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Research Article

ASSESSMENT OF THE LEVEL AND IMPACT OF SELECTED PHYSIOCHEMICAL PARAMETERS OF KOTA SUPER THERMAL POWER PLANT'S EFFLUENT ON CHAMBAL RIVER, KOTA, RAJASTHAN INDIA

Parveen Kumar[1]*., Manju Rawat Ranjan[2]., Ashutosh Tripathi[2]., Prateek Srivastava[2] and Balachandran S[3]

[1]Amity Institute of Environmental Sciences, Amity University, Noida, UP
[2]Faculties, Amity University Uttar Pradesh, India
[3]Departments of Environmental Studies, Siksha Bhavana, Visva-Bharati, Santiniketan, India

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A B S T R A C T

This task quantitatively assesses the level and impact of selected physiochemical properties of Kota super thermal power plant's effluent on the Chambal River Kota, Rajasthan, India. Water sampling was carried out judgementally from designated points nearby confluence point of effluent and analysed for physiochemical properties using standard methods of APHA. Impact of selected parameters such as temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), total organic carbon (TOC), chloride and sulphate, was studied for twelve months from July 2015 to June 2016. Annual range concentration of physiochemical properties was observed as temperature (23.1-36.1 ^{0}C), pH (6.4-8.1), EC (280-357μS/cm), TDS (180-241 mg/1), DO (1.3-7.1 mg/1), TOC (1.6-3.86 mg/1), Chloride (25.5-41 mg/1) and Sulphate (8.88-24.2 mg/1). The impact of effluent on Chambal river's physiochemical properties decreased in following order: DO > TOC > Temperature > Sulphate > Chloride > TDS > EC > pH, with respect the values of coefficient of variation. On calculating the analysis of variation (ANOVA) of parameters it was concluded at 5% level of significance, samples had come from populations having the same mean.

INTRODUCTION

Rivers are the most important freshwater resource for man. Unfortunately, river waters are being polluted by indiscriminate disposal of sewerage, industrial waste and plethora of human activities, which affects their physic-chemical characteristics. Increasing numbers and amounts of industrial, agricultural and commercial chemicals discharged into the aquatic environment have led to various deleterious effects on aquatic organisms. Hence, water quality monitoring is essential for the assessment of pollution control is needed in different water bodies or their part and to assess fitness of water for different uses. The following discussions were related solely to that the evolution of level and impact of selected physiochemical parameters of Kota Super thermal power plant's effluent on Chambal River on water quality . Thermal pollution affects the distribution of populations on both small and large geographical scales (Wilson, 1981), and determines the structure of communities and ecosystems (Glynn, 1988) by affecting the physiological processes and behaviour of fish species (Dembski *et al*., 2006). Among the various factors governing fish life in pond, the dissolved oxygen is of primary importance, as all fishes, as well as their food organisms, depend on dissolved oxygen for their respiration (Biswas, 1990). Temperature is among the most important environmental variable that influence behaviour of aquatic poikilotherms (Kinne., 1963). Organic matter decomposition in surface water produces inorganic nutrients such as ammonia, nitrate and phosphate with resulting effects of eutrophication and other serious ecological problems of such water body (Ogunfowokan *et.al*., 2005). The main source of oxygen for the aquatic organism is by diffusion of oxygen in water and also by photosynthesis (Singh and Raje, 1998). The low dissolved oxygen is common in aquatic system especially estuarine and marine system that have high nutrient loading and are seasonally stratified into water with different densities. This stratification allows microbial degradation of organic matter of water (Kolar and Rabel, 1993). Water–borne diseases continue to pose a major threat to public health both in the developed and developing world (Ford, 1990).

