Recent Research in Science and Technology 2014, 6(1): 215-218
ISSN: 2076-5061
Available Online: http://recent-science.com/

Present status of acid mine drainage in caol mines of secl and its prevention

Manoj Kumar Pandey, Manoj Pradhan and Piyushkant Pandey

PhD (Research scholar), Mining & Environmental Engineering, National Institute of Techonology Raipur, India.

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. In Chhattisgarh region S.E.C.L., division of CIL plays a major role for coal extraction.The AMD management practices followed by SECL were not found adequate owing to the technological, environment and natural water resource management problems. Thus there is an urgent need of research regarding control and abatement of AMD. Depending upon site characteristics, so improved reliability and efficiency is required. 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.

Keywords: AMD, CIL. Coal, Mines

INTRODUCTION

NCPH colliery is situated in the eastern part of chirimiri coalfields.Latitude- $23^0$11'36"Longitude- $82^0$21'5".Premises of R-6 colliery starts after 1 km from Chirimiri railway station in north. Direction

Table 1. Details of R6 colliery, Chirmiri area, SECL.

Parameter	1st seam	2nd seam	3rd seam
Thickness	1.8-2.3 m	1.2-3 m	4.0-7.0 m
Gradient	1 in 45	1 in 40	1 in 45
Max depth	200 m	230 m	260 m
Gassiness	Degree -1	Degree-1	Degree-1
Area	230 acre	780 acre	1010 acre
Reserve	5.28 mt	5.6 mt	7.56 mt
Production/day	450 te	230 te	450 te

Sampling of mine water

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

Table 2. Location from where samples were collected

Sample no	Spot from where sample was collected
1	Working face water
2	Goaf area
3	Discharge at surface (through drainage, near water treatment plant)
4	Sump
5	Main return (near temple through pumping)
6	Sealed off area

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 19^{TH} May1993]' have been carried out in Applied Chemistry Laboratory of NIT Raipur and results are given below.

Status of industrial pollution.

Table 3. Results of laboratory chemical tests

Physical Properties		Sample no.					
		1	2	3	4	5	6
pH	Supernatant	6.46	7.62	7.1	4.33	8.29	6.62
	Turbid	7.33	7.41	6.75	4.47	7.90	6.07
TDS (in ppm)		1990	1855	1210	1930	1085	855
TSS (in ppm)		1620	915	549.5	320	895	865
TS (in ppm)		3610	2770	1759.5	2250	1980	1720
Total hardness (in ppm)		975.65	924.3	916.4	1224.5	622.125	513.5
Chloride conc. (in ppm)		7.09	24.815	31.905	28.36	14.18	17.725
Calcium conc. (in ppm)		167.5	287.5	160	302.5	157	262.5

*Corresponding Author

Manoj Kumar Pandey
PhD (Research scholar), Mining & Environmental engineering, National Institute of Techonology Raipur, India.

Email: manojpandeynit@gmail.com

Magnesium conc. (in ppm)	40.87	83.57	29.28	74.42	72.59	32.94
Iron conc. (in ppm)	16.95	11.3	43	16.95	5.65	11.3
Sulphate conc. (in ppm)	1205.45	1464.1	1092.3	2145.5	814.605	1692.98

FINDINGS

Working face (sample no 1, R6 mine)

Total dissolved solids' is found to be highest in water sample no 1. In the working face, different production and auxiliary operations are being carried out that is why TDS amount is highest here.

As the water near working face is subjected to iterative mixing of dust and agitating action due to movement of machinery and workmen, the amount of total suspended solids is found to be highest in working face sample.

pH value is found to be a little bit acidic and is 6.46, which shows that, coal is containing FeS_2 which is main contributor of AMD production. Total solid content is 3610 ppm, total hardness is 975.65ppm,Chlorid concentration is 7.09 ppm, Calcium concentration is 167.5ppm, Magnesium concentration is 40.87 ppm, Iron concentration is 16.95 ppm, Sulphate concentration is 1205.45 ppm.

