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Water Quality Index of Coal Mine Drainage of Surakachhar Underground Coal Mine, District Korba, Chatissgarh, India During Monsoon

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ABSTRACT

Coal as a source of thermal energy has many good and bad effects. As coal water drainage is used in public sector so this attempt to focus effect of coal mine drainage water in public water resource. In this study water sample from underground coalmine of Surakachhar district Korba Chhattisgarh were collected during monsoon, and were analysed to focus water quality of water. About sixteen physiochemical parameters were taken to evaluate the water quality of coal mine water. Parameters like pH, Alkanity, TotaI Hardness, Chlorides, Fluorides, BOD, COD. DO, Nitrates, Sulphate, TDS, Electrical Conductivity etc. Present study shows the Water Quality Index of sample collected from coal mine, of Surakachhar, The water quality Index shows the water is not fit for drinking.

Key words : *Acid mine drainage, Thermal power, Water Quality Index, BOD, COD, DO, TDS, Alkanity.*

Introduction

Coal mining is major profitable activity performed in Chhattisgarh. Most coal production comes from Surakachhar, Dipka, Gevra, and Kusmunda of district Korba. Mining Operation not only disturbs the surface topology but also vegetation is tremendously affected. It is also harmful to human body. Due to ground water level there must be effort done to utilise drainage from mine and simultaneously used for drinking and domestic purpose. In this study the physiochemical properties of 12 samples of coal mine water from underground mine were determined and compared with international BIS drinking and domestic uses which are based upon Water Quality Index WQI. (Brown *et al.*, 1972), developed a water quality index. The WQI is a dimensional numbers with unique digital rating expression with value ranking between 0 to 100.

Study area

Many Coalmines are placed in district Korba of Indian state, Chhattisgarh in the basin of the River Hasdeo, a branch of the river Mahanadi. It is located between latitude (22°.15′N and 22°.30′N) and Longitudes (82°.15′E End 82.55′E) further Korba covers an area of about 530 sq. kilometre. The Surakachhar coal mine is a mine complex operated by South Eastern Coalfields limited which is subsidiary of Coal India limited located in Korba, Chhattisgarh India. During Monsoon season (July to October) the average rainfall is about 1000 mm to 1050.2 mm respectively mine is mostly flooded due to heavy rainfall. 12 samples were collected during monsoon season in collecting bottles of one litre capacity between 8.00AM to 10.00AM and were sterilized to avoid any unpredictable contamination and kept in 4°C to 5°C in laboratory (Arjun Ram *et al.*, 2010). Ground water quality using Water Quality Index WQI under BIS frame work (Arjun Ram,

Tiwari, Singh, 2021). The weighed Arithmetic Water Quality Index WQI represented as-

$$WQI=\Sigma W_iQ_i/\Sigma W_i \text{ ……. (1)}$$

Where n= no.of variable of parameter, i=1

W_i = Unit weight for i^{th} parameter, Q_i= Quality rating sub index of i^{th} water quantity parameter,

W_i is inversely proportional to the recommended standard for the corresponding parameters

$Wi=K/Sn$ ……(2) S= Standard value for it^h parameter. K= Proportional Constant

The value of $K= 1/\Sigma 1/Sn$……. (3),

The value of $QI = Q\ 100[(V_o-V_i)/ (S_n-V_i)]$… (4) Where Vo = Observed value of i^{th} parameter.

Q_{pH}= 100, Q_{DO} =100, $[V_{pH}$ -7.0/8.5-7.0], $[V_{DO}$-14.6/5.0-14.6] …(5)

Where V_{pH}= Observed value of (DO), Vi= Ideal value of i^{th} parameter in pure water Vi are taken as 0 for drinking water except for pH and dissolved Oxygen (DO).

For pH ideal value is 7.0 and permissible value is 7.0. Similarly for DO ideal value is 14.6 mg/l and permissible value is 5.0 mg/l. So the quantity rating for pH and DO are calculated from the equation respectively shown below.

SNo.	WQI	Rating
1	0-25	Excellent
2	26-50	Good
3	51-75	Poor
4	76-100	Very Poor
5	>100	Unsuitable

Classifications of water quality based on WQI Chaterjee and Raziuddin (2002) and Sankar (2020).

Results and Dicussion

This study is based on selected parameters and BIS considered as standard for reference.

pH is one of important indicator for assignment of water. In the present study it ranges from 6.5 to 8.5 ideal for consumption. Only the sample 2 has pH 6.54 due to dissolved ions and the WQI rating is very poor due to that, Turbidity it ranges from 14 to 20. Unsuitable for consumption. The Electrical Conductivity directly proportional to dissolved material.In this study it ranges from 228 to 300 unfit for drinking. TDS. It is due to Calcium Magnesium, Sodium Sulphate Here it range from 402 to 408 suitable for consumption whereas Alkanity-It is due to bicarbonate, carbonate and hydroxide. It this