Corresponding author:* **Parveen Kumar
Amity Institute of Environmental Sciences, Amity University, Noida, UP

MATERIAL AND METHODS

Study area and field study

Kota is a city located in the southeast of northern Indian state of Rajasthan. It is located around 250 kilometres south of the state capital Jaipur, situated on the banks of Chambal River. The cartographic coordinates are 25.18°N 75.83°E. The Chambal River separates these districts from Kota district, forming the natural boundary. Kota thermal power plant is located on the bank of Chambal River in Kota city. The effluent of Kota thermal power plant has been drained in to Chambal River near Kota Barrage. The map (Figure 1) on the following page shows Kota where the Chambal River is located and selected sampling points. Six sampling points (A, B, C, D, E and F) were taken from the confluence point as 2.5 km, 2.0 km, 1.5 km, 1.0 km, 0.7 km and 0.5 km respectively.

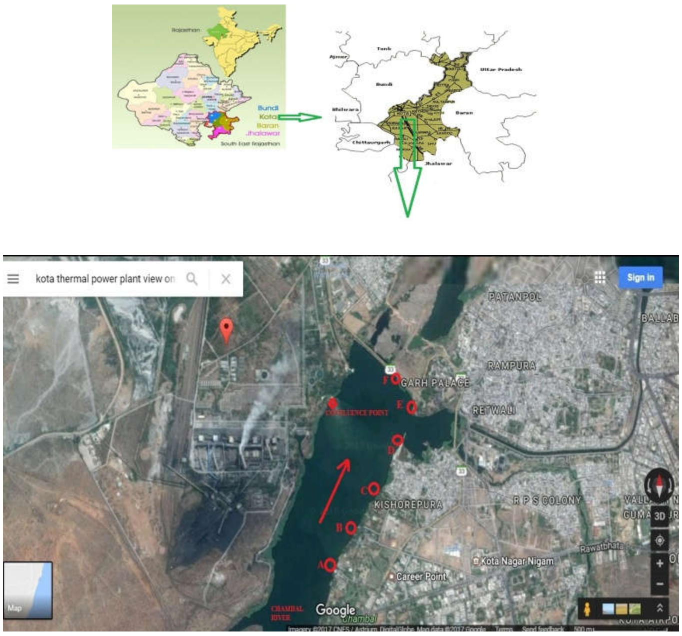

Figure 1 Selected surface water sampling points near confluence point of Kota Super Thermal Power Plant.

Six sampling stations established along the stretch of Chambal river upstream (US) midstream (MS) and downstream (DS) to Kota thermal Power Plant (KTPP) for collection of water samples. The study was carried out for one year on monthly basis in all seasons viz. summer, monsoon, and winter seasons. Water samples were processed for their physicochemical parameters. Important physicochemical parameters like Temperature, pH, Dissolved Oxygen (DO), Electrical Conductivity(EC), Total Dissolved Solids (TDS), Chlorides (Cl^-), Sulphates (SO_4^{--}), and Total organic content (TOC) had been investigated according to American Public Health Association (APHA, 2012).

The upstream ,midstream and downstream sampling stations were visited in every month season during July 2015 to June 2016.The study was limited to six sample points A, B, C , D, E and F, representing sample point A) upstream: the river before the point of wastewater discharge. B, C, D, E) midstream: the river at the point of wastewater discharge and F) downstream: the river after the point of wastewater discharge. Precautions were taken to ensure that the samples were representative of the river. The water samples were collected from amber coloured bottles in the morning time between 9-11 am from six selected sampling points in Chambal River.

Statistical analysis of results: One way ANOVA test for six sampling points means were as following.

One way ANOVA test for Temperature: (Table 3)

Test for equal means

Source of variation	Sum of squares	Degree of freedom	Mean square	F	p (same)
Between groups:	4.42611	5	0.885222	0.0385	0.9992
Within groups:	1517.34	66	22.99		
Total:	1521.76	71			

F (5,66) =2.354 at 5% level of significance.

