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Assessment of ground water quality due to coal mining at Talabira-I coal mine, Sambalpur, Odisha

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ABSTRACT

Determination of physico-chemical characteristics of ground water is essential for assessing the suitability of water for drinking purposes. Keeping this view, a systematic study was carried out to assess the ground water quality at Talabira-I coal mine area, Sambalpur, Odisha, India. In the present study, 10 nos. of tube wells located in different areas adjacent to Talabira-I coal mine were chosen for analysis. A large number of physico-chemical parameters such as pH,conductivity,turbidity,TDS,TH,Ca,Mg,Cl,F,SO_4,PO_4,Fe and Cr were found to be well within the permissible limits. Concentrations of iron and TH in some samples were slightly high in the study stretch. So the water samples indicate that after removal of iron, the water can be used for drinking purpose.

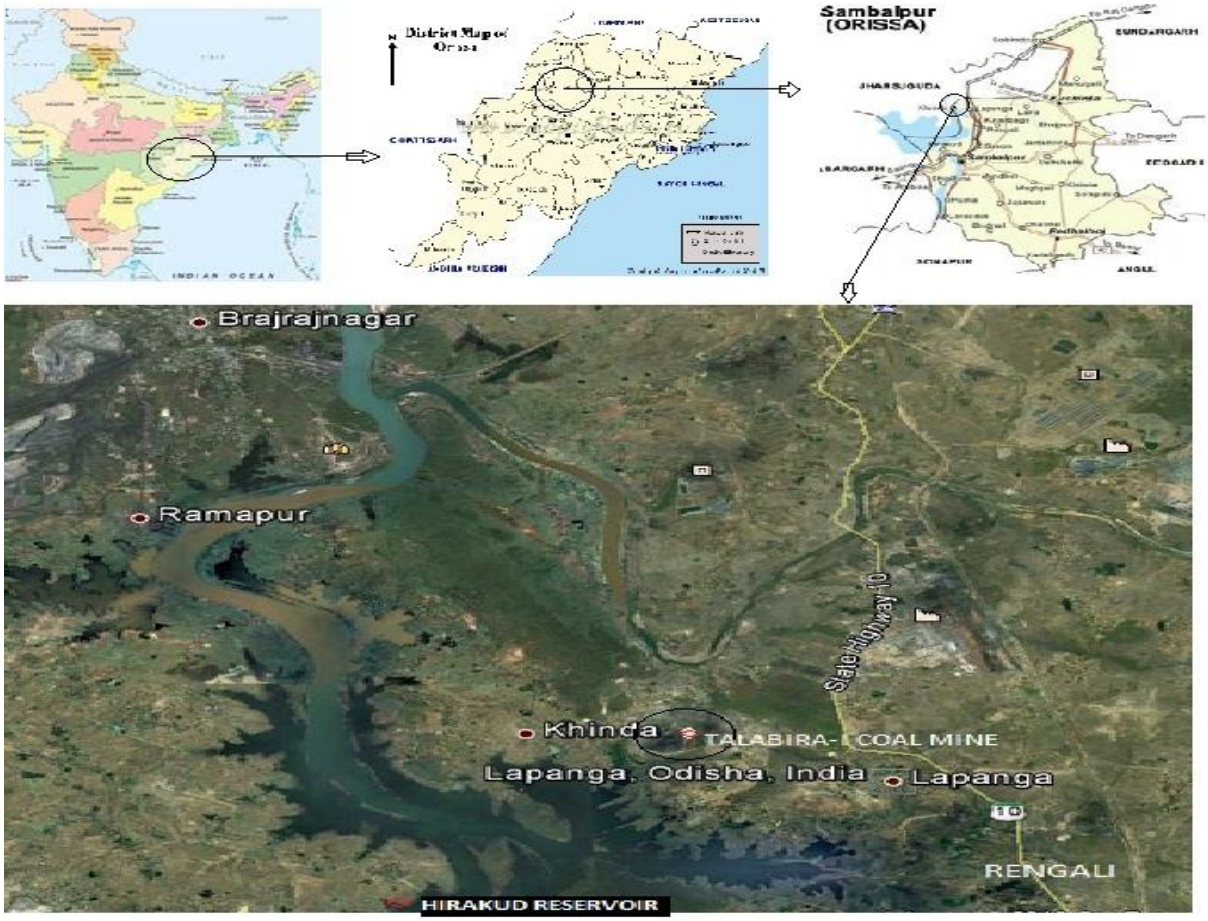
Keywords: Drinking water, Physico-chemical parameters, Permissible limits, Talabira-I coal mine.

