ANALYSIS OF WATER AND SOIL NEAR COPPER MINE

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ABSTRACT

Metals have been an indispensable part of human life from last centuries. Mining is only way for extraction of metal from earth. Metal rich soil near mines is a prominent abiotic stress for living organisms especially plants. The aim of the study was to investigate metal contamination in soil and water collected from proximity of copper mining sites. The samples were collected and subjected to test pH, EC, total hardness and concentration of Cu, Zn and Cd. Water sample has an average concentration of copper in ranges from 26.0 mg/liter to 115 mg/liter. Similarly in soil also 88.8 mg/kg to 249 mg/kg copper was recorded. The concentration of copper and other metals is higher than normal permissible limit which can causes abiotic stress to flora and fauna flourish near metal mine.

INTRODUCTION

Metal contamination in ground water is a major concern around the world. Main causes of metal pollution are natural (volcano, weathering of metal rocks) as well as anthropogenic sources (Domestic waste, Industrialization, metallurgical operations, spread of herbicides and pesticides, smelting, tilling and mining). It has been suggested by various researchers that flora and Fauna of area near mine shows maximum effect of metal pollution (Stein et al., 2013, Sharma 2012a). Similarly, copper mining also leads to contamination of water, soil and vegetation in nearby area of mine. Copper is a cofactor and activator of many biochemical reactions (Gang et al., 2013). WHO sets maximum permissible limit for

Cu in water is 0.05 mg/L. Zinc is another important metal for metabolism but high concentration of Zn is considered as lethal for living being. Generally Zn is present in a limited amount on earth surface but Zn and Cd are also extracted with copper ores. The presence of metal contamination alters physicochemical properties of water and soil. Numerous reports are available on water pollution near khetri region (Singh B. 2013) but present study is conducted to evaluate concentration of metals in water and soil samples in vegetation rich zone under vicinity of Khetri copper mining area.

MATERIALS AND METHODS

The samples were collected from Banwas, 200 meter vicinity of khetri copper mine located in Rajasthan. It is situated between latitude $28^0 03' 35''$ to $28^0 04' 45''$ and longitude $75^0 47' 40''$ to $75^0 46' 45''$ in Aravali ranges.

Water sampling and Testing

Water samples were collected from test areas in separate collection bottles of 200 ml capacity. Four water samples were collected to estimate the distribution of metal in different region of area filled with vegetation. Various parameters were analyzed in water sample. Each samples was mixed with 1 ml of HNO_3 (Analytical grade) at pH lower then 2.0 and stored at 4°C to control any change before testing of metal. APHA (2012) protocols were used for analysis of water samples. Analytical grade chemicals were used for water analysis. Water samples were directly used for metal estimation by atomic absorption spectrophotometer.

Soil Sampling and testing

Soil samples were collected from 10 inch depth from surface. Each sample is collected and sealed in separate labeled sterilized polythene bags. The soils were air dried and sieved through 3mm sieve to remove litter and gravel. Soil pH was measured by digital electronic pH meter. Total hardness was measured by standard method. Electrical conduction (EC) of soil and water samples was measured by conductivity meter.

Concentration of metals in soil sample was measured by Diethylene triamine penta acetic acid (DTPA)-extraction method. A 5gm of soil sample was mixed with 25 ml DTPA (0.005M) and pH 7.4 was adjusted with 0.1 M TEA. The tubes were kept on shaker for one hour thereafter soil sample were used to evaluate metal concentration by atomic absorption spectrophotometer according to method given by Lindsay and Norvell (1978).

RESULT AND DISCUSSION

Water and soil samples were numbered according to distance as far most to in close proximity in mining area. Results shows higher metal concentration in water collected from inner most area (Sample J) than outer region. Table 1 Shows results of water testing in different samples. Variation in water pH was observed in all samples. It was noticed that maximum metal pollution in sample J causes decrease in water pH respectively.

Table 1: Analysis of water samples collected from mine area

Water Sample No.	pH	EC µmho/ cm	TH mg/L	Cu mg/L	Zn mg/L	Cd mg/L
Max. limit	6.5-8.5	250-4000 µmho/ cm	600 mg/L	0.05-1.5 mg/L	5-15 mg/L	0.0-0.01 mg/L
A	7.9±0.001	1207±0.001	210±0.001	31.5±0.01	12.0±0.001	2.8±0.002
B	7.6±0.001	1733±0.002	218±0.001	28.0±0.002	15.0±0.001	2.9±0.002
C	8.9±0.002	3213±0.005	228±0.011	26.3±0.003	10.0±0.001	1.8±0.001
D	8.8±0.001	4114±0.001	305±0.022	28.8±0.002	10.0±0.001	1.5±0.002
E	7.5±0.003	1122±0.002	302±0.012	29.9±0.001	15.5±0.001	2.0±0.010
F	8.5±0.001	4311±0.003	340±0.013	39.1±0.002	12.0±0.001	1.8±0.001
G	8.8±0.001	4225±0.001	507±0.001	32.7±0.001	13±0.001	1.4±0.002
H	8.6±0.001	4200±0.021	610±0.001	42.2±0.001	13.4±0.001	1.6±0.005
I	7.4±0.002	1101±0.011	518±0.002	67.1±0.001	17.0±0.001	3.2±0.002
J	7.1±0.001	900±0.020	315±0.001	115.2±0.001	17.8±0.001	3.7±0.004

