



## Spectrophotometric study of Iron, Nitrate and Phosphate of the water of river Sai of Jaunpur

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### ABSTRACT

The present study specially aims to study spectrophotometrically the water quality of river Sai of Jaunpur. In the river Sai direct wastes like household garbage, sewage as well as industrial wastes is dumped without treatment. River Sai is continuously been contaminated by the sewage and other types of wastes. In the present study three parameters were chosen viz. iron, nitrate and phosphate. Although river water of Sai would contain appreciable amount of iron, nitrate and phosphate. This study revealed that there is marked variation in the levels of these parameters during the years of study 2009, 2010 and 2011, sometimes it has been found to be more than WHO maximum contamination level.

### Keywords : iron, nitrate, phosphate, spectrophotometer

**INTRODUCTION-** In continuation of our study<sup>1,2</sup> on water quality of different rivers, we have now chosen river Sai of Jaunpur. Jaunpur is situated southeastern part of Uttar Pradesh and lies 25.730N latitude and 82.680E longitude embracing an area of nearly 4,038 km<sup>2</sup> (1,559 sq mile) with the total population 4, 476,072 as per census of 2011 having density of 1,108 km<sup>2</sup> (2,870 sq mile). A preliminary survey of the river Sai at Jaunpur showed that there were several points of interest. It flows from the suburban areas of the Jaunpur district and merges with River Gomti at the trimuhani (Oodpur) of the Jaunpur. It provides important source of water for the purpose of irrigation and drinking to the people of Jaunpur. The river water of Sai would contain appreciable amount of iron, nitrate and phosphate.

Iron is essential nutrient reached into the river water with surface runoff during rains, because in rains iron dissolves from the soil in the runoff water. So during rainy season the level of iron contamination is higher in comparison to other season. Increase in the iron enhances the growth of the algae which can block the sunlight to reach the other aquatic bodies. High concentration of iron may increase the acidity of the water which not good for aquatic life. Iron is not hazardous to human health but it is considered as secondary aesthetic contaminant at high concentration.

Nitrate is an important mineral in the river water. Nitrate in water is present as highly soluble salt, as per the public health standard the maximum contaminant level (MCL) of nitrate for safe drinking water is 10 ppm as nitrate-N or 45 ppm as nitrate. Consumption of drinking water with high nitrate level causes hypertrophy of thyroid gland resulting in hyperthyroidism.

Phosphate enter the river water from human and animal wastes, phosphate rich rocks, laundries wastes, treatment of boiler water and agricultural practices in the form of fertilizers' residues. Organic phosphates are found primarily by biological processes, but also contributed by domestic sewage. Phosphates also occur in bottom sediments and in biological sludge, both in the precipitated inorganic forms and incorporated into organic compounds. Phosphate enhancement in the river and lakes are the cause of algal bloom (eutrophication) which reduces the dissolved oxygen in water and

disrupt the natural water cycle. In general phosphate would not hurt human beings and animals unless present in very high concentration. The WHO threshold limit<sup>3</sup> for phosphate is 0.05mg/l.

**SAMPLING-** Water samples were randomly collected at seven sampling stations, details of which are given in table (1). Samples were taken at a distance of 3.0 meters inside the river from the bank and depth of about 0.20 meter before about two months from the start of rainy season, during rainy season and about two months after the rainy season.

**TABLE-1  
DETAILS OF SAMPLING STATIONS**

S.No.	SAMPLING STATION	SAMPLING STATION	LOCATION
1	TEJI BAZAR BRIDGE	SS1	ENTRY POINT
2	BARGOODAR BRIDGE	SS2	-
3	RAM DAYAL BRIDGE	SS3	-
4	KERAUN GHAT	SS4	-
5	JALAL PUR BRIDGE	SS5	-
6	OODPUR BRIDGE	SS6	EXIT POINT

The samples were collected from the above mentioned sampling station for last three years viz. 2009, 2010 & 2011.

**MATERIALS AND METHODS-** Reagents were prepared from analytical grade chemicals provided from Qualigens fine chemicals. To minimize the interference of any other ions deionized distilled water is used and all the analysis carried by UV visible Spectrophotometer (UB29).

**Determination of iron-** Any solution which is colored or can be made colored by adding a complexing agent can be analyzed using a spectrophotometer<sup>4,5</sup>. Solutions containing iron ions are colorless, but with the addition of ortho-phenanthroline, the iron (II) ions in the sample are immediately complexed to produce a species which is orange in color. More iron (II) ions in a sample will result in a deeper orange color. From data obtained from a series of iron (II) standards, it is possible to be able to determine the amount of iron in an unknown sample.

Dissolve 0.7022 grams of ferrous ammonium sulfate hexahydrate in deionized water. Dilute to 1.00 l. This solution is

100 mg/l Fe +2 (same as 100 ppm). Prepare standard solution 100.0 ml calibrated flasks. To this flask add 5 ml of a 0.25% ortho-phenanthroline solution. Dilute with deionized water to 100.0 ml. Now the solution in calibrated flask was diluted to the mark. After 30 minutes the absorbance of the solution was measured at 510nm ( $\lambda$  max). Now, after pre concentration of collected samples, it was transferred to 100.0 ml calibrated flask, add 5 ml of the 0.25% ortho-phenanthroline solution to the 100.00 ml calibrated flask. Dilute to the mark with deionised water, and after 30 minutes the absorbance was measured. Then concentration of iron was determined in mg/l.