Table 1 Annual Summery statistics of parameters in river water

	Temp.	pH	EC	TDS	DO	TOC	Chloride	Sulphate
Min	23.1	6.4	280	180	1.3	1.6	25.5	8.88
Max	36.1	8.1	357	241	7.1	3.86	41	24.2
Mean	28.87778	7.426389	301.2222	200.2222	4.885556	2.222639	30.10319	17.18542
Variance	21.4333	0.136618	356.5978	207.6119	1.812239	0.19129	16.00655	5.839287
Stand. dev	4.629611	0.369618	18.8838	14.40874	1.346194	0.437367	4.000818	2.416462
Coefficient of variation	16.03174	4.977095	6.269059	7.196376	27.55458	19.67784	13.29034	14.06112

Table 2 Percentage of change in parameters of upstream and downstream in river water

Parameters	At point 'A'	At point 'F'	% Change	Status
Temperature (^{0}C)	28.766	29.266	1.738	Increased
pH value	7.458	7.333	1.676	Decreased
E.C. (µS/cm)	300	303.917	1.305	Increased
T.D.S. (mg/1)	197.75	203.333	2.823	Increased
D.O. (mg/1)	5.258	4.421	15.918	Decreased
T.O.C. (mg/1)	2.123	2.295	8.102	Increased
Chloride (mg/1)	28.633	31.8	11.060	Increased
Sulphate (mg/1)	17.016	17.814	4.689	Increased

As calculated F = 0.0385< 2.354, we accept H_0 (null hypothesis) at 5% level of significance and conclude that samples have come from populations having the same mean.

One way ANOVA test for pH: (Table 4)

Test for equal means

Source of variation	Sum of squares	Degree of freedom	Mean square	F	p (same)
Between groups:	0.289028	5	0.0578056	0.4054	0.8434
Within groups:	9.41083	66	0.142588		
Total:	9.69986	71			

F(5,66) =2.354 at 5% level of significance.

As calculated F = 0.4054< 2.354, we accept H_0 at 5% level of significance and conclude that samples have come from populations having the same mean.

One way ANOVA test for Electrical Conductivity (EC): (Table 5)
Test for equal means

Source of variation	Sum of squares	Degree of freedom	Mean square	F	p (same)
Between groups:	471.778	5	94.3556	0.2506	0.9381
Within groups:	24846.7	66	376.465		
Total:	25318.4	71			

F (5,66) =2.354 at 5% level of significance.

As calculated F = 0.2506< 2.354, we accept H_0 at 5% level of significance and conclude that samples have come from populations having the same mean.

One way ANOVA test for TDS: (Table 6)
Test for equal means

Source of variation	Sum of squares	Degree of freedom	Mean square	F	p (same)
Between groups:	511.778	5	102.356	0.4748	0.7938
Within groups:	14228.7	66	215.586		
Total:	14740.4	71			

F (5, 66) =2.354 at 5% level of significance.

As calculated F = 0.4054< 2.354, we accept H_0 at 5% level of significance and conclude that samples have come from populations having the same mean.

One way ANOVA test for Dissolved Oxygen (DO): (Table 7)
Test for equal means

Source of variation	Sum of squares	Degree of freedom	Mean square	F	p (same)
Between groups:	7.67439	5	1.53488	0.8108	0.5462
Within groups:	124.942	66	1.89305		
Total:	132.616	71			

F (5, 66) =2.354 at 5% level of significance.
As calculated F = 0.8108< 2.354, we accept H_0 at 5% level of significance and conclude that samples have come from populations having the same mean.

One way ANOVA test for TOC: (Table 8)
Test for equal means

Source of variation	Sum of squares	Degree of freedom	Mean square	F	p (same)
Between groups:	0.371774	5	0.0743547	0.3715	0.8664
Within groups:	13.2098	66	0.200149		
Total:	13.5816	71			

F (5, 66) =2.354 at 5% level of significance
As calculated F = 0.3715< 2.354, we accept H_0 at 5% level of significance and conclude that samples had come from populations having the same mean.

