International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.10 No.13, pp 242-249, 2017

A Physico-Chemical Assessment of Water Quality at Two Locations of River Chambal in Dholpur (Rajasthan)

V. K. Jain[1], M.K. Singh[2] & Kapil Shroti[1]*

[1]Department of Chemistry, Ambah P.G. College, Ambah, Morena- 476111 (India)
[2]Department of Chemistry, Govt. P.G. College, Dholpur-328001 (India)

Abstract: The present study deals with Physico-chemical characteristic of Chambal river water in national sanctuary region of Rajasthan, at Dholpur District, India. The study is aimed to evaluate the various physico-chemical characters as well as seasonal effects on water quality parameters like pH, hardness, BOD, COD, DO, calcium, magnesium, sodium, potassium, chloride, fluoride, sulphate, phosphate etc. along with some heavy and Trace metals within the sanctuary area. The analyzed water quality data indicates that the Chambal river water at two location is pollution free except exceeding value of lead i.e. 0.03 mg/l. Thus the Chambal river water can serve as a good habitat for many aquatic flora and fauna.
Keywords : Chambal River Water, Heavy Metals, Physico-chemical Parameters, National Chambal Sanctuary etc..

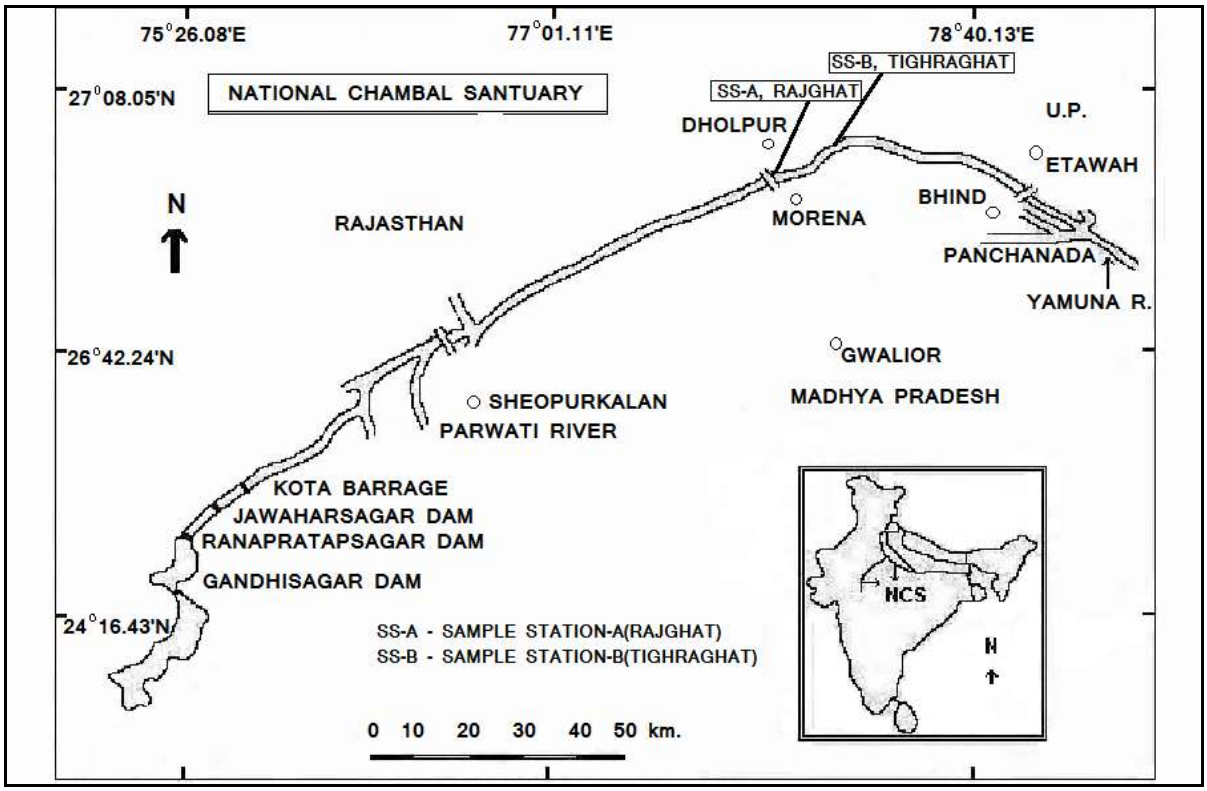
Introduction:

