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Acid Mine Drainage Status and Water Quality Parameter in NCPH Colliery Coal Mine

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Abstract: ***Acid Mine Drainage (AMD) is a very common environmental pollution problem which occurs worldwide in mining region. AMD forms when sulfide minerals in rocks are exposed to oxidizing condition in coal and metal mining, highway construction and other large scale excavations.. During mining, the exposed wall rocks come in contact with the oxygenated water, interaction between these causes generation of AMD. Bacterial activity also plays an important role in acid formation. Coal has a crucial role in meeting current needs and is a resource bridge to meet future goals. Through the enhancement of knowledge and technology the challenge is to apply the right technology in the most efficient and environment friendly way. The biggest environmental challenge facing the coal industry is the issue of greenhouse gases and acid rain. The aim of this project is to investigate the water quality parameter in relation to acid mine drainage for the Indian coal fields that includes possibilities for control, minimization and optimal feasibility for the implementation of control method. An attempt is made to view the status of acid mine drainage in Indian coal mine and to study about its preventive measures is an issue of further research.***

Key words: Acid mine drainage, Water quality, Parameters, Coal, mines

1. Location of Study Area

NCPH colliery is situated in the eastern part of Chirimiri coalfields Latitude- $23^0$11'36"Longitude- $82^0$21'5".Premises of R-3 and R-6 colliery starts after 1.5 km from Chirimiri railway station in north Direction.

2. Sampling of Mine Water

Water samples from 6 different locations were collected and tested, corresponding locations are as follows –

Table 1: Location from where samples were collected

Sample no.	Spot from where sample was collected
1	Input of old R-III Mines
2	Output of Old R-III Mines
3	Mohan Nagar Colony
4	PHED Supply Water
5	Input of old R-VI Mines
6	Output of Old R-VI Mines

Tests of water samples for various parameters with respect to standards of 'General Standards For discharge of Environmental Pollutants [INS. by GSR 422 (E) and 801 (E), dated 19TH May1993]' have been carried out in Applied Chemistry Laboratory of NIT Raipur and results are given below.

3. Status of Industrial Pollution

Table 2: Results of laboratory chemical tests

Properties	Sample no.					
	1	2	3	4	5	6
pH	8.68	8.52	7.89	7.88	8.33	8.16
Turbid (NTU)	03	02	02	02	01	02
TDS (in ppm)	240	622	450	448	126	808
Total hardness (in ppm)	168	376	224	196	76	528
Alkalinity (in ppm)	160	200	184	192	68	208
Chloride conc. (in ppm)	20	214	24	22	20	108
Calcium conc. (in ppm)	16	280	56	49.6	28.8	166.4
Nitrate conc. (in ppm)	1.77	2.22	6.20	4.43	1.77	22.59
Iron conc. (in ppm)	BDL	BDL	BDL	BDL	BDL	BDL
Sulphate conc. (in ppm)	10	67	71	67	11	105

4. Results and Discussion

- **pH**
  pH were found between range of 7.88 to 8.68. Minimum pH observed from sample no.4 and maximum from sample no. 1. All values show that water is slightly basic in nature.
- **Turbidity**
  Turbidity ranged between 1 to 3 which is within the permissible limit.
- **TDS**
  TDS ranged between 126 ppm (from sample no. 5) to 808ppm (from sample no. 6) TDS value is higher than the permissible limit in sample no. 2 and 6.
- **Total Hardness**
  Total Hardness found in the range of 76 ppm to 528 ppm. Minimum from sample no. 5 and maximum from sample no. 6. Higher value of Total Hardness found from sample no. 6 which shows that the water is slightly hard.
- **Alkalinity**
  Alkalinity ranged between 68 (from sample no. 5) ppm to 208 ppm (from sample no. 6). Sample no. 6 is more alkali than the permissible limit.
- **Chloride**
  Chloride content of water samples ranged between 20 ppm to 214 ppm and the values are within the permissible limit.
- **Calcium**
  Calcium content of water samples found between the range of 16 ppm to 166.4 ppm. Maximum value found from the sample no. 6 which is far more than the permissible limit.

- **Nitrate**
  Nitrate content is ranged between 1.77 ppm(from sample no. 1 and 5) to 22.59 ppm (from sample no. 6) which are within the permissible limit.
- **Iron**
  Iron content from all the water samples found below the detection limit.
- **Sulphate**
  Sulphate content ranged between 10 ppm to 71 ppm. Minimum content found from sample no. 1 & 6 whereas maximum content from sample no.3. All the values are within the permissible limit.

5. Adverse Effects Of Acid Mine Drainage

- It supports only limited type of flora like acid resistant moulds and algae. It goes on increasing and forms a mat over the water and when this algae decomposes, produces toxic material.
- Because of decreased pH, the solubility of heavy metals such as Fe, Mn, Zn, Cu etc increases. The metal consumes the oxygen present in water for their oxidation. As a result oxygen dissolved in water reduces and it can no more support life.
- Water becomes corrosive and cannot be used for industrial purpose.
- It also leads the water body unacceptable for recreation.
- This water is not suitable for agricultural and drinking purposes.

6. Acid Mine Drainage Control Measures

- Modified mining methods like long wall mining
- Mine sealing.
- Surface reclamation.
- Water diversion.
- Control of ground water flow system by well fields and other methods.
- Deep well injunction for containing polluted water.
- Subsurface dams and ground curtains.
- Dilution of AMD to achieve acceptable effluent quality.
- Spraying bacteriophage viruses in to mines to kill acid forming bacteria.
- Chemical grouting to make rock impermeable and to bind sulphur by using plastic bubbles to fill abandoned mines.

7. Workout Plan

After this practical observation and theoretical study on various parameters of occurrence, causes, prediction and prevention of AMD, following measures are being recommended for control of Acid Mine Drainage at underground coal mine R3 and R6, NCPH colliery :-

1) **Pumping Arrangement:-** Sufficient pumping arrangements should be installed, enough for complete and efficient pumping the accumulated acid water. Pump fittings, impellers, supply pipes should be made of corrosion resistant material.
2) **Application Of Biotechnology:** Use of bactericides should be preferred so that, production of acidic water will be minimized. Sodium Laurel Sulphate (SLS), Alkyl Benzene Sulphonate (ABS), Sodium Benzoate (SBZ) can be used for abutment of AMD economically.
3) **Proper Stowing: -** Stowing practice should be forced to minimize the percolation of water through water feeders and also it cuts the contact time between water and oxygen and retards the formation of AMD.
4) **Drainage Control In Rainy Season: -** Proper drainage of surface water in rainy season can reduce percolation of water through cracks to underground and thus will reduce availability of water for AMD formation.
5) **Protective Devices**: like Shoes, hand gloves should be used for prevention of skin diseases in workers.
6) **Diversion Wells**: It can be efficiently used for treatment of acid mine water which is coming out of the R6 mine.

8. Conclusion

Water samples collected from different area shows that maximum samples parameters are within the permissible limit. But proper treatment should be required for removing few parameters which are more than maximum limit. Coal mining, despite the very substantial benefits they bestow on society, stir strong Emotions. A great ongoing social challenge for the mining industry is sustainable development and community acceptance of its role in society. The problem of mining-induced displacement and resettlement (MIDR) poses major risks to societal sustainability.

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