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IMPACT OF MINING ON WATER QUALITY OF TOSHAM, DISTT. BHIWANI (HARYANA)

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ABSTRACT

Water is one of the most essential requisite that provided by the nature to sustain the life on the earth. It becomes polluted by the addition of industrial waste in which mining industry play very big role. In the present research impact of mining on water quality was assessed by analyzing the various physico-chemical parameters such as pH, EC, TDS, hardness, fluorides, chlorides calcium, magnesium, sulphates, phosphates and heavy metals. The analysis results indicated that water quality of mined area is much more polluted than the mining area as abundant mining is done in mined area which pollutes the water by leaching process. The water quality parameters such as TDS, Ca2+, Mg2+, Fe, SO42-, total hardness and fluorides are found in concentration higher than the permissible limits.

KEYWORDS: Mining, abundant, leaching, hardness, fluoride

INTRODUCTION

Water is one of the most precious resources on Earth in which not only life exists but also survival of living beings depends. Only 1% of the total earth water is available in usable form as fresh water for the living beings in the different sources such as ponds, rivers, estuaries, streams, lakes and ground water. It is estimated that about one third of the world's population consume groundwater out of these sources for drinking purposes and about half of the world's population depends upon it for their survival [1]. It involves in every function of our body and contributes about 2/3 of our body.

But day by day by increased flux of pollutants through increased industrialization and urbanization to it is deteriorating its quality. Industrializations are main contributor, especially the mining industry. Mining is carried out for limestone in Ambala, silica sand in Gurgaon & Faridabad and for Kankar in Distt., Bhiwani, Haryana.. The study area of present research is the mining and mined area of Tosham subdivision which is situated at a distance of 35 KM north west of Bhiwani in state of Haryana and extended upto foothills of Khank hill (Aravalli hills) [2] [3]. It is an important resource area for metals, minerals and a stone on which livelihood local population is depends but if mining is improper then it not only deteriorates the water quality but also destroys the natural vegetations and agricultural operations [4]. It also resulted in the collapse of building and roads by large cracks [5]. The importance of water makes it imperative that physico-chemical analysis be conducted to water.

MATERIALS AND METHODS

The experimental work in the present study was divided into two different parts to achieve the objectives of the research.

Collection of water samples

The water samples were collected from mining and mined area of Tosham subdivision, Distt., Bhiwani in high grade plastic bottles of one litter capacity in such a way that water quality of entire area may be presented.

It was ensured every time that collection bottles satisfy the following requirements such as free from contamination, resistant to any internal pressure and do not affect water characteristics. These samples were kept in refrigerator in the laboratory during analysis to avoid the any change in physico-chemical characteristics due to the various contaminants.

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Physico-chemical analysis of water samples

Water quality parameters such as pH, EC, TDS, total hardness, total alkalinity, sodium, potassium, calcium, chloride, sulphate, phosphate, fluoride and heavy metals were analyzed by APHA standards method [6]. pH, EC, TDS were measured by pH , EC and TDS meter respectively. Total hardness, total alkalinity and chloride were determined by standard EDTA, sulphuric acid and silver nitrate solution through titration method respectively. The parameters such as Sodium, potassium, calcium and magnesium by were estimated by using ELICOCL-220 flame photometer. However, the parameter such as sulphate , phosphotate , fluoride and heavy meals were analyzed by Nephlometer, spectrophotometer and atomic absorption spectrophotometer respectively.

RESULTS AND DISCUSSION

Sampling site and sample collection

Total nine samples were collected from Tosham subdivision, Distt., Bhiwani in which sample no. 1 to 6 collected from mined area and sample no. 7 to 9 from mining area in such a way that whole area is covered. The summary of sampling site is presented in table-1

Table 1. The summary of sampling site

SAMPLE NO.	SAMPLING SITE	SOURCE	DISTANCE FROM MINING(KM)
Tos-1.	Tosham residential area	Hand Pump	5
Tos-2.	Tosham bus stand	Hand Pump	5
Tos-3.	Residential area	Hand Pump	5
Tos-4.	Main bazaar	Hand Pump	5
Tos-5.	Near post office	Hand Pump	5
Tos-6.	Near girls school	Hand Pump	5
Tos-7.	Khanak	Well	1
Tos-8.	Khanak	Hand Pump	1
Tos-9.	Khanak	Well	0.5

Physico-chemical analysis of water samples

The analysis result of various water quality parameters such as pH, EC, TDS, total hardness, total alkalinity, sodium, potassium, calcium, chloride, sulphate, phosphate, fluoride and heavy metals is presented in table-2 and table-3.However the comparative result of mined and mining area with ISI standards is presented in table-4.
It was observed from these results that the water quality of study area is adversely affected by the mining activities.