Water is the basic element for the survival of life to all living creatures on this planet[1, 2]. In India, Rivers are the major sources of water where a large part of population depends on them for their daily needs. River pollution in one country inevitably affects other countries also in one way or other in this new century in which fresh water is the no.1 global environmental issue. Safe drinking water is prior need of every human being but the over exploitation of these vital sources may lead to decreasing of water resources and deteriorating the quality day by day. The natural quality of water tends to be degraded by uncontrolled human practices unplanned mining, overpopulation, agriculture activities, urbanization and industrialization[3]. That's why many lakes and rivers in India have been reached to the point of crisis. Most of the water sources in India have become polluted because of domestic sewage discharges, detergents and industrial effluents into these natural resources. Water to use for human consumption should be Safe and wholesome i.e. it should be free from pollutants, harmful chemicals, pathogenic agents and pleasant in taste[4].

Water pollution is the state of deviation from its pure and hygienic condition. Changes in physical, chemical or biological properties of water, addition of any foreign material via discharge of sewage, industrial and municipal waste etc. contaminate the quality of water which harms and affects all the living beings directly or indirectly[5]. The salient objective of this study is to find out the suitability of river water for drinking, bathing, irrigation and many other human purposes as well as its adequacy for aquatic fauna and to provide information about water quality of Chambal river water. In this paper, an attempt has been made to assess the water quality based on physico-chemical parameters like pH, total hardness, chloride, phosphate, sodium, nitrate, BOD, COD, iron, zinc, copper, chromium, lead etc. to study the extent of pollution in river Chambal at two locations where anthropogenic activities are more observed.

Study Area:

The study was carried out at river Chambal near Dholpur district in the month of February-March 2017 at two sample stations A - Rajghat and B - Tighra Ghat. The reason behind selecting the two locations is that majority of the gharial population found near these locations and a little anthropogenic activity observed near these areas. The river Chambal is located in west central India and flows through three indian states viz: M.P, Rajasthan and U.P. and located between latitude $25^0 23'$-$26^0 52'$ N, $76^0 28'$- $79^0 15'$E. River Chambal is the most prominent water resource in many cities and towns which is situated on its banks in all the three states[6]. The river is ecologically very important, as included in the National Reserve by the Central Government for the protection of rare species of Gharials and Dolphins. In 1978 river Chambal was declared as a crocodile sanctuary under crocodile project with an aim to provide fully protected habitat for conservation and propagation of them.



Material and Methods:

Water samples were collected for the present investigation from two different experimental sites within a specific stretch of 12-15 Kms of river Chambal. The Samples were collected in screw capped Jerri-can (a polyethylene bottle) from midstream of the river. Sample bottles were thoroughly rinsed with distilled water for three times and then rinsed with river water before collecting water samples. Caps of cans were closed tightly after filling up of can to avoid changes in physico-chemical characteristics. Some parameters were determined immediately on sampling sites. For rest parameters and heavy metals, samples were stored in a refrigerator at 4°C. The testing of samples was done according to the procedure prescribed by APHA[7, 8]. The instruments were used in the limit of precise accuracy, chemical used were of analytical grade and double distilled water was used for preparation of solutions for the analysis.

Present analysis comprises of interpretations and analysis of water samples collected from two sample stations. The samples were analyzed for different physical and chemical parameters and the results were carefully studied.

