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Impact of Mining on Land Degradation and Tribal Health of Hazaribagh and Ramgarh Districts, Jharkhand, India

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Abstract

The present investigation is confined to Hazaribagh and Ramgarh districts of Jharkhand state of India. The study is an attempt to examine the extent of environmental degradation that has taken place in the form of water contamination and degradation of forest due to rampant mining in the different areas of Hazaribagh and Ramgarh districts i.e. Sonda (w_1), Damodar River (w_2), Siyal (w_3), Udimari (W_4), Jarjara (w_5), Patel Nagar (w_6), Bhurkunda (w_7) and Birsa chowk (w_8). The water bodies of these areas are the greatest victims of coal mining and are badly affected by contamination of Acid Mines Drainage (AMD) originating from mines and spoils, causing various types of diseases among the tribal. Low pH, high electrical conductivity, high concentration of sulphate , iron, and toxic heavy metals, low Dissolved Oxygen (DO), and high Biological Oxygen Demand (BOD) are some of the physico-chemical and biological parameters which characterize the degradation of water quality. The altered content of water needs proper treatment before the use for drinking and irrigation purposes. Finally it can be suggested that an intensive study may be carried out before the domestic consumption.

Keywords: Acid mines drainage (AMD), electrical conductivity (EC), dissolved oxygen (DO), biological oxygen demand (BOD).

Introduction

Water is a major constituent of all living things (plants, animals and human beings) and of the atmospheric environment in which we live. It is one of the most important natural resources which forms more than 70% of earth's area and is present in the form of marine water (ocean and sea) fresh water (River , Lake, Pond, Stream)and Ground water etc.

Water is the prime requirement for life and used for drinking, bathing, irrigation, fisheries, navigation and power generation purposes etc. India receives 1800-1900 mm of rainfall annually. According to an estimate made by Indian Central Water commission (ICWC)[1] for pollution control, the total utilizable water from surface water sources is 690 cubic Km and from ground water sources is about 452 cubic Km (Km^3) [2].

India needs 85% water for drinking and 60% for irrigation purposes which depend mostly upon ground water.. India has more than 20 million bore wells in comparison to 0.2 million in USA. Water bodies of coal mining areas are the greatest victim of coal mining activities[3].

The increasing human population has tremendously increased the demand of fresh water. The rapid growth of population in urban areas has affected the ground water quality due to over exploitation of resources and improper waste disposal practices. National Environmental Engineering Research Institute (NEERI), Nagpur has estimated that about 70% of the available water in India is polluted[4].

Due to heavy mining activities in and around the coalfield areas, the quality of surface and ground water may deteriorate in future[5] but no intensive investigation and care about water quality of these regions has been carried out. Hence the present study and investigations have been designed to understand the chemical nature of water quality of Hazarabagh and Ramgarh districts.

Aim and Objective: Main objectives of present investigation are: To analyze surface-subsurface water contamination in the peripheral zone of coal mining areas. To suggest prioritization of water quality development schemes in this region keeping in view to mitigate the health risk after consumption of such contaminated water

Investigation Area: In the present investigation, water samples were collected from eight different areas of Hazaribagh and Ramgarh districts in the month of September 2013 to examine the quality of water. The collected water samples were extensively used for drinking purposes. The sampling stations are Sonda (w_1), Damodar River (w_2), Siyal (w_3), Udimari (W_4), Jarjara (w_5), Patel Nagar (w_6), Bhurkunda (w_7), and Birsa chowk (w_8).

Material and Methods

Destruction of forest due to mining was studied using multi

temporal satellite data. Different types of land degradation can also be analyzed through these. The analysis of phosphate, sulphate, iron, pH, total alkalinity, hardness, nitrate, nitrite ,ammonium, fluoride, residual-chlorine, chloride, arsenic etc were carried out by water testing kits which were supplied by Nice Chemicals (P) Ltd. Cochin, Kerela. The temperature of water samples were measured by thermometer (Celsius).The water analysis observed data were compared with the standard data provided by WHO[6] for drinking purposes.

Results and Discussion

The physico-chemical parameters, which are responsible for the degradation of water quality of surface and ground water, are given in table-1 and data are comparing with WHO and IS:10500 standards[7] for drinking water (table-2).

