Analysis of Water Quality in mines and its effect on Health

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Abstract

Mining is the process of extraction of ore from the earth crusts and has an adverse impact on environment. As no industrialization is possible without mining, it cannot be stopped. The damages incurred due to mining on environment are high and steps are taken to bring all spheres (Lithosphere, Hydrosphere and Atmosphere) to normalcy. So an environmental study of all spheres becomes very much essential in mining. In this paper, study is confined to hydrosphere. As water is open source, it is more contaminated due to mining. Different mining operations have different impact on water bodies. The mining operations depend on the type of ore and the topology of the area. Hence, the detrimental effects of mining are different in scale on water bodies and the aquatic life associated with them. This paper deals with effect of mining of different ores and its effect on water bodies. Water samples from different mines (Coal Mine - Samaleshwari coal mine MCL, Iron Ore Mine - Kiriburu Iron Ore Mines, Limestone and Dolomite Mines - OCL, Rajgangpur and Chromite Mines - Tata Steel, Sukinda) are collected and experimentally investigated. The samples are analysed with a series of physical and chemical tests and various parameters like pH, chloride, total hardness, turbidity, salinity, nitrate, TDS, conductivity, dissolved oxygen, biological oxygen demand, metal contamination etc. are studied which decide the pollution level of water body. After the analysis of water samples, correlation between the ore types and water pollutants are found out.

Keywords: - Detrimental Effects, pH, Biological Oxygen Demand

ANALYSIS OF WATER QUALITY IN MINES AND ITS EFFECT ON HEALTH

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INTRODUCTION

Mining is the process of extraction of minerals of economic value from the earth's crust. It adversely affects the environment by altering the biodiversity. It is one of the major causes of soil erosion, contamination of surface water, groundwater and soil. It also has a detrimental effect on the health of the people living around the mine.

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Human beings are most affected due to operations carried out in mining. People living near the mines suffer from many diseases due to contamination of water.

Disease

Typhoid

Amoebiasis

Giardiasis

Ascariasis

Jaundice

Hookworm

WATER BORNE DISEASE

S. No.	Metal	Disease
1	Arsenic	Nausea, Vomiting, skin eruptions, abdominal pain, diarrhea, Vision & bronchial disorder
2	Barium	Pneumonitis, cardiac strain, heart diseases.
3	Cadmium	Kidney, liver, gastrointestinal tract disorder
4	Chromium	Apnea, respiratory failure, paralyses
5	Copper	Hypertension, sporadic fever, paralyses
6	Lead	Loss of appetite, brain damage, convulsions, mild anemia
7	Mercury	Growth retardation, eye blindness, muscular fatigue, Impotency
8	Selenium	Dullness, erosion of joints, sclerosis, stiffness, lameness
9	Zinc	Pneumonitis, Vomiting, Renal damage, cramps

COLLECTION OF WATER SAMPLE

Sl. No.	Mine name	Ore type	Location of sampling
S1-A	Samaleshwari OCP, MCL	Coal	Drinking water for miners
S1-B	Samaleshwari OCP, MCL	Coal	Sump water
S2	Kiriburu Iron ore mine, SAIL	Iron	Drinking water from the hand pump near mine
S3 -A	OCL, Lanjiberna	Limestone and Dolomite	Quarry 1 & 2 discharge water
S3-B	OCL, Lanjiberna	Limestone and Dolomite	Quarry 3 discharge water
S4	Tata Steel, Sukinda Mines	Chromite	Quarry discharge water

ANALYSIS AND RESULTS

Analysis → Physical Properties

Analysis → Chemical Properties

Analysis → Metallic Properties

PERMISSIBLE LIMIT FOR DRINKING WATER IS10500

S. No.	Parameter	Requirement desirable Limit
1	pH	6.5-8.5
2	Turbidity	10
3	Total Hardness	300
4	Copper (in mg/l)	0.05
5	Iron (in mg/l)	0.3
6	Nitrates (in mg/l)	45
7	Mercury (in mg/l)	0.001
8	Cadmium (in mg/l)	0.01
9	Arsenic (in mg/l)	0.05
10	Lead (in mg/l)	0.1
11	Zinc (in mg/l)	5.0
12	Chromium (in mg/l)	0.05