INTRODUCTION

"Water" the elixir of life referred as nature and was worshiped since Vedic days. The Rig-Veda depicts that water function as givers and sustainers of life. Water has been vital to the development and survival of civilization. The total water available on this planet, about 97% is salty water and the rest is freshwater [1]. Water is the most essential commodity for human consumption and it is one of the renewable resources which must be prevented from deterioration in quality [2]. Ground water is a gift of nature and is about 210 billion M^3 including recharge through infiltration, seepage and evapotranspiration [3].Ground water contamination is generally irreversible i.e., once it is contaminated, it is difficult to restore the original water quality of the aquifer. Ground water pollution is usually or mainly occurs by the anthropogenic activities of human beings. The main origins are industries, domestic, agriculture, mining and over exploitation [4]. It is also deteriorating due to indiscriminate disposal of industrial waste both on land, surface of water channels and human activities [5, 6]. Major sources of drinking water are well, tube well and bore well. Since quality of public health in that area depends to a great extent on the quality of drinking water. Today good quality water has become a precious commodity. The quality of water is getting vastly deteriorated due to unscientific waste disposal, improper water management and carelessness towards environment. Monitoring of drinking water quality is essential to avoid any toxic effects on its consumption.

MATERIALS AND METHODS

Study Area : Talabira-I coal mine is an open cast working coal mine. This coal mine is the first drilling free and blast free coal mine in the country. It is situated in the South-Eastern end of Ib-Valley in Rengali Tahsil of Sambalpur District. The coal block lies between 21° 42' 58" N to 21° 44' 39"N latitude and 83° 58' 51" E to 84° 00' 39" E longitude in an area of 170.305 hectares. The coal block is located at a distance of 3.5 Km to the South-West of Rourkela-Sambalpur State Highway-10. The nearest township is Jharsuguda at a distance of 15 Km by road. The nearest railway station is at Lapanga at distance of 9 Km. The micro-meteorological data of the area have been collected from IMD Station, Sambalpur [7]. The minimum and maximum temperature of the area is 8.4^0C and 43.8^0C respectively and relative humidity lies in between 15% to 96%.



Source: Google Earth and Google Images.

Figure.1 Location map of country, state, district and study area

For the present study, 10 tube wells at different places in nearby area of Talabira-I coal mine, Sambalpur were selected for monitoring in the year 2012. The samples were collected in clean plastic bottles and the samples were brought immediately to the laboratory and kept in the refrigerator for further analysis. The pH and conductivity of the samples was measured on the spot by using a portable glass electrode pH meter and a portable conductivity meter. The physico-chemical parameters like pH, Conductivity, Turbidity, TDS, TH, Ca, Mg, Cl, F, SO_4, PO_4, Fe and Cr were analyzed as per standard methods [8, 9, 10]. Double distilled water and analytical grade chemicals were used throughout the experiments.

Table.1 Arrangement of sampling locations

Sl. No.	Name of Location	Sampling source number	Sampling source
1	Talabira-I office site	G1	Tube well
2	Khinda Village	G2	Tube well
3	Veer Surendra Sai High School	G3	Tube well
4	PHC, Khinda	G4	Tube well
5	Khinda Chhack	G5	Tube well
6	AOPL Office Site	G6	Tube well
7	Matul Camp	G7	Tube well
8	Rampur Village	G8	Tube well
9	Patrapali Village	G9	Tube well
10	Malda Village	G10	Tube well

RESULTS AND DISCUSSION

In the present study, the ground water collected from different places was analyzed for physico-chemical parameters in the year 2012. The value of physico-chemical parameters of 10 samples at Talabira-I coal mine are given in the table -3. The pH of the sample water was observed that the value varies between 6.8-7.9 which is indicates the pH value ranges in between the permissible limit. Conductivity of the water sample is in between 254 – 415 µ mho cm^{-1}. The TDS value of ground water samples varies from 183 to 251 mg L^{-1}. TDS is a most important parameter for assessing the ground water quality. Here the TDS value is in between the prescribed limit. Total hardness of the ground water samples were varied from 93 to 201 mg L^{-1}. Hardness is an important water quality parameter attributed due to presence of bi-carbonate, sulphate, chlorides and nitrates of calcium and magnesium. The range of calcium and magnesium are 21.05 to 43.08 mg/l and 18.02 to 38.47 mg L^{-1} respectively, which are well within the prescribed limit. The chloride content ranges from 93.45 to 178.56 mg L^{-1} which indicates that the chloride content is well within the norm. Excess fluoride content in the ground water may cause dental and skeletal fluorosis. The permissible limit of fluoride content is 1.5 mg L^{-1} [11].

