Assessment of Fluoride Contamination on Groundwater Along Jojari River Due to Discharge of Steel Industries Wastewater

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Abstract- *Environmental pollution is placing an ever-increasing load on the various resources of our environment, including soil. Soils polluted with various pollutants can be found near industrial areas, metropolises, along major transportation routes, underground soil, and areas treated with waste-water sludge, but soils can also be polluted geologically. Soils are able to accumulate these ions for many years without the obvious signs of their acute toxic effect. However, the filtering/purifying capacity of soils is finite and, above a certain level, soils are no longer able to absorb these elements and become sources of pollution themselves. Toxic elements are released into water, absorbed by cultivated crops and plants; they are assimilated into vegetative and generative organs, and enter the food-chain where they cause long-term harm. Presence of low or high concentration of certain ions is a major issue as they make the groundwater unsuitable for various purposes. Fluoride is one such ion that causes health problems in people living in more than 25 nations around the world. Waste water from steel industries of Jodhpur is discharged into the Jojari river. Fluoride ions from this wastewater leach into the groundwater and contribute high fluoride concentration in the nearby underground water. Samples of underground water were collected along the Jojririver. Concentration of fluoride in some of the samples was found above the permissible limits. Health impacts like dental fluorosis and skeletal fluorosis are found in many villages of Jodhpur district. Treatment of wastewater, generated in industries is urgent necessary to bring the concentrations under prescribed limits before discharging it into the river Jojri.*

Keywords- Pollution , Fluoride ,TDS, Steel Industry , Ground water

I. INTRODUCTION

Jodhpur is situated in the western part of the Rajasthan. It is the second largest city of Rajasthan after Jaipur. City is well known for its textile and steel industries. . Industries in Jodhpur are mainly located in Industrial Areas developed by RIICO and city is situated on the bank of river Jojari. This river is no more perennial in nature. Fresh water flows into it only in rainy season and in remaining seasons, water in the river contains treated or untreated domestic waste water and treated or untreated industrial waste water.Due to the critical condition of this river it was chosen as the study area. Samples of sludge and ground water were collected from various locations and at various depths. Locations of the sampling point were decided randomly to represent an overall view of the river length.

As wastes from Steel industries is discharged into the river Jojari pollutants are continuously depositing on the river bed. The waste contains large amount of fluoride in the form of HF, it can be harmful to human and crops if the water from tube-wells is used for drinking and irrigation purpose. In the present study, deposited sludge samples from the river bed and water samples from nearby tube well were taken along the river to find out the leaching effect of fluoride from the polluted river water to underground water.

II. OBSERVATIONS & ANALYSIS

Water samples were collected at various depths from investigated sites. 12 samples of underground water and 16 samples of sludge were taken. Before the samples were taken, the water was pumped out for 5-10 minutes until fresh water comes out from deep in the well. New polyethylene sample bottles were taken for sample collection. Two litres of water samples were collected. Grab samples were collected from the tube well and well near Jojari River at all the sampling locations. The sample bottles were soaked in 10% HNO_3 for 24hr and rinsed several times with double distilled water (DW) prior to use. Water samples were collected as per the sampling protocol and tested as per standard method. Water samples were tested for pH, total dissolved solids (TDS) and fluoride.

Table -1 shows the locations of the samples with their respective names which were taken from upstream to downstream, whereas table 2 shows the location of sludge samples near water sample locations at an average depth of 30 cm from surface. Table-3 shows the test results of various water samples for TDS, pH & fluoride. Concentration of fluoride in sludge of river is given in table-4.

Table 1: Water sample locations

S. No.	Sample Nomenclature	Water sample location
1	W-1	BanarVillage
2	W-2	RamjanjiHattah, Railway Cantt, BanarRoad
3	W-3	Nh-65, Near Asiyana-PaliRoad
4	W-4	SalawasJojariRiver Bridge
5	W-5	HP Petrol Pump (Near Salawas STP)
6	W-6	On Road To SalawasRailway Station
7	W-7	In Front Of Kalpatru Warehouse
8	W-8	SalawasNandwan Village
9	W-9	Village BhandukallaHeerkheda
10	W-10	Gelawas Village
11	W-11	Lunawaskhurd Village
12	W-12	Dhundara Village

Table 2: Sludge sample locations

S. No.	Sample Nomenclature	Sludge Sample Location
1	S-1	Near NandriSTP
2	S-2	Near KudiHodd
3	S-3	100 M Upstream to Salawas Railway Bridge
4	S-4	50 M Upstream to Salawas Railway Bridge
5	S-5	50 M Downstream to Salawas Railway Bridge
6	S-6	250 M Downstream to Salawas Railway Bridge
7	S-7	450 M Downstream to Salawas Railway Bridge
8	S-8	650 M Downstream to Salawas Railway Bridge
9	S-9	850 M Downstream to Salawas Railway Bridge
10	S-10	950 M Downstream to Salawas Railway Bridge
11	S-11	500 M Downstream to Salawas Railway Bridge
12	S-12	Near Salawas Road Bridge
13	S-13	Near Nandwan Village
14	S-14	Near BhandukallaHeeraKheda
15	S-15	Near LunawasKhurd
16	S-16	Near Dhundhara Village

