask with a small amount of double distilled water and sufficient quantities of conc. HCI (B.D.H) was added to solution. Distilled water was then added up to the mark (1ml of this corresponds to 1000/ug/ml of individual ions).

(2) Reference solutions were diluted to obtain the following concentration. 0-0.01-0.05-0.10-1.00-2.00-5.00-10.00-15.00ug/ml. Standard Range for individual element has been shown below in Table 1.

Table-1. Range of Standards (dilutations)

Elements	AD1	AD2	AD3	AD4	AD5
Cr	0.01	0.05	0.10	0.50	1.00
Fe	0.01	0.05	0.10	0.50	1.00
Co	0.01	0.05	0.10	0.50	1.00
Ni	0.01	0.05	0.10	0.50	1.00
Zn	0.01	0.05	0.10	0.50	1.00
As	0.01	0.05	0.10	0.50	1.00
Pd	0.01	0.05	0.10	0.50	1.00
Cd	0.01	0.05	0.10	0.50	1.00
Cn	0.01	0.05	0.10	0.50	1.00
Mn	0.01	0.05	0.10	0.50	1.00
P	0.01	0.05	0.10	0.50	1.00
Al	1.01	2.00	5.00	10.00	
Ca	5.00	10.00	20.00	25.00	
Mg	5.00	10.00	20.00	25.00	
Na	1.00	2.00	5.00	10.00	

RESULT & DISCUSSION

Dissolved Oxygen (DO)

The dissolved oxygen in water varied from 5.4 to 8.34 ppm. The stream waters show small increase in DO downstream. The fishes and crabs were found to have thick deposition of red slumy coating on body surface. The amount of DO sharply deceases in check dams due to increased TDS and situation. The check dams have a poor aquatic biota.

BOD & COD

Since DO is high in flowing waters of springs and streams, the biological oxygen demand tests were carried out in only some selected samples and their analysis show a low BOD indication low organic content. The water of check dam was found to have a high BOD indication high organic content and thus low aquatic microflora and fauna. The water was turbid with reddish muddy colour.

Total Suspended Solids

The water of Kiriburu is extremely low in TDS (excepting those of slime and check dams). TDS increases slightly towards downstream.

Chlorides & Sulphates

The Chloride Content of pump house, slime dam is extremely low. However, due to human activities, there is a gradual increase in chloride content downstream. The sulphates also show similar trends.

The different physical and chemical parameters of water quality were analyzed as shown in Table 2.

Table- 2. Average water quality of Kiriburu iron mines (Sampling date- 1997 to 1999)