Table.2 Water quality parameters used in the present study

Sl. No.	Parameters	Standards(WHO)	IS 10500
01	pH	7.0-8.5	6.5-8.5
02	λ µmho/cm	--	--
03	TDS	500-1500	500 (Max)
04	TH	100-500	300 (Max)
05	Ca	75-200	75 (Max)
06	Mg	30-150	30 (Max)
07	Cl	200-600	250 (Max)

08	F	0.7-1.5	0.6-1.2
09	SO_4	200-400	150 (Max)
10	PO_4	--	--
11	Fe	0.1-1.0	0.3 (Max)
12	Cr^{+6}	0.01	0.05

*All the values are expressed in mg/l except pH

In the present study the fluoride content of the ground water collected from Talabira-I coal mine, Sambalpur are well within the prescribed limit and ranges from 0.12 to 1.01 mg L^{-1}. Sulphate ion is one of the most important anion present in natural water produces cathartic effect on human being when it is present above permissible limit.

Table.3 Concentration of different parameters in ground water samples

Sample no.	pH	λ µmho/cm	TDS	TH	Ca	Mg	Cl	F	SO_4	PO_4	Fe	Cr
G1	6.8	254	251	93	21.05	18.02	93.45	0.12	19.54	0.047	0.17	0.009
G2	7.3	415	183	105	24.63	24.15	124.36	0.42	27.36	0.089	0.58	0.062
G3	6.9	289	219	201	43.08	38.47	178.56	0.35	38.42	0.415	0.49	0.024
G4	7.1	364	210	189	24.39	29.87	124.57	0.47	27.05	0.478	1.52	0.018
G5	7.9	312	180	143	34.58	19.98	113.04	1.01	21.08	0.258	1.24	0.053
G6	7.6	297	198	171	28.67	28.04	98.65	0.78	29.07	0.189	0.98	0.049
G7	7.2	259	189	116	21.84	25.80	124.36	0.34	21.98	0.089	0.31	0.025
G8	7.4	312	205	164	24.39	27.12	98.66	0.49	25.05	0.099	0.48	0.028
G9	6.9	287	210	144	29.24	24.15	113.94	0.51	36.02	0.091	0.39	0.018
G10	7.2	288	188	105	21.84	29.87	110.21	0.36	28.09	0.281	1.51	0.016

*All the values are expressed in mg/l except pH (Otherwise stated).

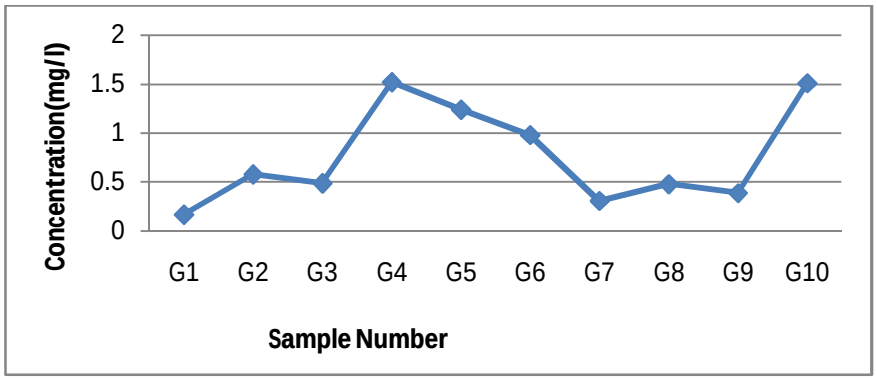


Figure.2 Distribution of Iron Concentration Found in Different Ground Water Samples

The sulphate concentration varied from 19.54 to 38.42 mg L^{-1} which indicates that in all the sample water, the sulphate values are well within the limit. Phosphate in drinking water indicates the degree of pollution of water system. The phosphate concentration in ground water of Talabira-I varied from 0.047 to 0.478 mg L^{-1}. Chromium content in all the samples are well within the prescribed norm and ranges from 0.009 to 0.062 mg L^{-1}. But in case of iron, some samples having iron content is high as per drinking water standard. It ranges between 0.17 to 1.52 mg L^{-1}. Iron in excess of 0.3 mg/l creates problem in staining of cloths and utensils. Also higher concentration is not suitable for food, beverages, dying, bleaching and so many items [12].

APPLICATIONS

Appropriate technology should be used for removal of iron in Talabira mining areas.

CONCLUSIONS

In the present study assessment of the ground water quality at Talabira-I coal mine, Sambalpur, Odisha has been done. The results reveal that the ground water of Talabira Station is suitable for drinking purpose after removal of iron. In all the stations except Iron, all the parameters are varied in between the permissible limits. So, after treatment it can be used for direct consumption.

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