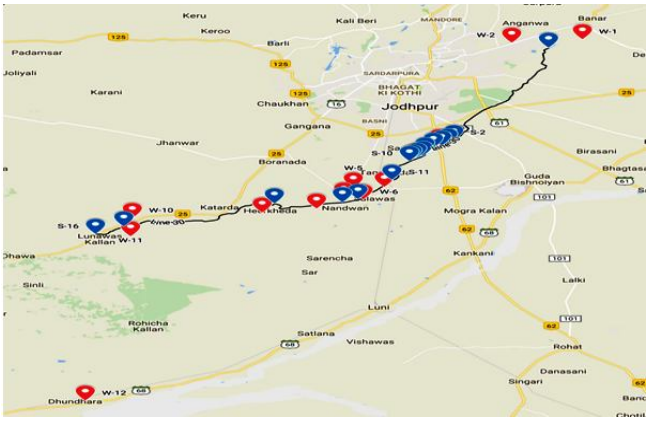

Figure-1: Map of the study area along with sampling stations

Table -3: Concentration of Different Parameters in Ground Water Samples

Sample Nomenclature	Location	pH	TDS mg/l	F mg/l
W-1	Banar Village	7.8	10205	31.6
W-2	RamjanJiHatta	7.84	7280	8
W-3	AshiyanaPali Road	8	7605	8
W-4	SalawasJojri River Bridge	7.24	60450	7.36
W-5	HpPetrol Pump	7.51	1495	6.32
W-6	Near Railway Line	7.85	3835	39.2
W-7	KalpatruWherehouse	7.03	7020	3.2
W-8	SalawasNandwan Village	7.07	6565	1.8
W-9	BhanduVillage	7.85	5915	7.84
W-10	Gelawas	6.86	5005	-
W-11	LunawasKhurd	7.23	14300	4.9
W-12	Dhundhara	7.53	6695	4.4

Table -4: Concentration of Different Parameter in Deposited Sludge on Bed of River Jojari

Sample nomenclature	Fluoride (mg/l)
S-1	3.45
S-2	8.1
S-3	2.92
S-4	63.08
S-5	99.63
S-6	68.31
S-7	55.8
S-8	53.73
S-9	70.18
S-10	12.354
S-11	12.517
S-12	10.89
S-13	12.12
S-14	5.406
S-15	5.733
S-16	7.321

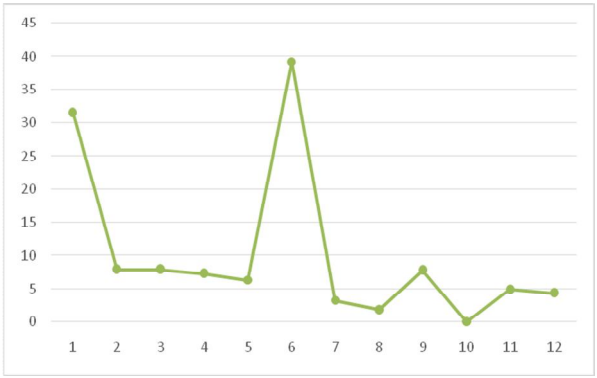

Figure -2: Concentration of fluoride in Ground Water Samples along river Jojari

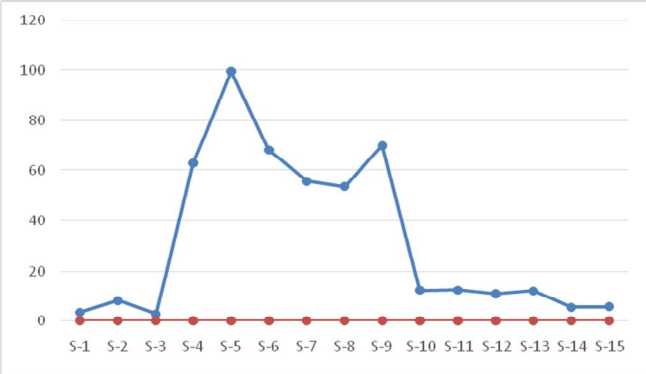

Figure-3: Concentration of Fluoride in deposited sludge on bed of river Jojari.

Location of sludge sampling points on the river bed are shown with blue colour in figure-1 whereas groundwater sampling stations are shown with red marks in figure-1. Figure-2 & figure-3 , indicates the variation of fluoride concentration in ground water and sludge respectively along the river bed.The Sludge and groundwater analysis of Jojari River and nearby areas throughout the length of the river was carried out. It can be clearly concluded from the observation data and graphical pattern that places where deposition of sludge contaminants is high, high concentrations of fluoride are found in underground water at corresponding locations. Maximum fluoride concentration was measured atnear 'Salawas railway station' where the industrial wastewater is discharged directly into the river Jojari. It is the same corresponding location for sludge analysis (S-4 to S-9) where maximum concentration for fluoride in sludge deposition was found. Thus, due to leaching, fluoride is getting accumulated in underground water continuously. Also, high concentration of fluoride was measured at 'Banar village', which is because of underground presence of minerals containing fluoride. Concentration of fluoride in ground water along the river reach after point of disposal of industrial waste water is almost following the same pattern that is found in the deposited sludge . Hence it can be concluded that leaching of fluoride from the sludge/ industrial water is taking place and this fluoride is joining the upper layer of ground water.

III. CONCLUSION

It can be concluded from the observations and analysis that most affected zone in river is from SalawasRailway Bridge to Salawas Road Bridge. Water is one of the most essential substances for humans to live and plants to grow. Industries are contaminating water by discharging its effluent in water bodies without treatment or giving partial treatment. If this practice is remain continue for a longer time, as it is happening now, situation may go beyond control. Hence it is the time now to remove the fluoride from the industrial waste of steel industries which are mainly responsible for fluoride in the waste water to save the ground water along the river Jojari in long term.

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