Temperature: Temperature of water plays important role for living beings. Quality of water is also maintained by temperature. The temperature of different sampling areas ranges from 22° C to 27°C.

pH:- The pH of surface water ranges from 4.70 to 7.83 which is slightly less than the range of drinking water proposed by ISI 1991 (6 to 8.5).

Electrical conductivity: Electrical conductivity or specific conductance is the measure of a fluid to carry charges which is directly related to the total dissolved solids (TDS). As the total dissolved substances in the water increases, the conductivity of water also increases. The conductivity of samples collected from the different areas under discussion ranges from 620.70 $\mu s / cm$ to 1732.00 $\mu s / cm$ (microsiemen per centimeter).

Alkalinity: Alkalinity is the measure of water tcapacity to neutralize acids. Compounds causing alkalinity in water are dissolves carbon dioxide, carbonate, bicarbonate and hydroxide which occurs due to dissolution of mineral present in the soil. The value of alkalinity ranges from 95 to 210 mg/litre.

Turbidity: It is measure of the cloudiness of water and is used to indicate water quality and filtration effectiveness. Higher turbidity levels are generally associated with higher level of disease causing micro-organism such as viruses, parasites, and some bacteria. The value of turbidity of water of these areas ranges from 01 to 20.

Iron: The concentration of iron in the collected sample varies from 1.1 to 1.40 mg/litre whereas standard limit for iron is 0.3 to 1.0 mg/litre. The high concentration of iron in water causes unpleasant metallic taste. Iron is essential for our health. In human nutrition, iron plays the most important role in the formation of haemoglobin, a protein which carries oxygen to all cells of the body. But excess intake of iron can cause a disease known as hemochromatosis, a severe disease that can damage the body's organs. Early symptoms include fatigue, weight loss, and joint pain, but if hemochromatosis is not treated, it can lead to heart disease, liver problems and diabetes. A blood test can identify iron overload.

Table-1
Results of Chemical analysis of different water samples

Location	Sonda	Damodar River	Sayal	Udimari	Jarjara	Patel Nagar	Bhurkunda	Birsa CHowk
No.	W_1	W_2	W_3	W_4	W_5	W_6	W_7	W_8
Temperature	25	26	22	23	23	24	22	24
pH	5.35	4.70	6.83	5.67	6.80	5.95	7.83	6.83
EC	1190.00	819.80	1723.00	1028.00	832.00	872.10	675.40	620.70
TUR	7	3	17	20	2	7	3	20
TDS	609.60	463.90	831.10	592.00	487.00	533.30	335.20	320.90
HA	660	116	288	264	92	210	102	178
ALK	150	190	210	110	115	190	95	210
Cl^-	26.52	24.99	116.96	39.98	19.99	21.99	20.99	91.97
SO^{-4}	468.48	350.79	509.92	516.00	459.00	464.00	559.00	567.00
N	7.32	6.58	8.76	6.89	7.86	8.42	8.04	7.65
Fe	1.37	1.10	1.40	1.36	1.24	1.36	1.38	1.32
Mn	0.08	0.03	0.08	-	0.07	0.08	0.04	0.03
Zn	1.58	2.10	3.10	2.70	2.20	2.60	1.90	2.10
DO	4.10	1.10	4.20	2.60	4.30	6.00	2.30	1.70
BOD	0.40	1.10	0.90	0.20	1.30	2.80	0.30	1.50

Abbreviation used in table: TUR-Turbidity, TDS- Total dissolved solids, HA- hardness, ALK- Alkalinity, EC- Electrical conductivity

Sulphate: It is found almost all natural water. The sulphate level in the collected samples varies from 468.48 mg/litre to 567.00 mg/litre but the maximum level of sulphate suggested by is 200 to 400 mg/litre. A high level of sulphate can cause severe chronic diarrhea and in some cases death.

Chloride: The chloride value ranges from 19.99 mg/litre to 116.26 mg/litre in the collected sample. But according to WHO and ISI, the amount of chloride in drinking water should be 250 mg/litre. The higher concentration of chloride may affect heart and kidney disease affected persons[8].