One way ANOVA test for Chloride: (Table 9), Test for equal means

Source of variation	Sum of squares	Degree of freedom	Mean square	F	p (same)
Between groups:	113.925	5	22.785	1.471	0.2113
Within groups:	1022.54	66	15.493		
Total:	1136.46	71			

F (5, 66) =2.354 at 5% level of significance.

As calculated F = 1.471< 2.354, we accept H_0 at 5% level of significance and conclude that samples had come from populations having the same mean.

One way ANOVA test for Sulphate: (Table 10)
Test for equal means

Source of variation	Sum of squares	Degree of freedom	Mean square	F	p (same)
Between groups:	17.1626	5	3.43251	0.57	0.7226
Within groups:	397.427	66	6.02162		
Total:	414.589	71			

F (5,66) =2.354 at 5% level of significance

As calculated F = 0.57< 2.354, we accept H_0 at 5% level of significance and conclude that samples had come from populations having the same mean.

RESULTS AND DISCUSSION

The range of temperature in studied period was 23.1 to 36.1 ^{0}C and coefficient of variation was 16.031. The percentage of change in temperature in upstream and downstream sampling points was 1.738 % increased (Table 2). On calculating ANOVA test the calculated F value was 0.0385 i.e. less than the critical value of F (5, 66) is 2.354 at 5% level of significance. As par ANOVA test samples had come from populations having the same mean (Table 3).The percentage of change in pH value was decreased as 1.676% in upstream and downstream sampling points (A & F) (Table 2). On calculating ANOVA test the calculated F value was 0.4054 i.e. less than the critical value of F (5, 66) is 2.354 at 5% level of significance. As par ANOVA test samples had come from populations having the same mean (Table 4). The range of electrical conductivity was observed as 280-357 µS/cm. Percentage of change in electrical conductivity was increased as 1.305 % in upstream and downstream sampling points (A & F) (Table 2). The coefficient of variation for TDS was observed as 7.196 it shows the homogeneity of the results of sampling points. On calculating ANOVA test the calculated F value was 0.4748 i.e. less than the critical value of F (5, 66) is 2.354 at 5% level of significance. As par one way ANOVA test, samples had come from populations having the same mean (Table 6). Dissolved oxygen below 5 mg/1 is undesirable in ponds (Boyd, 1990). . The coefficient of variation of the dissolved oxygen in studied period was 27.55 i.e. highest among observed parameters so it shows the highest impact on dissolved oxygen of river water. The percentage of changes of dissolved oxygen in upstream and downstream was observed as 15.92% increased. The percentage of change in TOC was calculated as increased by 8.102 % in upstream (A) and downstream (F) sampling points (Table 2). The coefficient of variation for TOC was calculated as 19.68. The second most impact of thermal power plant's effluent on the river water had observed. In river the chloride content is low indicating low pollution. Hence, Chambal river water was effectively used for aquaculture practices. Chloride is one of the major pollutant and is difficult to eliminate (Subramanian, *et al.*1993), high chloride level due to high eutrophication (Goel *et al*., 1980). The observed range of chloride contents was 25.5-41.0 mg/1 in studied period. The percentage of change in chloride was observed as 11.060 % i.e. increased in downstream (F) with respect to upstream sampling point (A) (Table 2). The percentage of change in sulphate was observed as 4.69% i.e. increased in downstream (F) with respect to upstream sampling point (A) (Table 2).

CONCLUSION

The results showed a level of significance for ANOVA test and percentage of change in selected parameters of upstream and downstream in river, the impact of Kota super thermal power plant's effluent on selected physiochemical properties Chambal river water by coefficient of variation. Statistically, there was no significant change in selected physiochemical properties of Chambal River. However in downstream there was the tendency the increasing contents of chloride and TOC, and decreasing Dissolved oxygen in over all sessions and summer session specially. The impact of effluent on Chambal river's physiochemical properties decreased in following order: DO > TOC > Temperature > Sulphate > Chloride > TDS > EC > pH, with respect of the values coefficient of variation.

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