Table 1: Methods used for physico-chemical analysis of samples

Parameters	**Method Used**
pH	Digital pH Meter
Total Hardness	Titration Method
BOD	BOD Incubator
COD	Titration Method
DO	Winkler's Method
Alkalinity	Titration Method
Sodium, Potassium	Flame Photometer
Calcium	EDTA Titration
Magnesium	Calculation
Chloride	Mohr's Method
Fluoride, Nitrate, Nitrite,	Spectrophotometer
Sulphate	Turbiditimetric and Azide Iodometric
Phosphate	Spectrophotometer
Free CO_2	Potentiometric Method
Ammonia	Distillation Method
Dissolve Silica	Spectrophotometer
Ni, Cu, Cr, Pb, Zn, As, Fe	Atomic Absorption Spectroscopy (AAS)

Results and Discussion:

Values for different physico-chemical parameters of Chambal river water are shown in Table 2.

pH:

pH determination is one of the important factor in treatment of wastes, pH has no direct adverse effect on health, however a lower value below 4 will produce sour taste and higher value above 8.5 an alkaline. In the present study the average pH of River Chambal is observed 7.9 which is in limit and safe for drinking and healthy growth of aquatic biota.

Hardness:

Hardness of water is formed when water percolates through deposits of limestone, chalk etc. which are largely made up of calcium and magnesium carbonates. Hard drinking water may have moderate health benefits but can pose serious problems. Here we observed the average hardness of river water is 162 mg/lt.

Chloride:

Chloride occurs naturally in all type of water. Chlorides are highly soluble with most of the naturally occurring cations and can not be removed biologically in treatment of wastes. During the present study average concentration of chloride is 39.02 mg/lt.

Fluoride:

Fluoride is also naturally occurring element. In water it can be above, at or below recommended level. Fluoride effects depend on the total daily intake of it from all sources. It can Cause dental fluorosis which can alter the appearance of developing teeth or enamel fluorosis. The present study shows average concentration of fluoride 0.36 mg/lt.

Calcium:

Calcium and magnesium dissolved in water are the two most common minerals that make water hard. Hard water is not a high health risk, but a nuisance because of mineral build up on fixtures and poor soap or detergent performance.

In present study the average concentration of calcium is observed 37.66 mg/lt.

Magnesium:

Magnesium is also one of the content that causes hardness of water. The degree of hardness increases as the concentration increases. In present study the average concentration of magnesium is 14.89 mg/lt.

Sodium:

Sodium is a mineral that commonly found in water. Our body needs sodium daily to regulate fluids, maintain blood pressure, for muscle and nerve functions. Sodium in river may be from soil, rocks and from waste discharge etc. The Quantity above 200 mg/lt. creates noticeable salty taste. During the present study average concentration is found 64.43 mg/lt.

Potassium:

Potassium works with sodium to maintain the body's water balance and is also involved in nerve function, muscle control and clotting of blood. Primary source of potassium is from silicate weathering e.g. potassium feldspar, mica, biotite etc. In the present study average concentration of potassium is observed 9.9 mg/lt.

Total Phosphate:

The major sources of phosphates are domestic sewage, detergents, industrial waste water and rocks. Higher the concentration of phosphorous in water, higher the ability to increase the growth of algae and eutrophication. During the present study average total phosphate in river is 0.12 mg/lt.

Sulphate:

It is also an important constitute of hardness. Above 400 mg/lt, Concentration of sulphate produces bitter taste in water and may cause gastro-intestine irritation and cantharsis[9]. During the present study average concentration of sulphate is found 43.5 mg/lt.

Nitrate:

The concentration of nitrate in drinking water is considered important factor for its adverse effect. Due to high concentration of nitrate, numerous cases of methemo-globinemia in infants is observed. Most of the industrial effluents contain high amount of nitrogen and its related compounds. During the course of present study average concentration of nitrate is 5.67 mg/lt.

Nitrite:

Excessive concentration of nitrite in drinking water can be hazardous to health especially for infants and pregnant women. It comes through fertilizers, decaying of plant and animal residues. In this study we found the average concentration of nitrite 0.26 mg/lt.