Total Hardness: The temporary hardness of water is only due to dissolved Calcium and Magnesium Bicarbonate in water; where as permanent hardness is due to presence of chlorides and sulphates of Calcium and Magnesium in water. The value of total hardness ranges 92 to 660 mg/litre. However, there is no firm evidence suggesting drinking of hard water cause any adverse effect on health[9].

Acid Mine Drainage: Acid mine drainage (AMD) refers to water with high concentration of sulphuric acid draining out of surface or subsurface coal mines. It can be released anywhere on the mine where sulphides are exposed to air and water Acid mine drainage is one of mining's most serious threat to water because it can occur after mining has ended. A mine draining acid can devastate rivers, stream and aquatic life.

Dissolved Oxygen: The dissolved oxygen (D.O) refers to the amount of oxygen that dissolved in water. The oxygen dissolves in water by diffusion process from the atmosphere. When dissolved oxygen levels drop below 5.0 mg/litre, aquatic life comes under stress. The concentration of dissolved oxygen varies from 1.10 mg/litre to 4.30 mg/litre in the collected sample. Only the sample W_8 has higher value of dissolved oxygen (6.00mg/litre). Low concentration of dissolved oxygen indicates poor quality of water and directly or indirectly it badly influences the flora and fauna of these reservoirs and ultimately the entire systems.

Table-2
Drinking water specification as per IS; 10500-1993 revised

Parameters	Desirable limit	Permissible limit
Total Hardness as caCO3(mg/L)	300	600
Iron(mg/L)	0.3	1.0
Chloride(mg/L)	250	1000
T.D.S(mg/L)	500	2000
Calcium(mg/L)	75	200
Magnesium(mg/L)	30	100
Nitrate(mg/L)	45	100
Sulphate (mg/L)	200	400
Alkalinity(mg/L)	200	600
Sodium(mg/L)	75	nil

Biochemical Oxygen Demand: The biochemical oxygen demand (B.O.D) is the amount of oxygen that would be consumed if all the organic materials in one litre water were oxidized by bacteria in a specific time interval. The BOD value ranges from 0.02 to 2.80 mg/litre in the present sample. The acceptable limit of BOD in drinking water is3.0 mg/litre as suggested by WHO and ISI. A sample containing more than 5.0 mg/litre BOD indicates a nearby pollution source[10].

The observed values of Nitrate, Sodium, potassium, phosphate are within the permissible limits as per WHO guideline for drinking water.

Conclusion

The analysis revealed that total dissolved solids, sulphate, hardness and iron content in both groundwater and surface water are high. The low value of dissolved oxygen and high value of biochemical oxygen demand indicate the poor quality of water in these areas. Contamination with Acid Mine Drainage (AMD) originating from mines also causes degradation of water quality. Use of such water as drinking purposes cause severe health hazard to the people of these areas.

Suggestion: Coal mining destroys or significantly alters all the physical features that influence the fertility of the land and quality of water. Mining, either opencast or underground is considered as an unfriendly activity as it affects all the components of the environment, namely society, ecosystem, land, water regime and atmosphere. Due to underground mining, huge volume of polluted water flooded in the mines and are channeled into the stream or river which in turn gets chemically polluted . Opencast mining also disturbs the aquifers and water table.

The first step of opencast mining is to remove the soil and rock covering the coal. This causes permanent flow of water into the mines and loss of water from aquifers. Mining activities particularly opencast mining results into loss of biodiversity, loss of nutrient quality and microbial activities of the soil system. It releases huge amount of mining wastes to the upper part of the land surface as overburden dump materials. Hence following measures should be adopted to mitigate the health risk of people in the coal mining areas.

Near coal mines, dense plantation should be done in proper way to mitigate air pollution as well as soil erosion. Plants of different species , which suit the environment and also maintain the biodiversity in the coal mines locality, should be planted because any interruption in biodiversity leads a drastic change in flora and fauna and finally the ecosystem. Dry landfills and wet ponds should be established to collect ash released from coal-fired power plants. For maintaining quality of water, five principal technologies e.g. diversion systems, containment ponds, groundwater pumping systems, subsurface drainage systems and subsurface barriers should be used.

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