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Influence of a Chemical Industry Effluent on Water Quality of GobindBallabh Pant Sagar – A Long Term Study

Kachhal Prabhakar[1], Beena Anand[2], SN Sharma[3], Pankaj Sharma[4], SL Gupta[5]
[1-5]*(Central Soil & Materials Research Station, Ministry of Water Resources, New Delhi – 110016 (INDIA)*

ABSTRACT: *GobindBallabh Pant Sagar was created in 1962 on the river Rihand. The Dam is located in the state of Uttar Pradesh (24°12'9"N83°0'29"E 24.2025°N 83.00806°E). It was commissioned for the purposes like irrigation, flood control, fishery and wild life conservation etc. along with electricity generation. Many thermal power plants of different capacity have been raised around the reservoir. Abundance of power promoted establishment of chemical industries. The industrial effluents discharged in the reservoir without proper treatment contaminate the hydro-environment. For the purpose of monitoring the degree of pollution, a long term detailed investigation program was initiated in the region near one of the major industries. The studies aim at monitoring the degree of chemical pollution of reservoir water which will have multifold impacts on both biotic as well as abiotic components. The studies clearly indicate that further deterioration in the quality of the reservoir water has been arrested since monitoring of the quality of reservoir water was initiated. This paper presents the details of the observations carried out in the region around this in different seasons during the period October 2002 to August 2012.*

KEYWORDS: *Chemical effluents; pH; Conductivity; Suspended matter; Total dissolved salts; Pollution*

I. INTRODUCTION

GobindBallabh Pant Sagar (GBS), also known as Rihand reservoir was created in 1962 on the river Rihand, a tributary to Sone, which in turn joins the Ganga on its right flank. The river originates from the hills of Madhya Pradesh, draining a catchment of 13 344 km^2. Rihand Dam on it is located in the state of Uttar Pradesh (24°12′9″N83°0′29″E 24.2025°N 83.00806°E). The reservoir has a capacity of 10 625 million m^3 at the FRL of 268’ above MSL and a surface area of 46538 ha, which shrinks to 13759 ha at the dead storage (mean 30149 ha). It has a maximum length of 48 km and the mean depth at FRL is 22.8 m. Annual rate of inflow is estimated at 6 301 million m^3.

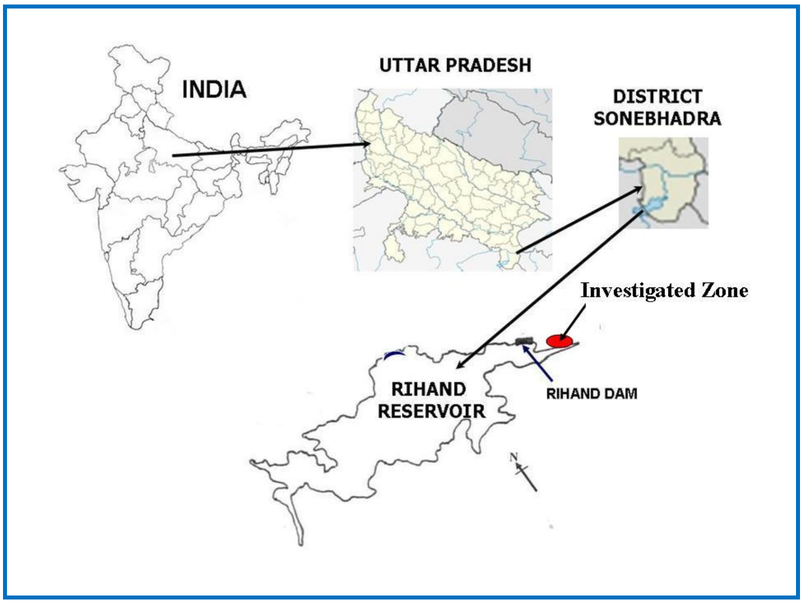

Fig. 1: Location of the Investigated Region of GBS around CHI

Large quantities of readily available reservoir water and the abundance of coal from nearby open cast mines led to the installation of a number of thermal power plants (TPP). Availability of power promoted many chemical industries around it. For the study the region around one of these chemical industries situated in northern region of GBS (CHI) (Fig 1) have been selected for carrying out observations. The CHI use water from reservoir for discharging its run off in the reservoir. The discharged effluents increase the percentage of suspended solids in the reservoir waters[1]. The contaminated water discharged from it in the reservoir increase the temperature of reservoir[1] and change the chemical composition of reservoir water[2]. For the purpose of monitoring the degree of pollution caused by CHI, a long term detailed investigation program was initiated. The study aims at long term monitoring and highlighting the degree of pollution of reservoir water so that measures to regulate it can be timely administered to arrest multifold impacts on both biotic as well as abiotic components.

