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STUDY AND ANALYSIS OF POLLUTION IN KHAN RIVER

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Abstract:- *Pollution studies of the River Khan, Indore (India) have been made, with an emphasis on the biological assessment of water quality. The study covers a critical analysis and testing of various European methods for the biological monitoring of water pollution, under the Indian conditions in the River Khan. The river has been divided into different zones of pollution. The biological data have been correlated with the chemical data, and the practical implications of the European saprobity system, under the Indian conditions have been discussed. The importance of rivers in the assessment of water quality in the river has also been discussed. A total 14 water quality minimum and maximum value of colour, pH, , total dissolved solids, Phosphate, total alkalinity, chloride, total Calcium Hardness, nitrate, biochemical oxygen demand, chemical oxygen demand, Sulphate, Sodium and potassium were noted and it was found that these factors were responsible for bad condition of river in the city. Author enlightens the importance of eliminating wastes from the river.*

Keywords: *alkalinity, Hardness, biochemical oxygen demand, chemical oxygen demand, wastes.*

Introduction

Water is an elixir of life. It is precious natural resource and important component for human survival. It's found abundant amount on the earth. Out of the total water reserves of the world, about 97% is salty water (marine) and only 3% is fresh water. Even this small fraction of fresh water is not available to us as most of it is locked up in polar ice caps and just 0.003% is readily available to us in the form of groundwater and surface water. Due to its unique properties water have the multiple uses of all living organisms. Water is absolutely essential for life. Most of the life processes take place in water contained in the body. Human beings depend on water for almost every development activity. Water is used for drinking, irrigation, and transportation, washing and waste disposal for industries and used as a coolant for thermal power plants. Water shapes the earth's surface and regulates our climate. With increasing human population and rapid development, the world water withdrawal demands have increased many folds and a large proportion of the water withdrawal is polluted due to atmospheric activities. Rivers are the most important water resources. It has long been used for discharging the wastes. Unfortunately the rivers are being polluted by indiscriminate disposal of sewage, industrial wastes and by human activities. Pollution of the river first affects the physico-chemical property and then systematically destroys the community disrupting the delicate food web. The objective of the present study is to assess the water quality of river khan in Indore city.Total generation of sewage in Indore city is 200 MLD on the basis of present population. Indore Municipal Corporation is treating only 90 MLD of sewage, the rest is disposed without treatment into Khan river. They said STP is located near Kabitkhedi water bodies. There are 163 units which are water polluting. Out of industries Industries generate industrial effluent more than 2000 CMD. Total quantity of industrial effluent generated from industrial area is 2.2 MLD and total domestic effluent generated is 200 MLD.

Figure 1: Pollution in khan river

Study Area And Methods

The River Khan has been selected for the present study (Fig. 1). It is a shallow, turbulent river originating near the city of lndore (22"l0N. 75"47"E and 491 m above sea level). The river joins another river called the Kshipra river after a flow of about 64 km. The river as it comes out of the city of Indore is open to sewage and industrial pollution. Three sampling

stations have been selected along the course of the river. Sampling station I is Khan river at **Kabitkhedi**, before STP is situated at the sewage and industrial waste discharge point of the river. Sampling station II is situated at **Shakkarkhedi** which is 10 km downstream of the river. Sampling station III is situated 30 km downstream of the river.

Samples were collected in acid wash 1 litre plastic canes and brought to the laboratory for further analysis. The sampling was done 9 a.m.-3 pm. Physico-chemical parameters like water temperature, pH, conductivity, DO, free Carbon-dioxide and total alkalinity were measured in the field. Other parameters were mostly tested within 24 hrs of collection. Preservation of water samples was done at 4°C temperature. The water quality parameters were analyzed by standard methods given in APHA (1998) and Trivedi and Goel (1987).

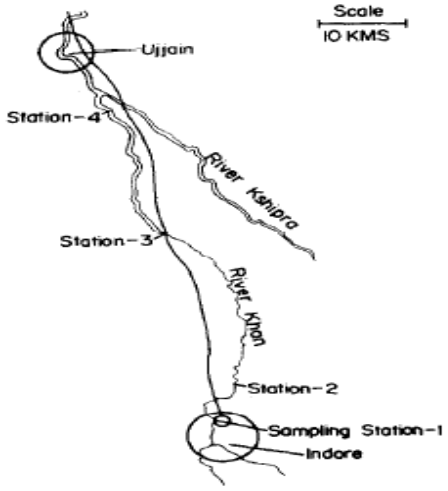

Fig. 1. Physical features of River Khan.