WATER QUALITY MODELING

Water quality modeling is a numerical model that uses various parameters and determines the quality of water and decides its fitness for different activities. It consists of 6 parameters that are taken into consideration while determining the water quality. They are

1) Dissolved oxygen (DO)
2) pH
3) Biochemical oxygen demand (BOD)(5-day)
4) Nitrate
5) Turbidity
6) Total solids

The water quality is estimated as follows:

$$NSF\ WQI = \Sigma Wi * Qi / \Sigma Wi$$

Where Q = quality value of a parameter

W = weight of the parameter

WATER QUALITY QUALIFICATION

WQI	Water Quality
0-25	Very bad
25-50	Bad
50-70	Medium
70-90	Good
90-100	Excellent

PHYSICAL PARAMETERS

The physical properties that were studied and measured are

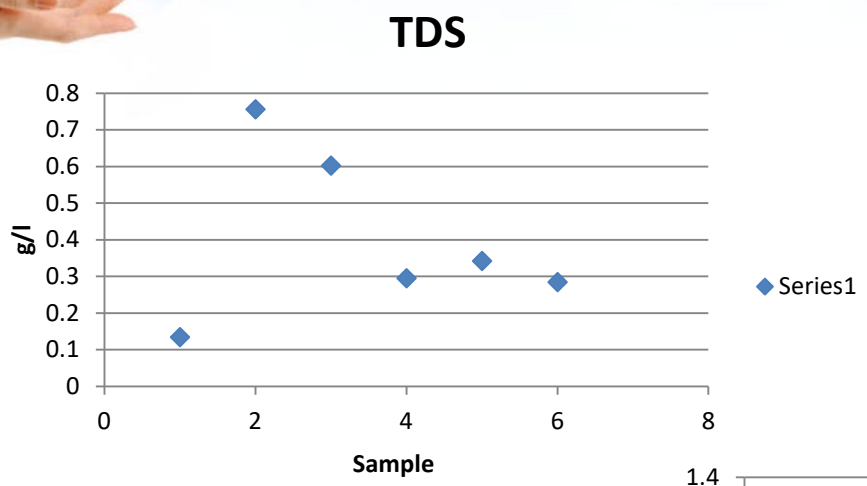
1. Temperature

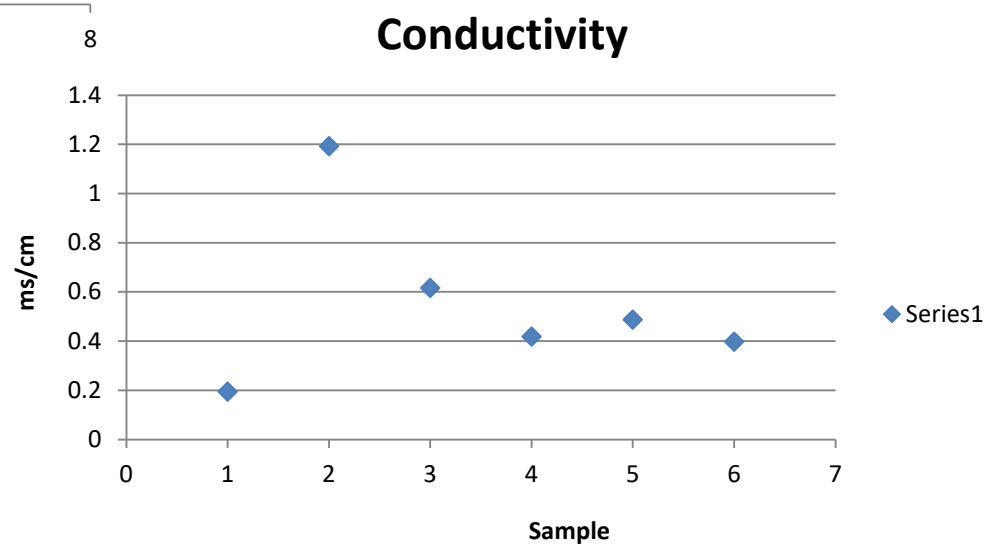
2. Total dissolved solids

3. Conductivity

4. Turbidity

PHYSICAL PARAMETERS



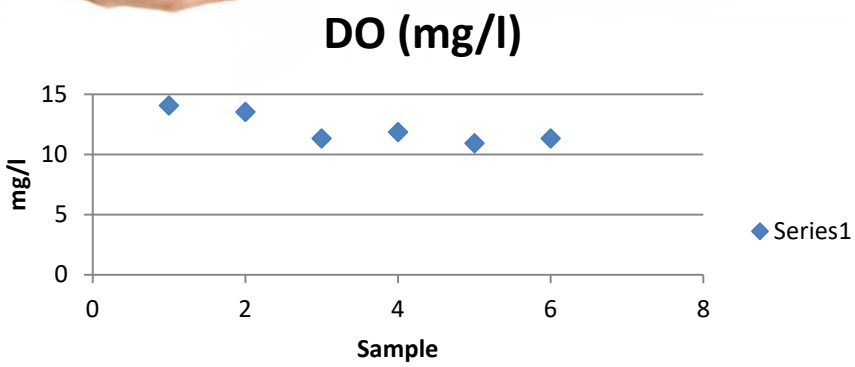


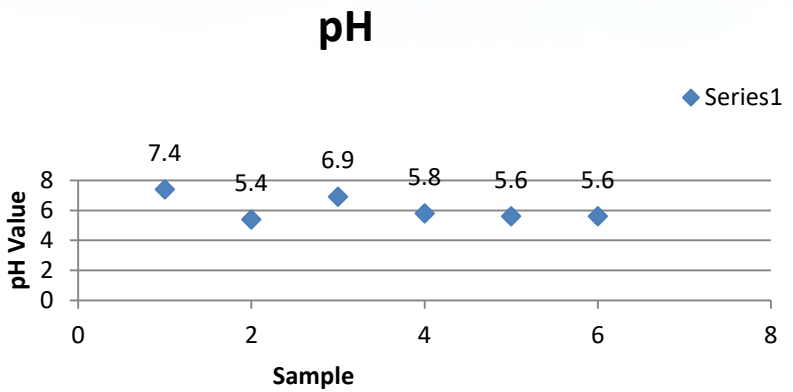
CHEMICAL PARAMETERS

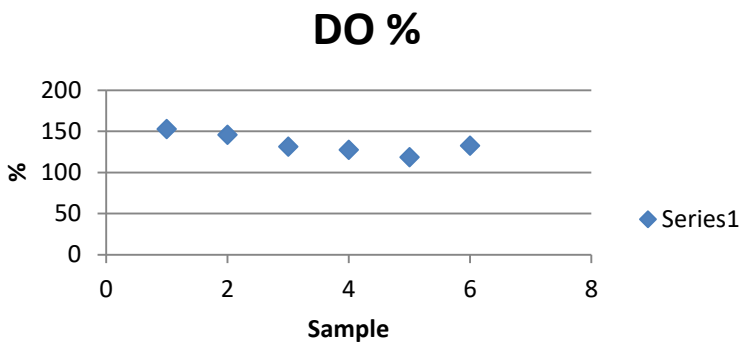
The chemical parameters that were measured are

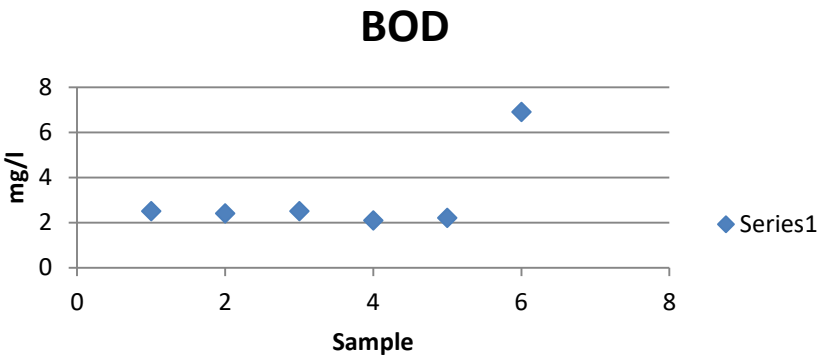
1. pH
2. Nitrate
3. Dissolved Oxygen
4. Biological Oxygen Demand
5. ORP