Table 2. Results of various physico- chemical parameters

SAMPLE NO.	pH	EC (mmho/ cm)	TDS (ppm)	Alkalinity (ppm)	Total hardness (ppm)	Na^+ (ppm)	K^+ (ppm)	Ca^{2+} (ppm)	Mg^{2+} (ppm)
Tos-1.	7.5	2.5	1600	301.6	1468	130	31	510	46.89
Tos-2.	7.9	2.18	1400	364.0	900	120	39	100	157.95
Tos-3.	8.0	7.18	4600	208.0	1660	310	340	260	250.29
Tos-4.	7.9	2.18	1800	208.0	2448	130	24	140	509.81
Tos-5.	7.9	4.84	3100	301.6	2120	580	12	300	331.91
Tos-6.	7.5	3.43	2200	416.0	1888	300	16	180	349.43
Tos-7.	8.1	2.34	1500	176.8	2164	140	08	140	445.66
Tos-8.	7.9	3.75	2400	218.4	1628	330	08	100	286.25
Tos-9.	8.2	2.18	1400	83.2	1264	190	04	130	228.17

Table 3. Results of various physico- chemical parameters

SAMPLE NO.	Cr (µg/ ml)	Cd (µg/ ml)	Fe (µg/ml)	Zn (µg/ ml)	Pb (µg/ml)	HCO^{3-} (ppm)	CO_3^{2-} (ppm)	Cl^- (ppm)	PO_4^{3-} (ppm)	SO_4^{2-} (ppm)	F^- (ppm)
Tos-1.	4.02	ND	139.1	ND	1.36	367.9	NIL	265	0.102	313.8	1.98
Tos-2.	4.16	ND	101.9	ND	0.96	444.8	NIL	192	0.106	147.9	6.29

Tos-3.	4.06	ND	50.9	ND	1.71	253.76	NIL	549	0.151	2050	4.37
Tos-4.	4.30	ND	1.24	ND	1.75	253.76	NIL	217	0.62	1074	3.46
Tos-5.	4.25	ND	ND	ND	0.61	367.95	NIL	637	0.111	919.4	2.0
Tos-6.	4.32	ND	ND	ND	0.43	607.52	NIL	368	0.102	918.1	2.59
Tos-7.	3.99	ND	26.4	ND	0.70	215.69	NIL	2.51	0.102	838.8	3.93
Tos-8.	4.11	ND	21.0	ND	0.17	266.44	NIL	824	0.244	581.3	2.16
Tos-9.	4.04	ND	10.32	ND	0.83	101.50	NIL	288	0.191	718.1	4.09

ND: Below the detection limit.

The parameters wise result is described as under:

pH :
It is the negative logarithm of hydrogen ion concentration. It varies from 7.5 to 8.0 in mined area and 7.9 to 8.2 in mining area. pH of all the sample lie within the permissible limit.

Electrical conductivity:
It is an indicator of salinity, its value in mined area varied from 2.18 to 718 mmho/cm and in mining area from 2.18 to 3.75 mmho/cm. The high value of EC in mined area shows higher concentration of chemical species in that area.

Total Dissolve Solids:
It was evident from the results that most of the samples having TDS value more than the permissible limit and maximum 4600ppm TDS was observed in sample no. 3 of mined area.