GOAF Area (sample no 2)

pH value is 7.62, total solid content is 2770 ppm, total hardness is 924.3 ppm, Chloride concentration is 24.815 ppm, Calcium concentration is 287.5 ppm, Magnesium concentration is 83.57 ppm, Iron concentration is 11.3 ppm, Sulphate concentration is 1464.145 ppm.

Discharge at the surface (sample no 3)

It contains highest concentration of Iron, but water sample no 4 is found to be most acidic, this is due to the fact that formation of acid merely depends upon available contact time between water, iron and oxygen, and for sample no 3 contact time is less than contact time for samples no 4.

pH value is 7.1,total solid content is 1759.5 ppm, total hardness is 916.4 ppm, Chloride concentration is 31.905 ppm, Calcium concentration is 160 ppm, Magnesium concentration is 29.28 ppm, Iron concentration is 43 ppm, Sulphate concentration is 1092.31ppm.

Mine sump

pH value of water taken from sump is found to be most acidic among all other water samples, it can be concluded that contact time of water with rock and mixing of samples leads the water sample to lower pH.

Sample no 4 contains highest sulphate concentration, that shows the concentration of acid formed, and least pH value.

pH value is 4.33, total solid content is 2250 ppm, total hardness is 1224.5 ppm, Chloride concentration is 28.36 ppm, Calcium concentration is 302.5 ppm, Magnesium concentration is 74.42 ppm, Iron concentration is 16.95 ppm, Sulphate concentration is 2145.5 ppm.

Main return (sample no 5)

Sample collected from main return is found to be of most alkaline nature among all samples collected. Iron concentration is least in this sample and also Sulphate concentration is least among all, that leads to its low acidity and high alkalinity. Proper pumping is also a reason for reduced acidity.

pH value is 8.29, total solid content is 1980 ppm, total hardness is 622.125 ppm, Chloride concentration is 14.18 ppm, Calcium concentration is 157 ppm, Magnesium concentration is 72.59 ppm, Iron concentration is 5.65 ppm, Sulphate concentration is 814.605 ppm.

Sealed off area (sample no 6)

Sample collected from sealed off area is of a little bit acidic nature and is 6.62, total solid content is 1720 ppm, total hardness is 513.5 ppm, Chloride concentration is 17.725 ppm, Calcium concentration is 262.5 ppm, Magnesium concentration is 32.94 ppm, Iron concentration is 11.3 ppm, sulphate concentration is 1692.98

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

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.

Recommendations
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 R6, Chirmiri area :-

(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) Treatment method :- Concerning the chemical analysis in the previous chapter which have been carried out it is recommended that in NCPH R-6 colliery acid water can be treated by wetland method after it is discharged to the surface either by pumping or by drainage

(5) P^H Control ;-Limestone channel or combination of channels will be suitable for treatment of acid water to increase pH value before discharging it to any stream or river feasibly and also terrain of the area is suitable for this method.

(6) 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.

(7) **Protective devices**: like Shoes, hand gloves should be used for prevention of skin diseases in workers.

(8) **Diversion wells**: It can be efficiently used for treatment of acid mine water which is coming out of the R6 mine.

(9) **Control method suggested- open limestone channels**: Under these conditions the best suitable method for acid mine drainage treatment will be "open limestone channel" .Where AMD must be conveyed over some distance prior to or during treatment, use of open channels lined with limestone has been shown to be an effective mechanism for removing and generating small amounts of alkalinity.

The acidic water is allowed to flows through these channels. The water treated after this treatment must be randomly checked through lab test.