Total Alkalinity:

Alkalinity refers to the capability of water to neutralize acids and really an expression of buffering capacity. It is an important factor for aquatic life because it protects them against sudden pH changes. In present study the alkalinity of Chambal river water is found 174.5 mg/lt.

BOD:

Biochemical oxygen demand is the amount of dissolved oxygen needed by aerobic biological organisms to breakdown organic material, present in water sample at certain temperature over a specific time period. BOD approximates the amount of oxidisable organic matter present in the solution and BOD value can be used as a measure of waste strength[10]. During the present study average BOD of river Chambal is observed 7.65 mg/lt.

COD:

Chemical oxygen demand test allows measurement of a waste in terms of the total quantity oxygen required for oxidation to carbon-dioxide and water. COD values are taken as basis for calculation of efficiency of the treatment and also figure in the standards for discharging industrial and domestic effluents in various kinds of water. During the present study average COD of river Chambal is observed 17.07 mg/lt.

DO:

Dissolve oxygen is one of the most important factor, crucial for the organisms and creatures living in it. As the amount of dissolved oxygen drops below normal levels in water bodies, the quality of water is harmed and creature begins to die off. It is very essential to maintain biological life in a water body. Low concentration of oxygen is generally associated with heavy contamination by organic matter[11].In the present study average concentration of dissolve oxygen is observed 5.8 mg/lt.

Ammonia:

Ammonia is one of the several forms of nitrogen that exists in water. The presence of ammonia is an evidence of sewage inflow to a water body; causes direct toxic effects, comes through municipal effluent discharges and the excretion of nitrogenous wastes from animals, indirect means such as nitrogen fixation, air deposition runoff from agricultural lands and fertilizers. In present study the average concentration of free ammonia is found BDL(<0.01) mg/lt.

Free Carbon-dioxide:

Almost all natural sources of water contain some carbon-dioxide which they gain in several ways as rain falls through the air, it absorbs some of this gas. Carbon-dioxide is readily soluble in water at ordinary temperature and comes from aerobic and anaerobic decomposition of organic matter. Excess of free carbon-dioxide water may be harmful for aquatic flora and fauna. In this study the average concentration of free CO_2 is found 7.94 mg/lt.

Iron:

Iron in water comes from various minerals in the soil and its level in water depends on several factors that can affect aquatic life their population and health. High amount of iron in water exists due to pollution related to construction or mining. The present study shows an average concentration of iron in Chambal river water is BDL(<0.01) mg/lt.

Copper:

Natural sources of copper in water bodies is geological deposits, weathering, erosion of rocks and soil; anthropogenic sources of copper include mining activities, agricultural, some metallic and electrical wastes, municipal wastes, sludges etc. It is an essential nutrient at low concentration but toxic at higher. Continue Exposure to copper can lead adverse effect on survival, growth, reproduction as well as alteration of brain function, enzyme activity and metabolism. In present study the average concentration of copper is found 0.01 mg/lt.

Arsenic:

It usually Occurs in trace quantities in all rocks, soil, water and air and a very toxic element that can cause acute toxicity; comes from agrochemicals, preservatives, industrial sources, mineral processing and burning of fossil fuels etc[12] . Arsenic causes numerous illness like keratosis, skin cancer, internal cancer such as that of the lung cancer and bladder cancer. In present study the average concentration of Arsenic is found to be BDL(<0.001) mg/lt.

Zinc:

Naturally present in water and normally leaks from zinc pipes, car tires crust on roads, also present in fungicides and insecticides, chemical wastes, municipal wastes etc. Although zinc is a dietary trace mineral for

humans, but still overdose may lead negative effects and may even be toxic. Due to Overdose of it nausea, vomiting, colics, fever and diarrhea etc. occurs. In present study the average concentration of zinc in river water is found BDL(<0.01) mg/lt.