**Determination of nitrate-** After pre concentration of samples, it was treated with NitraVer® 5 Nitrate Reagent Powder Pillows<sup>6</sup> in a 25.0 ml sample cell and shaken vigorously for 2 minutes and absorbance of the solution was measured at 500 nm ( $\lambda$  max). Same procedure was repeated for known solution and absorbance observed was recorded for each solution and concentration of nitrate was determined in mg/l.

**Determination of phosphate-** The molybdenum blue phosphorous method in conjunction with UV-Visible spectrophotometer is a very sensitive method<sup>7,8</sup> for the determination of phosphate at 830 nm. Phosphate in the sample can be determined at sub-ppb concentration at 830 nm. Orthophosphate and molybdate ions condense in an acidic solution to form phosphomolybdic acid, upon selective reduction (e.g. with hydrazinium sulphate) a blue color is produced. The intensity of the blue color is proportional to the amount of phosphate initially incorporated into the heteropoly acid. If the acidity at the time of reduction is 0.5 M in sulphuric acid and hydrazinium sulphate is the reductant then the resulting blue complex exhibits a maximum<sup>9</sup> absorbance at 830 nm ( $\lambda$  max). Intensity of the color solutions is measured on a UV visible spectrophotometer.

**RESULTS AND DISCUSSION-** The results obtained from the analysis of different parameters and for different years of study were recorded in table (2).

**TABLE-2**  
**DATA FROM DIFFERENT SITES OF RIVER SAI IN JAUNPUR**

S. No.	SAMPLING STATION	2009									2010									2011								
		Concentration in mg/l			Concentration in mg/l			Concentration in mg/l			Concentration in mg/l			Concentration in mg/l			Concentration in mg/l			Concentration in mg/l								
		iron	nitrate	phosphate	iron	nitrate	phosphate	iron	nitrate	phosphate	iron	nitrate	phosphate	iron	nitrate	phosphate	iron	nitrate	phosphate	iron	nitrate	phosphate						
1	SS1	3.93	4.78	4.23	13.22	15.35	14.21	11.56	13.65	12.50	4.21	5.93	4.98	13.69	16.11	15.21	11.21	13.12	12.78	4.25	6.12	5.09	15.70	18.83	17.21	11.56	15.21	14.19
2	SS2	3.97	4.90	4.78	15.72	17.16	16.22	12.22	14.29	13.50	4.11	6.22	5.50	15.89	17.67	16.89	12.55	14.88	14.00	4.58	6.72	5.79	16.59	18.56	17.98	12.79	15.23	14.59
3	SS3	4.19	5.18	4.88	15.90	17.89	16.70	12.48	14.29	13.50	4.56	6.54	5.65	16.17	18.28	17.25	12.89	15.81	14.78	4.89	6.98	5.99	16.98	19.29	18.15	13.48	15.99	14.89
4	SS4	4.39	5.48	5.19	16.35	18.43	17.22	12.78	14.29	13.50	4.89	7.21	5.98	16.50	18.73	17.97	13.58	16.46	15.26	5.11	7.48	6.49	17.24	19.34	18.89	13.91	16.58	15.36
5	SS5	5.69	6.20	5.69	16.94	19.19	17.64	13.20	14.29	13.50	5.00	7.48	6.18	17.18	19.21	18.29	13.98	17.64	16.03	5.21	7.59	6.63	17.81	20.11	19.26	14.29	17.53	15.92
6	SS6	5.61	6.18	5.63	16.75	19.09	17.58	13.05	14.29	13.50	4.99	7.41	6.09	17.10	19.05	18.14	13.88	17.09	15.99	5.01	7.48	6.49	17.68	20.01	19.04	14.09	17.48	15.76

BRS=BEFORE RAINY SEASON; DRS=DURING RAINY SEASON; ARS= AFTER RAINY SEASON

Data in table (2) revealed that the concentration of iron, phosphate and nitrate is increasing gradually with the subsequent years. It also revealed that the concentrations of these parameters are also increasing gradually from entry point of river in the city to exit point.

The concentration of all the parameters varies seasonally, maximum concentration were reported during rainy season. The variation in the concentration of various reported parameters is gradual. As if we move from the entry point to exit point the concentration of iron is gradually increasing from 3.93 mg/l to 5.61 mg/l before rainy season, from 4.78 mg/l to 6.18 mg/l during rainy season and from 4.23 mg/l to 5.63 mg/l after rainy season in the study year 2009 this trend is continued in the subsequent years.

Similar trend of variation in concentration of nitrate and phosphate is seen if move across the entry to exit point as well as from 2009 to 2011.

**CONCLUSION-** It has been observed during this study that there is gradual increase in concentrations of iron, nitrate and phosphate during subsequent years. The concentration of nitrate is in control as per MCL is concern. But the concentration of iron and phosphate are increasing rapidly, especially concentration of phosphate increased many fold during the years.

The concentration of phosphate is increasing due to uncontrolled use of phosphate fertilizers, dumping of household garbage which contains large percentage of phosphate and industrial wastes.

The concentrations of iron, nitrate and phosphate is increasing with every passing year and it is high time to control the dumping of untreated sewage, agricultural wastes and industrial wastes to the river water to save the river from pollution.

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