Table 4 Comparison of results of mined and mining area with ISI standards

S.NO.	PARAMETERS	MINED AREA			MINING AREA			ISI STANDARDS	
		Minimum	Maximum	Average	Minimum	Maximum	Average	Highest desirable limit	Maximum Permissible limit
1	pH	7.5	8.0	7.7	7.9	8.2	8.0	6.5-8.5	6.5-9.2
2	TDS(ppm)	1400	4600	3000	1400	2400	1900	500	1500
3	TA(ppm)	208	416	312	208	218	213	200	600
4	TH(ppm)	900	2448	1679	1264	2183	1724	300	600
5	Ca^{2+}(ppm)	100	510	305	130	180	155	75	200
6	Mg^{2+}(ppm)	46.89	509.81	278.35	228.17	445.66	337.18	30	100
7	Cr(µg/ml)	4.02	4.32	4.17	3.99	4.11	4.05	0.05	0.10
8	Fe(µg/ml)	1.24	139.1	71.17	10.32	26.4	18.36	0.3	1.0
9	Pb(µg/ml)	0.43	1.75	1.09	0.17	1.71	0.94	0.05	0.05
10	HCO^{3-}(ppm)	253.76	507.52	308.64	215.69	266.44	241.06	244	732
11	Cl^{-}(ppm)	172	549	260.5	257	824	540.5	250	1000
12	SO_4^{2-}(ppm)	147.9	2050	1056.55	581.3	838.0	710.05	200	400
13	F^{-}(ppm)	1.98	6.29	4.135	2.16	4.09	3.125	1.0	1.5

CO_3^{2-} , HCO^{3-} and Total Alkalinity:
The alkalinity of water is attributed due to the presence of OH^- , CO_3^{2-} and HCO^{3-} ions. CO_3^{2-} alkalinity was observed nil in all the samples but bicarbonate as well as total alkalinity varied from 208-416 and from 215.69 to 507.52 respectively and lie within the maximum permissible limit but higher than the desirable limit.

Total Hardness:
It was evident from the results that total hardness varied from 900 to 2448 ppm in mined area and 1264 ppm to 2184 ppm in mining area with maximum hardness in sample no.-4. Hardness in all the samples is observed more than the maximum permissible limit which may cause urinary concretion, bladder, kidney and stomach disorder.

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Sodium and Potassium ions:
The maximum 580 ppm sodium content is observed in sample no. 5 while the maximum 340 ppm potassium content is observed in sample no. 03, both are present in concentration more than the permissible limit as presented in table no-2. The high concentration of sodium may cause the heart problem and potassium may cause the salinity problem which renders the soil barren.

Heavy metals:
Fe, Cr and Pb varied from 1.24-139.1 µg/ml, 4.02-4.32 µg/ml, 0.43 -1.75 µg/ml in mined area while 10.32-26.4 µg/ml, 3.99-4.11 µg/ml, 0.17-1.71 µg/ml in mining area respectively. Their higher concentrations are very toxic for human beings. They may enter in our body and disturb our metabolic functioning by accumulating there. They may cause cancer, damage of liver & kidney and also inactivate the enzymes by binding the metabolically active site of the enzymes.

Sulphates and phosphates:
It was varied from 147.9-2050.0 ppm with maximum value in sample no.-3. Around 80% of the samples are having sulphate content more than the permissible limit. Its higher concentration may cause cathartic action and laxative effect in presence of magnesium. Phosphate content lie within ISI permissible limit.

Chlorides:
Chloride content was varied from 172-544 ppm in mined area and 257-824 ppm in mining area. Around 80% samples are having chloride content more than the ISI desirable limit but all lie within maximum permissible limit. Its high concentration in water is conductive in corrosions of pipes. It also affacts tastes, causes indigestion.

Fluorides:
Fluorides varied from 1.98-6.29 ppm in mined area while 2.16-4.09 ppm in mining area that indicates more fluoride content in mined area. The value of fluoride in all the samples is higher than the ISI maximum permissible limit. At high concentration it may cause mottling of teeth, skeletal and crippling fluorosis.

CONCLUSION
From the results, it was be concluded that the water quality of mined area is much more polluted than the mining area as abundant mining is done in mined area which pollutes the water by very slow leaching process. In mined area leaching is taking place for a longer period than the mining area. The water quality parameters such as TDS, Ca^{2+}, Mg^{2+}, Fe, SO_4^{2-}, total hardness and fluorides are found in concentration higher than the permissible limits in most of the samples. So, result indicated that improper mining was done in Tosham which adversely affected the water quality of Tsham, Distt., Bhiwani, Haryana.
The study area imperatively requires implementation of water management and recharge schemes along with proper mining.

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