DESCRIPTION	UNIT	KARO NALLAH	BOREWEL TOWN	PARDIH NALLA	RTD	KUMDI	TAILING DAM NEAR TOWN	TAILING DAM OUTLET	GAGIRATHI NALLAH	RING-RUNG TAILLING DAM
Temp	C	25.00	23.00	25.00	25.00	25.00	25.00	22.00	26.00	29.00
pH		6.75	6.58	7.15	7.45	7.32	8.32	8.78	7.23	7.40
DO	mg/lit	8.43	5.40	7.83	6.53	8.23	7.14	8.34	7.34	7.50
BOD at 20^0C for 5 days	mg/lit	2.20	2.60	1.55	3.03	2.53	1.64	1.31	1.54	N.A.
COD	mg/lit	21.03	25.70	22.03	6.53	8.23	7.23	8.34	7.34	7.50
Conductance	Microhos	83.03	211.70	32.43	36.03	28.00	27.00	33.04	34.00	N.A.
Turbidity	NTU	8.09	5.00	4.03	3.53	3.23	61.00	41.34	6.00	1.50
Oil & Grease	mg/lit	Nil	Nil	Nil	Nil	Nil	0.14	0.14	0.20	1.50
TSS	mg/lit	31.03	31.00	21.03	18.53	15.23	2300.00	100.34	80.34	43.00
TDS	mg/lit	31.03	81.00	41.03	21.53	40.23	40.50	25.34	28.34	19.00
Na	mg/lit	1.43	1.35	1.03	1.23	0.63	1.30	1.34	0.90	0.80
K	mg/lit	1.53	0.60	0.53	0.43	0.93	0.30	0.34	0.92	0.28
Mg	mg/lit	9.33	56.00	5.50	2.00	1.80	1.00	0.90	T	0.50
Ca	mg/lit	6.30	26.00	5.03	4.53	4.50	4.05	5.00	5.10	2.06
Hardness as Ca	mg/lit	51.03	292.00	16.50	18.53	18.23	11.15	10.34	12.34	8.50
Free SO_2	mg/lit	4.50	6.70	2.43	3.53	2.23	2.25	2.34	2.44	3.50
Dissolved Fe as Fe	mg/lit	3.04	2.10	0.60	0.80	2.00	2.60	2.00	1.00	
Alkalinity	mg/lit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Acidity	mg/lit	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Cl	mg/lit	17.50	18.50	12.30	18.50	12.50	12.55	8.60	11.56	6.60
SO_4	mg/lit	11.90	6.50	4.53	6.70	12.70	10.85	8.60	10.40	6.50
Total PO_4 as P	mg/lit	N.A	N.A	N.A	N.A	N.A	0.03	0.03	0.04	0.07
Inoragnic P as P	mg/lit	T	0.02	T	T	T	T	T	T	N.A
Nitrates as N	mg/lit	1.30	0.60	T	T	T	0.20	0.20	0.30	N.A
Nitrites as N	mg/lit	N.A	N.A	N.A	T	0.00	T	T	T	0.007
Free HN_3	mg/lit	1.30	0.20	0.90	1.35	0.90	0.80	0.45	0.30	0.35
Kjeldal N	mg/lit	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A.
Sulphides	mg/lit	N.A.		0.50	T	0.60	0.65	0.65	0.50	N.A.
Cadmiun as Cd	mg/lit	-	-	-	-	-	<0.02	<0.02	-	-
Lead as Pd	mg/lit	-	-	-	-	-	0.04	0.030	-	-
Selenium as Se	mg/lit	-	-	-	-	-	<0.02	<0.02	-	-
Arsenic as As	mg/lit	-	-	-	-	-	<0.02	<0.02	-	-
Copper as Cu	mg/lit	-	-	-	-	-	Nil	Nil	-	-
Zinc as Zn	mg/lit	-	-	-	-	-	0.20	0.03	-	-
Dissolved Mn as Mn	mg/lit	-	-	-	-	-	0.30	Nil	-	-
Hexavavalent Cr as Cr	mg/lit	-	-	-	-	-	Nil	Nil	-	-
Phonois as C_6H_5OH	mg/lit	-	-	-	-	-	<0.002	<0.002	-	-
Cyanide as CN	mg/lit	-	-	-	-	-	-	<.02	-	-

Sodium & Potassium

Sodium and potassium content were observed to be very low at the beginning of the spring. But as the stream flows down it picks up Na from percolated wastes.

Calcium & Magnesium

Calcium and magnesium content of water which determines the total hardness do not show much change in the river, Ca & Mg content is around 20 ppm throughout the sample areas Ca/Mg varies from 1 to <1 to 2.2. However the bore well water in the town shows high Ca & Mg content of 26.56 & 56.60 respectively.

Iron

The Iron content of these water is <1 ppm in apring samples but increases slightly downstream. The iron content of the slime and check dams are quite high. The stored water shows red sedimentation containing very high percentage of Fe & Al.

Heavy Metals

Various water samples analyzed for different heavy metals in order to understand the quality of effluents. Generally the heavy metal content of this natural water is below detectable level. Arsenic content (As) varied from 0.02 ppm to 0.2 ppm. In all these samples it was above permissible limit making them unsuitable for drinking purpose. The amount of lead (Pb) varied from 0.03 ppm to 0.1ppm. Amount of zinc (Zn) varied from 0.03 ppm to 5.00 ppm.

Nitrates & Ammonia

Nitrate and ammonia contents are indicative of population from organic waste. The presence of NO_3 in higher amounts can cause blue baby disease. In Kiriburu area nitrates are seen only trees. The free NH_3 also show a slight increase downstream.

CONCLUSION

The water samples collected from the various sources in and around Kiriburu mining area were analyzed based on different analytical parameters shows great influence of mining activities on water quality. There is a need to take necessary steps to avoid contamination of water.

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