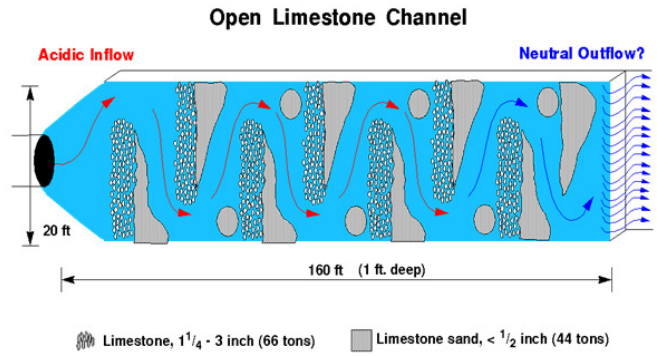

Fig 1.

CONCLUSION

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

REFERENCES

[1]American Public Health Association. 1985. Standard Methods for the Examination of Water and Wastewater. 16th Edition. American Public Health Association, Inc., Washington, DC, p. 870-886.

[2] Paul Ziemkiewicz, Robert Darmody, John Sencindiver, Tim Phipps, Jerry Fletcher, Keith Garbutt, 1997. "Acid Mine Drainage Control and Treatment," by the American Society for Agronomy and the American Society for Surface Mining and Reclamation.

[3]Bhattacharya J. 2002. "Acid Mine Drainage and Wetland Treatment", Associate Professor, Department of Mining Engineering, IIT Kharagpur, Contour page 65-73.

[4]Bhattacharya J, 2003. Principles of Mine Planning, Allied Publishers Pvt. Limited, New Delhi.

[5]Caruccio, F.T. and Geidel G., 1985. "Inducсd alkaline recharge trenches-an innovative method to abate Acid Mine Drainage-proceeding", sixth West Virginia surface mine drainage task force symposium, Morgantown, WV.

[6]Cathles, L.M. 1982. Acid Mine Drainage, Earth and Mineral Science, p.37-41, Pennsylvania State University, University Park, P.A.

[7]Dhar B.B. Ratan S. and Jamal A., 1986. Impact of opencast coal mining on water environment, A case study. Journal Of Mines Metals and Fuels 34 (12).

[8]Hedin *et al.* 1994. Flowchart for selecting a passive AMD treatment system based on water chemistry and flow adapted.

[9]Jamal A., Dhar B.B. and Ratan S., 1993. Acid mine drainage control in opencast coal mine- A creochemical Approach. First world mining environment congress, New Delhi.

[10] Kousen J.S., Sencindiver J.G. and Smith R.M., 1987. "Review to procedures for surface mining and reclamation in areas with acid-producing minerals". West Virginia University,

Margentown, West Virginia.

[11] Faulkner and Skousen 1995. Limestone Ponds.

[12] Moore, Fred S. 1989. “Evaluation of the Elk Creek Acid Mine Drainage Abatement Project”. Report on file at the West Virginia Division of Environmental Protection, Office of Water Resources, and Charleston, WV.

[13] Nordstrom D.K., Alpers C.N., Ptacek C.J., D, Blowes D.W. 2000. "Negative pH and Extremely Acidic Mine Waters from Iron Mountain". Environmental Science & Technology 34: 254-258.

[14] Richard W.Hammack, George R. Watzlaf, 1990.“Mining and Reclamation Conference and Exhibition”, Paper presented at the 1990, April 23-26, 1990.

[15] "Reclamation of Drastically Disturbed Lands," 1998. by the American Society for Agronomy and the American Society for Surface Mining and Reclamation.

[16] Sengupta, M. 1993. "Environmental Impacts of Mining - Monitoring, Restoration, and Control." Lewis Publishers , Boca Raton, Fl. 1993, pp 3-25.

[17] Singh Gurudeep. 2005. Chemical, microbiological and Geological aspects of acid mine drainage and its control aspects, The Indian Mining and Engineering Journal,44 (2-3):20-30

[18] Kepler and McCleary 1994. Successive Alkalinity Producing Systems.

[19] www.answers.com

[20] www.infomine.com.

[21] www.neeri.res.in

[22] www.sciencedirect.com.

[23] www.wvu.org

[24] www.megaessays.com