Lead:

Lead is a very toxic element and very harmful to human health. High level of lead can result in major neurological damage, fatigue, vomiting, constipation, sleep disorder, gastrointestinal disease, organ failure, coma and ultimately death[13]. Lead found in water from paint industries, from pipes, soil, pottery, traditional folk medicines, cosmetic wastes and from many other domestic and municipal wastes. The present study shows an average concentration of lead is 0.03 mg/lt.

Nickel:

Nickel is directly discharged from various industries, used in batteries, alloys of coins, in coating of kitchen wares, ceramic paint Production, textile printing and also in some phosphate fertilizers. Excess of nickel causes carcinogenic effects like lung cancer, nasal tumor, dermatitis etc. In the present study average concentration of nickel ranges BDL(<0.01) mg/lt.

Chromium:

Normally chromium doesn't occur freely in nature. The metal industry mainly discharged chromium via industrial waste water originates from tanning and painting and comes from alloys too and from synthetic domestic and municipal wastes. Chromium is a very toxic element, high concentration of chromium causes diarrhea, stomach and intestinal bleedings, cramps, liver and kidney damages etc. In present study the average concentration of chromium is found BDL(<0.01) mg/lt.

Dissolved Silica:

Silica dissolved in natural water is considered to be a good indicator of weathering and circulating conditions, released as a result of chemical weathering of silicate minerals in rocks interaction with surface water[14]. During the present course of study, the average dissolved silica is observed 13.91 mg/lt.

Table 2: **Physico-chemical Parameters of river Chambal**

S. No.	Parameters	Sample Station 'A' (Upstream)	Sample Station 'B' (Downstream)	Average Values	Desirable limit as per BIS IS:10500:2009	Acceptable limit as per WHO
1.	pH	8.1	7.8	7.9	6.5-8.5	6.9-8.5
2.	Total Hardness[mg/lt]	160	164	162	200	100-500
3.	Chloride[mg/lt]	40.8	37.25	39.02	250	250
4.	Fluoride[mg/lt]	0.34	0.39	0.36	1.0	1.0-1.5
5.	Calcium[mg/lt]	38.4	36.92	37.66	75	75-200
6.	Magnesium[mg/lt]	15.55	14.24	14.89	30	30-150
7.	Sodium [mg/lt]	65.54	63.33	64.43	-	200
8.	Potassium[mg/lt]	10.0	9.8	9.9	-	-
9.	Phosphate[mg/lt]	0.11	0.13	0.12	-	0.1
10.	Sulphate[mg/lt]	43.0	44.0	43.5	200	200-250
11.	Nitrate[mg/lt	5.21	6.13	5.67	45	40-50
12.	Nitrite[mg/lt]	0.25	0.27	0.26	-	-
13.	Total Alkalinity[mg/lt]	172	177	174.5	200	300
14.	BOD[mg/lt]	7.4	7.9	7.65	30 acc. CPCB[15]	-
15.	COD[mg/lt]	17.09	17.05	17.07	250 acc.CPCB[15]	-
16	DO[mg/lt]	6.0	5.6	5.8	-	6.0
17.	Ammonia[mg/lt]	BDL(<0.1)	BDL(<0.1)	BDL(<0.	0.5	-

				1)		
18.	Free CO_2[mg/lt]	8.0	7.88	7.94	-	-
19.	Iron [mg/lt]	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	0.3	2.0
20.	Copper[mg/lt]	0.01	0.01	0.01	0.05	1.5
21.	Arsenic[mg/lt]	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	0.01	-
22.	Zinc [mg/lt]	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	5.00	15
23.	Lead[mg/lt]	0.03	0.03	0.03	0.01	-
24.	Nickel[mg/lt]	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	0.02	-
25.	Total Chromium[mg/lt]	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	0.05	-
26.	Dissolve Silica[mg/lt]	14.33	13.50	13.91	-	-

The findings shows that some parameters have higher values in the month of February at station-A (rajghat) in comparison to station-B (tighra), but a few were found higher at station B too. No sudden major ups and downs have found in the values and appear normal circumstantial variations. Overall it is revealed that the river is not in too much drastic situation but can't deny of being any contamination in river water as faecal coliform testings have not done in this study.