II. SALIENT FEATURES OF CHI

The CHI is built aside GovindBallabh Pant Sagar Lake. It produces caustic soda on a very large scale. CHI is one of the leading industries in the chlor-alkali segment in India.

III. ANTICIPATED PROBLEMS

Some of the anticipated problems associated likely to be encountered in the project are

- Increase in average temperature of the reservoir water.
- Change in pH of reservoir water over a long period of time.
- Change in the total dissolved salts (TDS)
- Increase in aggressivity of water which may affect the concrete structures.

IV. FOCUS OF INVESTIGATION

Continuous monitoring of the quality of water has been carried out for assessing degree and rate of contamination. Following important aspects were taken into consideration during investigation

- Quality of water in the immediate vicinity of the confluence of effluents from CHI with the reservoir water .
- Quality of the chemical effluent water
- Identifying the effluent samples from CHI going into the reservoir and Reservoir water from various locations (RW) conforming/not conforming to Central Pollution Control Board of India (CPCB) standard for emission or discharge of environmental pollutants, in a ash pond[3] and ISI standards for potable water[4]Suspended solid contents and pH value of the effluent samples of CHI for pollution studies was carried out apart from determining other chemical parameters

V. MATERIAL S AND METHODS

Sampling location was selected for collection of CHI effluent and RW samples (Fig 1). During the period from October 2002 to August 2012 samples were collected during pre monsoon, monsoon and post monsoon periods. The samples were analyzed as per analytical procedure laid down in IS 3025-1986[5]. Wherever necessary, reference was also made to the procedure laid down by American Public Health Association and Water Pollution Control Federation, USA [6].

VI. FIELD INVESTIGATIONS

The in situ parameters viz. pH, Conductivity, Temperature, $CaCO_3$ Saturated pH, NH_4^+ and S^{2-} of water samples collected from various locations were determined immediately after collection of each sample.

VII. LABORATORY INVESTIGATIONS

Detailed laboratory chemical analysis was carried out on water samples collected from various locations. Chloride, Sulphate, Bicarbonate, Carbonate, Calcium, Magnesium, Sodium, Potassium, Copper, Zinc, Manganese, Lead, Chromium and Iron content is determined using state of the Art equipment like

AtomicAbsorption Spectrophotometer,microprocessor based flame photometer, UV Visible Spectrophotometer etc. In addition, amount of suspended solids was also determined using gravimetric method.

VIII. OBSERVATIONS

8.1 Temperature

The observed insitu temperature for the CHI effluent RW samples collected during different seasons is presented in Fig. 2.

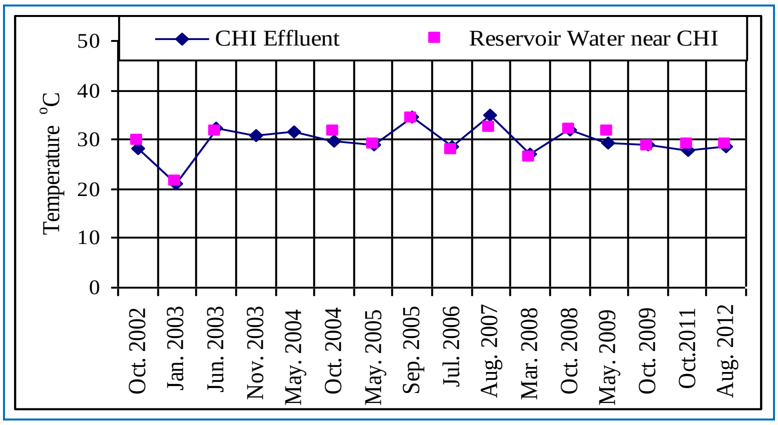

Fig. 2: Insitu Temperature of Samples collected in Different Seasons

8.2 pH values

pH values of CHI effluent and RW the samples is presented in Fig 3.