Data Shows mean ±SD where n=3 for all samples. pH: Hydrogen ion concentration, EC: Electrical conductance, TH: Total Hardness

Permissible limit according to Drinking Water Standards of BIS (IS: 10500: 1991)

Table 2 illustrates variations in metal concentration in soil samples collected as far to close order. Highest 229.0 mg/Kg Copper, 33.0 mg/Kg Zinc and 28.5 mg/Kg Cadmium was documented during

experiment. These values are much higher than normal values. Similarly lowest value for Copper is 88.8 mg/kg, 10.4 mg/Kg Zinc and 11.4 mg/kg Cadmium was observed in areas comparatively far from mine. Metal contamination was found higher in test area than normal accepted values as maximum limit for Cu is 0.1 to 5 mg/L, Zn 1to 10 mg/L and for cadmium the upper limit is 0.001 to 0.05 mg/L water (Gutam Patel et. al., 2011). Copper and other metals occur as ore enhances metals concentration in soil and water. Thus, Study indicates increasing concentration of metal ions with reducing distance from core area. High concentration of metal ions in soil and water samples indicates that metal ore and their filtrates accumulates near mine region.

Table 2: Analysis of Soil samples collected from mine area

Soil Sample No.	pH	EC µmho/ cm	TH mg/L	Copper mg/kg	Zinc mg/kg	Cadmium mg/kg
Max. limit	6.5-8.5	250-4000	600	10mg/kg	50 mg/kg	0.02 mg/kg
A	7.4±0.001	2212±0.001	350±0.001	225.5±0.01	31.0±0.002	22.4±0.001
B	7.6±0.002	1304±0.002	338±0.001	229.8±0.002	33.0±0.004	21.9±0.009
C	7.7±0.001	4221±0.005	357±0.011	99.8±0.003	18.0±0.011	12.8±0.004
D	7.6±0.002	3122±0.001	388±0.022	88.8±0.002	11.0±0.002	11.4±0.002
E	8.5±0.001	1456±0.002	405±0.012	249.9±0.001	19.5±0.003	13.0±0.017
F	8.7±0.002	3367±0.003	365±0.013	129.6±0.002	10.4±0.002	12.7±0.004
G	8.0±0.003	4562±0.001	677±0.001	122.7±0.001	12.6±0.001	13.5±0.003
H	7.9±0.002	3208±0.021	780±0.001	152.2±0.001	12.3±0.002	12.7±0.006
I	7.1±0.001	1232±0.011	789±0.002	155.1±0.001	15.0±0.011	23.2±0.002
J	6.8±0.002	1200±0.020	432±0.001	229.2±0.001	27.8±0.010	28.5±0.005

Data Shows mean ±SD where n=3 for all samples. Data Shows mean ±SD where n=3 for all samples. pH: Hydrogen ion concentration, EC: Electrical conductance, TH: Total Hardness

In collected water and soil samples total hardness was above the limit. Similarly pH and electrical conductivity was observed under and over permissible limit in different water and soil samples. pH of soil and water is an important factor to standardization of cellular health of living beings (Sharma and Travlos, 2012b). Whereas electrical conductivity (EC) shows amount of electrolytes or minerals in water and soil as high values of EC indicates excess of Na^+, K^+, Cl_2^-, and SO_4 ions in test samples. High values of total hardness in water and soil sample indicates about excess amount of carbonates and bicarbonates in samples.

Thus, Study indicates increasing concentration of metal ions with reducing distance from core area. High concentration of metal ions in soil and water samples indicates that metal ore and their filtrates accumulates near mine region. Alteration of pH with metal concentration also applies abiotic stress condition for flora and fauna exist near copper mine.

CONCLUSION

Industrialization is a foundation for human advancement. It is closely related to Mining and metals. Mining activity has always been considered as health hazards. Water and soil properties were evaluated especially from vicinity of area rich in vegetation. Concentration of metals such as Cu, Zn, Cd and physicochemical properties viz. pH, EC and total hardness were observed above limit in water and soil samples. Vegetation grown in above unfavorable and harsh conditions is also a matter of interest.

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