Sample S1 to S12			July			August			September			October		
S.No	Parameter	BIS	S1	S2	S3	S4	S5	S6	S7	S8	S9	SS10	SS11	S12
1	pH	8.5	8.4	6.54	8.43	8.5	8.45	8.1	8.3	8.4	8.5	8	8.2	8.4
2	turbidity	5	14.5	14	14.5	14.6	20	19	14	15	14.5	14.5	14	15.1
3	total hardness	300	150	156	150	151	154	153	154	153	152	149	151	152
4	TDS	500	406	409	406	402	405	408	407	409	403	406	405	406
5	Alkanity	200	60.7	62.7	60.7	124	125	121	124	69	79	101	103	102
6	Calcium	7.5	36	37.22	36	34	35	29	30	31	32	30	30	30
7	Magnesium	30	15.3	15.4	15.3	15.2	13.4	13.4	14	15.1	15.2	15.3	14.8	14.7
8	Iron	0.3	0.3	0.3	0.3	0.31	0.34	0.35	0.34	0.35	0.33	0.35	0.34	0.35
9	fluoride	1	0.12	0.7	0.12	0.9	0.15	0.08	1	1.1	1	0.9	0.9	0.087
10	Nitrate	45	0.4	0.3	0.4	0.54	0.34	0.38	0.35	0.34	0.36	0.35	0.35	0.36
1111	sulphate	400	32	23	32	31	30	35	34	36	34	34	35	35
12	Chloride	250	35	32	35	35	33	34	35	31	32	32	34	34
1314	BOD PPM	20	10	19	10	16	21	18	21	9	20	17	18	18
14'6	CODmg/l	100	70	56	70	81	76	75	80	80	82	71	75	75
15	DO mg/l	5	12	11	12	11	11	12	7	10	11	13	12	12
1616	EC	300	231	240	231	231	234	231	232	233	229	229	228	231
Water Quality Index		104	109	93	113	110.	106.	119	125	119	119	117	118	

Calculation of Water Quality index for sample 4

Sample 4												
Sn.	Parameter	STD (sn)	1/sn	Σ1/sn	k=1 (Σ1/Sn)	Wi=K/ Sn	Ve	Vn	n/Sn	Vn/Sn* 100=Qn	WnQn	ΣWnQn/ ΣWn
1	pH	8.5	0.117	5.120	0.195	0.023	7	8.5	1	100	2.30	113.11
2	Turbidity	5	0.2	59	0.195	0.039	0	14.6	2.90	292	11.41	113.11
3	Total hardness	300	0.003	5.120	0.195	0.01	0	151	0.503	50.33	0.032	113.11
4	TDS	500	0.002	5.120	0.191	0.004	0	402	0.804	80.4	0.03	113.11
5	Alkanity	200	0.005	5.120	0.191	0.0009766	0	124	0.62	62	0.06	113.11
6	Calcium	7.5	0.133	5.120	0.195	0.006	0	15.2	0.506	50.66	0.329	113.11
7	Magnesium	30	0.033	5.120	0.195	0.006	0	15.2	0.506	50.66	0.329	113.11
8	Iron	0.3	3.333	5.120	0.195	0.6	0	0.31	1.033	103.3	67.27	113.11
	Fluoride	1	1	5.120	0.195	0.2	0	0.9	0.9	90	17.57	113.11
9	Nitrate	45	0.022	5.120	0.195	0.004	0	0.54	0.012	90	0.005	113.11
10	sulphate	400	0.002	5.120	0.195	0.001	0	31	0.077	7.75	0.003	113.11
11	Chloride	250	0.004	5.120	0.195	0.001	0	35	0.14	14	0.010	113.11
12	BOD	20	0.05	5.120	0.195	0.001	0	16	0.8	80	0.781	113.11
13	COD	100	0.01	5.120	0.195	0.002	0	81	0.81	81	0.158	113.11
14	DOMG/L	5	0.2	5.120	0.195	0.03	14	11	0.33	33	1.289	113.11
15	EC	300	0.003	5.120	0.19	0.001	0	231	0.77	77	0.050	113.11
	Total		5.120	5.120							113.11	113.11
											WQI	

it ranges from 60.7 to 125 mg/l Ideal for consumption. Total. hardness is due to dissolved Calcium and Magnesium. Here ranges from 149 to 154. The Calcium (Ca^{+}) In this study it ranges from 29 to 37.2 mg/l unfit for consumption but Magnesium content (Mg^{+}). in the present study ranges from 14 to 15.3 ideal for consumption.

Sulphate in the present study ranges from 23 to 35 mg/l, ideal for domestic purpose. Chloride (Cl^{-}) and Fluoride (F^{-})-In this study range from 31 to 35 mg/l and 0.12 to 1.1 mg/l respectively ideal for consumption. They are lightest and reactive halogens and higher value is Hazardous for human health (Kaminski *et al.,* 1990; Pius *et al.,* Sadit Noori *et al.,* 2021). In the present study nitrates range from 0.3 to 0.54 mg/l for consumption. Iron (Fe) in this study ranges from 0.3 to 0.35 mg/l ideal for consumption. Biochemical Oxygen Demand BOD-The range in present study is 9 to 21 ppm. It measure the Oxygen required by the microbe to degrade the organic matter under aerobic condition ideal for consumption. In the present study Chemical Oxygen Demand COD ranges from 70 to 82 is enumerating the mount of oxidizable pollutant found in underground water and Dissolved Oxygen DO for healthy water is 6.5 mg/l to 8 mg/l. In the present study it ranges from 7 to 13 mg/l which is fine.

Conclusion

The outcomes of the underground coal mine water drainage of Surakachhar, reveals that this water is not suitable for drinking purpose and agricultural practices. Since the water flow through various rocks and land and finally enter the coal mine. So it contain loose soil and weathered rock fine particles, it increases the range of suspended and dissolved solids. There is no noticeable variation in coal mine water during Monsoon season further this water can be used for domestic and agricultural practices if this underground water goes treatment process by water treatment plants like water treatment disinfection process,

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