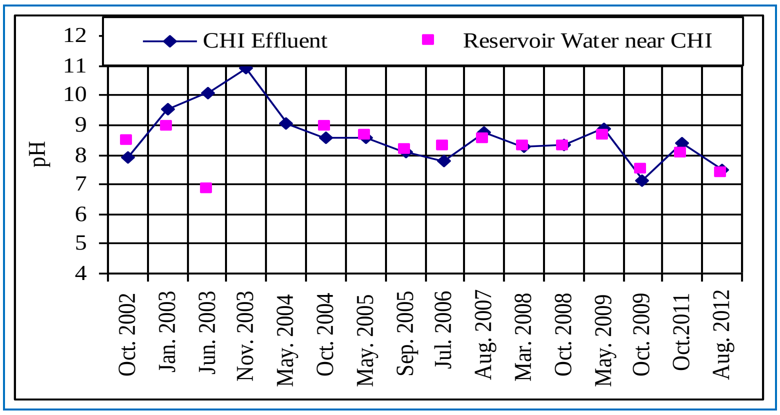

Fig. 3: pH of Samples collected in Different Seasons

8.3 Conductivity values

The conductivity value of CHI effluent and RW samples is presented in Fig 4.

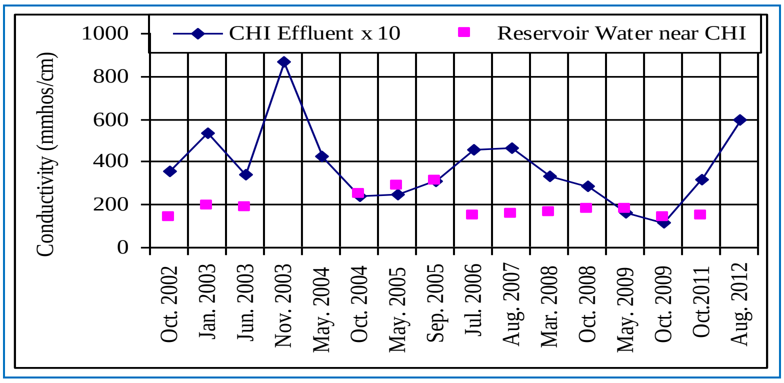

Fig. 4: Conductivity of Samples collected in Different Seasons

8.4 Suspended solids

The observed value for CHI effluent and RW presented in Fig. 5.

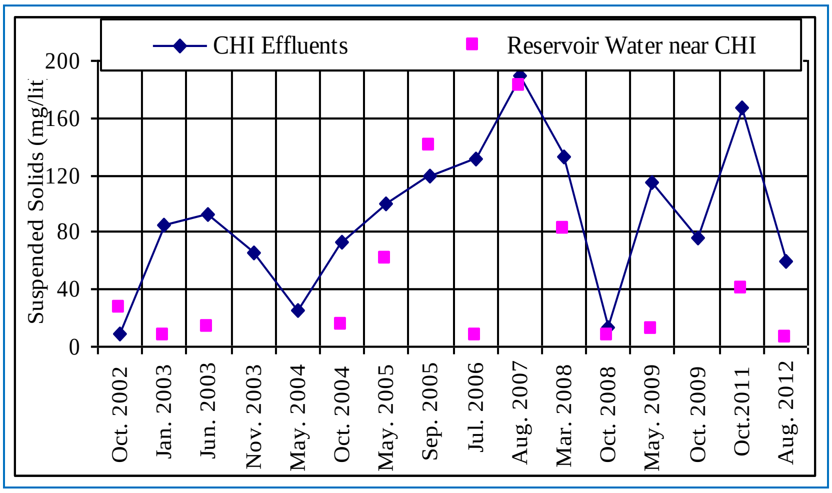

Fig. 5: Results of Suspended Solids in the Samples collected in Different Seasons

8.5 Chloride (Cl^-)

Chloride (Cl^-) concentration in CHI effluent and RW samples is presented in Fig 6.

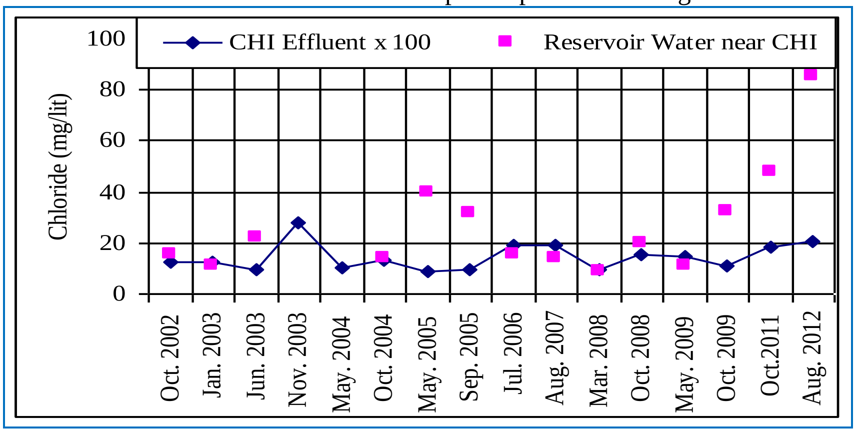

Fig. 6: Results of Chloride Content in the Samples collected in Different Seasons

8.6 Sulphate (SO_4^{2-})

Sulphate (SO_4^{2-}) concentration in CHI effluent and RW samples are presented in Fig. 7 .