CHEMICAL PARAMETERS

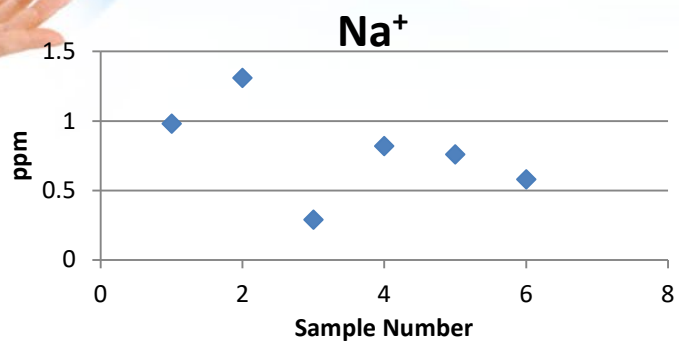


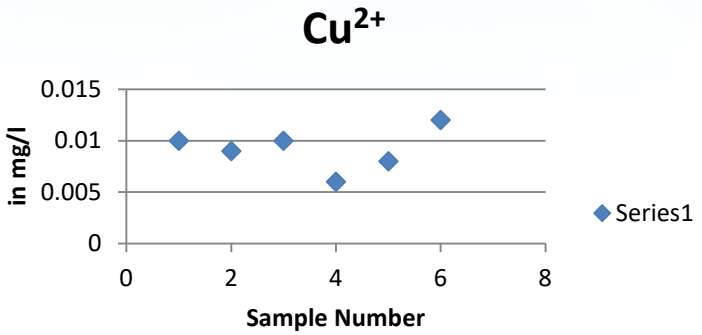


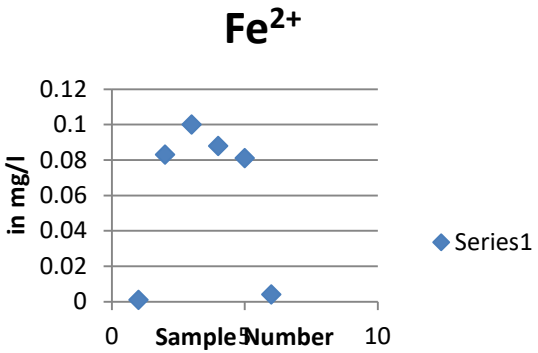


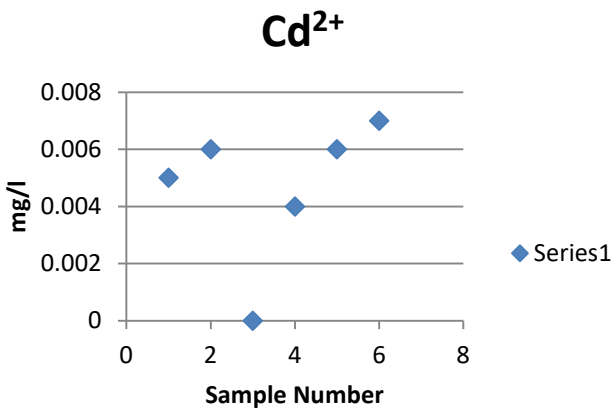


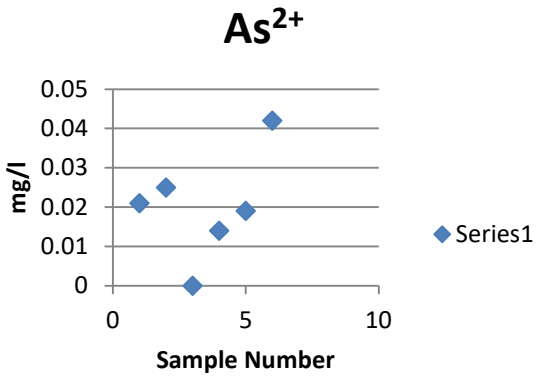
METALLIC PARAMETERS





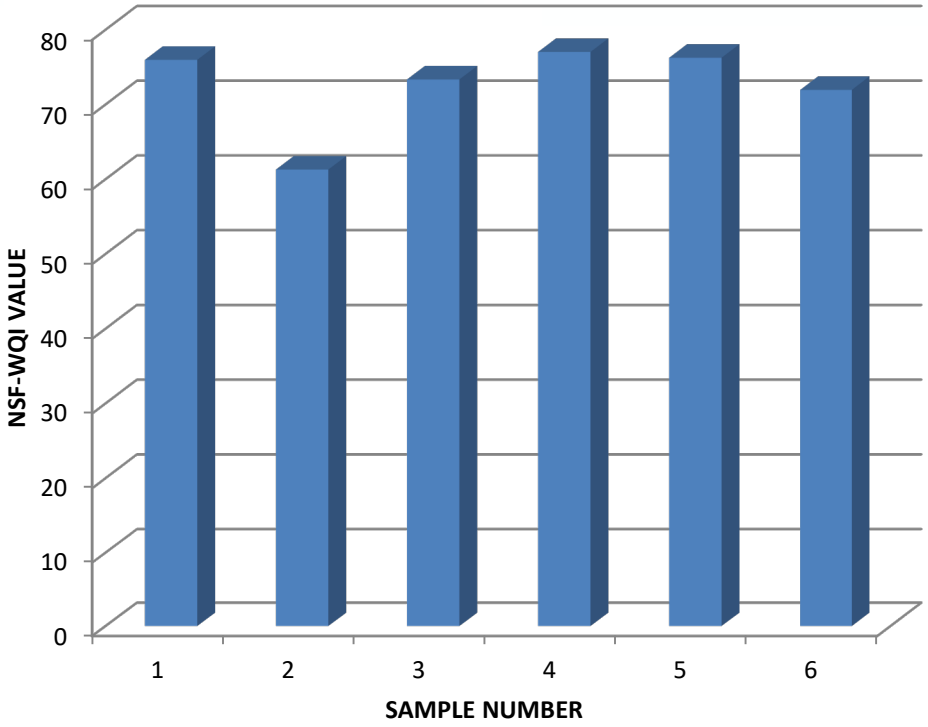






NSF- WQI OF WATER SAMPLE

1 - OCP, MCL (DW)
2- OCP, MCL (Sump)
3 – SAIL
4 - OCL, (1&2)
5 - OCL, (3)
6 - Tata Steel



CONCLUSION

The water quality assessment of the six mine water samples provides good results. The results revealed that the levels are under permissible limits but they have the potential to be detrimental to the environment. As far as the water quality is concerned, most of the mines have a good quality of water. The pH of most of the samples is below 7 and can be alarming if the water remains in contact with any other source of drinking water or groundwater. The water from the mines should be preferably treated properly before being discharged.

REFERENCES

- Carpenter S., Jawalkar M and Pandey Subhash C., Physicochemical and Bacteriological analysis of drinking water quality of public places of Bhopal, India, Journal of Environmental Research and Development, Vol. 13 No. 01, July-September 2018
- Dwivedi, P. R., & Augur, M. R., Physico Chemical Analysis of Ground Water in Chirimiri Area of Korea District, Chhattisgarh. Research Journal of Engineering and Technology, vol(1), PP: 38-43. (2014).