Conclusion:

On the basis of various parameters analyzed in this investigation, it was concluded that the water quality of river Chambal is fit for drinking purposes and it comes under the bracket of good quality. The Physico-chemical parameters measured at set locations of the river revealed that the pollution level has not crossed the limits of the set standards prescribed by BIS and WHO[16-17]. The measured concentrations of almost all heavy metals in Chambal river water are lower and found below detection level but lead has a value of about 0.03 mg/lt which is clearly exceeding the limit set by BIS. If this situation persists consistently then it may create a big problem to all human and aquatic life in near future. Therefore in view of this situation, we should make necessary plans from now to make the river water more potable, suitable for domestic purposes, irrigation and for healthy sanctuary life.

References:

1. Jayaraman, P.R., Gangadevi, T., and Vasuenanaya, T., (2003); Water studies on Kasmane river, Thrruvanantpuram district South kerala, *India.Poll. Res*., 32: 89-100.
2. Patil, H.D., et al. (2013); Water quality index of Velhala lake in Jalgaon district. *Asian Journal of Chemical and Environment Research,* vol. 6(3-4): 91-95.
3. Patil, P.N., Sawant, D.N., and Deshmukh, R.N., (2012); Physico-chemical parameters for testing of water- A review. *International Journal of Environmental Sciences*, 3(3):1194-1207.
4. Parashar, C., Dixit, S., and Srivastava, R., (2006); Seasonal variation in physico-chemical characteristics in upper lake of Bhopal. *Asian J. Exp. Sci.*, vol. 20(2): 297-302.
5. Sawyer, C.N., and McCarty, P.L.; *Chemistry for Environment Engineering*, McGraw Hill Book Company, Singapore (1985).
6. Tiwari, P.S., and Singh, M.K., (2008); Physico-chemical study of Chambal river water in Dholpur (Rajasthan), *Current World Environment*, vol. 3(2): 289-292.
7. APHA, *standard methods for the examination of water and waste water*. 20th Ed., (1998), American Public Health Association, Washington.
8. Trivedi, R.K., and Goel, P.K., (1984); Chemical and biological methods for water pollution studies. *Enviro Media Publication, Karad* pp, 1-251.

9. Manivaskam, N., (2005); *Physico-chemical examination of water sewage and industrial effluent.* 5th Ed., Pragati Prakashan, Meerut.
10. Dubey Monika and Ujjania N.C. (2016); Seasonal variation in water quality of weir cumcauseway, Tapi river, India. *Poll. Res.,* 35 (2): 429-433.
11. Saksena D.N., Garg R.K., Rao R.J., (2008); Water quality and pollution status of Chambal river in National Chambal Sanctuary, Madhya Pradesh. *Journal of environment Biology*, 29(5): 701-710.
12. Wogu, M.D., & Okaka, C.E., (2011); Pollution studies on Nigerian rivers: Heavy metals in surface water of Warri river, Detta state. *Journal of Biodiversity and Environment Sciences*, vol.1(3),7-12.
13. Singh, L., Choudhary, S.K., and Singh P.K., (2012); Status of heavy metal concentration in water and sediment of river Ganga at selected sites in the middle Ganga plain. *Int. J. Res. Chem. Environ.*, 2:236-243.
14. Davis, N.S., (1964); Silica in streams and ground water. *Am.J.Sci*. 262, 870-891.
15. Central Pollution Control Board. *The Environment (Protection) Rules 1986: Schedule VI*
16. WHO, *Guidelines for drinking water quality*, 2nd Ed., (1993), World Health Organization, Geneva.
17. BIS, *Indian standards specifications for drinking water*; BIS 10500:2009 (2009).

*****