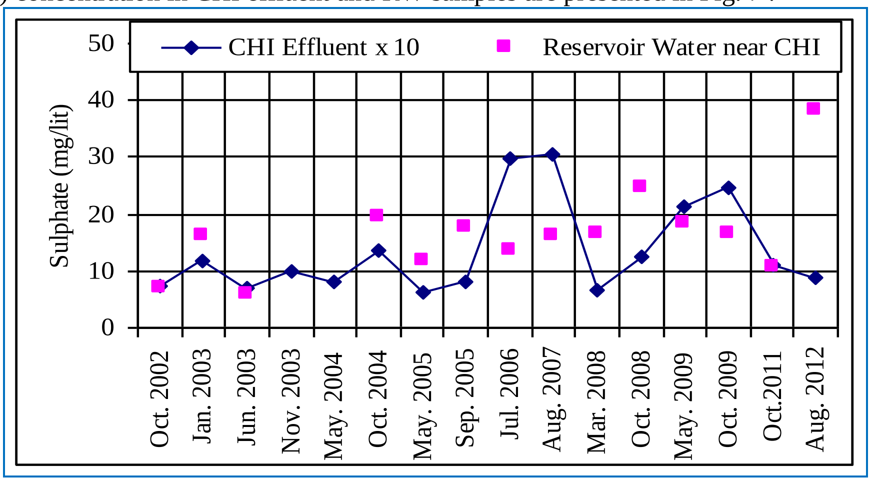

Fig. 7: Results of Sulphate Content in the Samples collected in Different Seasons

8.7 Calcium (Ca^{2+})

The Calcium (Ca^{2+}) concentration for CHI effluent and RW samples is presented in Fig 8.

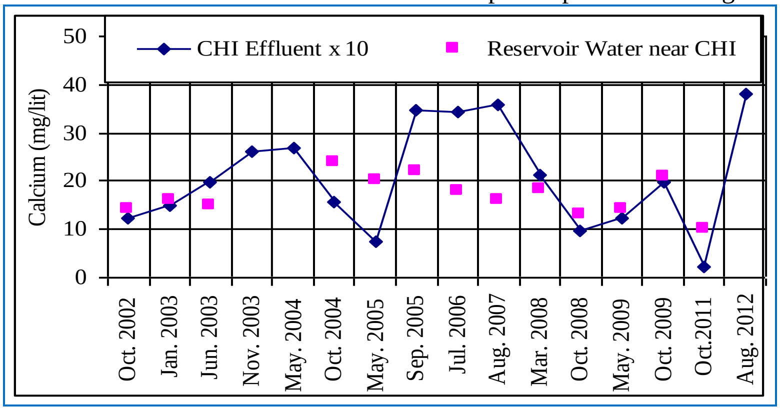

Fig. 8: Results of Calcium Content in the Samples collected in Different Seasons

8.8 Magnesium (Mg^{2+})

The Magnesium (Mg^{2+}) concentration for CHI effluent and RW samples is presented in Fig 9.

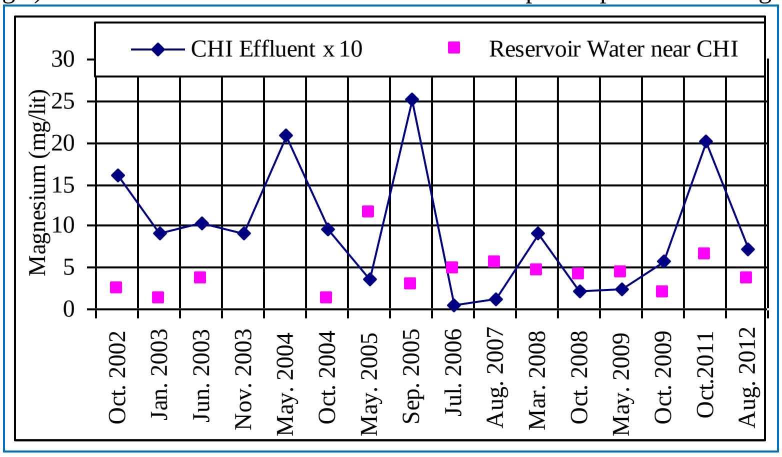

Fig. 9: Results of Magnesium Content in the Samples collected in Different Seasons

8.9 Total dissolved salts

The result of total dissolved salts for different samples is presented in Fig 10.