- Hossen, M. Z., Islam, M. M., Arafat, M. Y., & Sharmin, S., Hydrogeochemistry and quality assessment of waters of an open coal mine area in a developing country: A case study from Barapukuria, Bangladesh, International Journal of Geosciences Research (IJGR), 1(1). PP: 241-248 (2013).
- Kumari, B., Mukherjee, S., & Singh, N., Groundwater Quality Assessment in hard rock terrain of the part of Ranchi district, Jharkhand, India: An integrated approach. International Journal of Environmental Sciences, 5(4), PP: 754-758 (2015).
- Pandey S. C., Bharadwaj P. S. and Peerzada M. P., Physicochemical analysis of water quality of Ratan Talao, Bharuch, Gujarat, India, Journal of Environmental Research and Development, Vol.10 No. 02, October-December 2015
- Saxena R. and Sharma M., Qualitative and quantitative evaluation of Water sources of few areas in and around Gwalior, Madhya Pradesh, India, Journal of Environmental Research and Development, Vol. 8 No. 3, January-March 2014
- Sirajudeen J. and Abdul Vahith R., Applications of water quality index for groundwater quality assessment on Tamil Nadu and Pondicherry, India, Journal of Environmental Research and Development, Vol. 8 No. 3, January-March 2014
- Tirkey, P., Bhattacharya, T., Chakraborty, S., & Baraik, S., Assessment of groundwater quality and associated health risks: A case study of Ranchi city, Jharkhand, India. Groundwater for Sustainable Development, Vol (5), PP: 85-100 (2017).

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