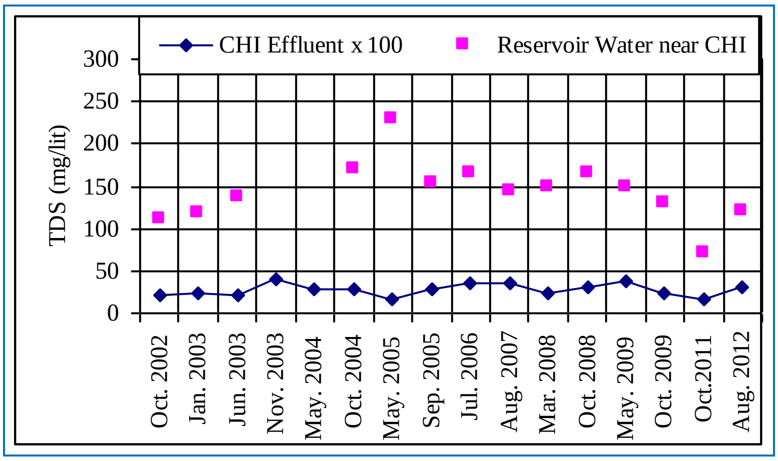

Fig. 10: Results of Total Dissolved Solids in the Samples from Various Locations

8.10 Ammonium (NH_4^+)

Ammonium content of water samples collected from various locations was found to be nil. The ammonia level of such water drastically reduces[2].

8.11 Copper, Manganese, Iron, Lead, Chromium and Zinc
Heavy metals like copper, manganese, iron, lead, chromium, zinc are found absent or in very low concentration.

IX. DISCUSSIONS OF RESULTS

9.1 Temperature

The main ecological consequence of polluted water discharged by CHI into the aquatic ecosystem is increase in water temperature. Elevation of temperature of reservoir water by 8 to 10 °C[2] has been reported by many observers. During the period of observations the average temperature of the CHI effluent varied in the range 21.1 to 31.9°C and that of RW samples between 21.4 to 34.1°C.

9.2 Assessment of pH, suspended solids, conductivity, total dissolved salts and chloridewith respect to the standard parameters for discharge of environmental pollutants

CHI effluent may cause pollution hazards and ecological damage in the reservoirs. Further it is high in total alkalinity, specific conductivity and chloride[1], [2]. Results of pH, suspended solids, conductivity, total dissolved salts and chloride for the tests conducted on the CHI effluents and RW samples[7, 8, 9, 10, 11] are discussed w.r.t standard values (Table 1).

Table - 1
Assessment of TPP AS and RW Samples w. r. t. Recommended Standards

Sample	Parameter	Observed range for the collected samples	CPCB prescribed limits[4]* and ISI prescribed limits[5]**	Samples confirming to CPCB or ISI prescribed limits	Samples exceeding CPCB or ISI prescribed limits
CHI Effluent	pH	7.1 – 10.9	6.5 – 8.5*	8	8
	Suspended solids, mg/l	9.6 – 189.0	100mg/l*	11	5
	Conductivityµm hos/cm	1152 – 8720	Less than 1500 µmhos/cm**	1	15
	Total dissolved solid, mg/l	29.6 – 195.0	500 mg/l. **	-	16
	Chloride, mg/l	4.0 – 13.10	200 mg/l**	-	16
RW	pH	6.85 – 8.96	6.5 – 8.5*	5	9
	Conductivityµm hos/cm	71.3 – 205	Less than 1500 µmhos/cm**	14	-
	Total dissolved solid, mg/l	28.8 – 152	500 mg/l. **	14	-
	Chloride, mg/l	2.8 – 20.0	200 mg/l**	13	-
	Suspended solids, mg/l	6.7 – 181.4	100mg/l*	11	2

X. CONCLUSION

Sensing these concerns as raised by many authors a long term detailed investigation program was initiated for the purpose of monitoring the degree of pollution caused by ever growing industries. Constant monitoring of the hydro-environment in GBS in the region around CHI have arrested further deterioration in the quality of the reservoir water.

XI. ACKNOWLEDGEMENT

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