Figure 2: Map Of Khan River

Results And Discussions

Khan river water quality results at different locations are shown as below :-

1. Water Quality of Khan River at Kabitkhedi

S.no.	Parameters	Unit	Sample-1	Sample-2	Sample-3	Sample-4	Sample-5	Sample-6
1	Colour	Pt-Co Sca	01	01	01	01	01	01
2	Odour	--	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
3	pH	pH Unit	8.5	8.1	7.36	7.0	8.0	8.2
4	Total Solids	Mg/L	1204	1503	1558	1365	1266	1043
5	Chloride	Mg/L	295	240	300	350	215	245
6	B.O.D.	Mg/L	78	44	50	120	62	58
7	C.O.D.	Mg/L	300	220	240	410	180	170
8	Phosphate(PO_4)	Mg/L	4.87	3.69	3.0	4.94	3.69	3.63
9	Alkalinity	Mg/L	520	552	712	680	640	650
10	Total Hardness($CaCO_3$)	Mg/L	320	364	360	550	400	510
11	Sulphate(SO_4)	Mg/L	59.69	42.5	24.84	36.5	29.75	32.36
12	Sodium	Mg/L	149	45	111	158	113	158
13	Potassium	Mg/L	61	7	33	69	24	48
14	Nitrate	Mg/L	6.57	4.185	2.84	7.66	3.108	4.22

2. Water Quality of Khan River at Shakkarkhedi

S.no.	Parameters	Unit	Sample-1	Sample-2	Sample-3	Sample-4	Sample-5	Sample-6
1	Colour	Pt-Co Sca	01	01	01	01	01	01
2	Odour	--	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
3	pH	pH Unit	8.0	8.0	7.22	8.0	7.5	7.5
4	Total Solids	Mg/L	1213	1431	1578	1400	1445	1159
5	Chloride	Mg/L	410	275	325	420	225	315

6	B.O.D.	Mg/L	48	52	65	70	58	68
7	C.O.D.	Mg/L	260	270	260	250	220	210
8	Phosphate(PO_4)	Mg/L	4.06	3.78	3.4	4.81	3.89	3.40
9	Alkalinity	Mg/L	510	495	675	715	690	540
10	Total Hardness($CaCO_3$)	Mg/L	345	378	385	490	420	560
11	Sulphate(SO_4)	Mg/L	54.89	40.45	28,46	38.75	30.65	34.56
12	Sodium	Mg/L	152	47	110	169	110	148
13	Potassium	Mg/L	67	19	45	39	29	57
14	Nitrate	Mg/L	6.57	5.05	2.98	7.87	3.89	4.22

3. Water Quality of Khan River at Sanwer

S.no.	**Parameters**	**Unit**	**Sample-1**	**Sample-2**	**Sample-3**	**Sample-4**	**Sample-5**	**Sample-6**
1	Colour	Pt-Co Sca	01	01	01	01	01	01
2	Odour	--	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
3	pH	pH Unit	8.5	8.1	7.36	7.0	8.0	8.2
4	Total Solids	Mg/L	1204	1503	1558	1365	1266	1043
5	Chloride	Mg/L	295	240	300	350	215	245
6	B.O.D.	Mg/L	78	44	50	120	62	58
7	C.O.D.	Mg/L	300	220	240	410	180	170
8	Phosphate(PO_4)	Mg/L	4.87	3.69	3.0	4.94	3.69	3.63
9	Alkalinity	Mg/L	520	552	712	680	640	650
10	Total Hardness($CaCO_3$)	Mg/L	320	364	360	550	400	510
11	Sulphate(SO_4)	Mg/L	59.69	42.5	24.84	36.5	29.75	32.36
12	Sodium	Mg/L	149	45	111	158	113	158
13	Potassium	Mg/L	61	7	33	69	24	48
14	Nitrate	Mg/L	6.57	4.185	2.84	7.66	3.108	4.22

Potential of Hydrogen(pH)

pH, or the "potential of hydrogen" is a measure of the concentration of hydrogen ions in the water. This measurement indicates the acidity or alkalinity of the water. On the pH scale of 0-14, a reading of 7 is considered to be "neutral". Readings below 7 indicate acidic conditions, while readings above 7 indicate the water is alkaline or basic. Naturally occurring fresh waters have a pH range between 6 and 8. The pH of the water is important because it affects the solubility and availability of nutrients, and how they can be utilized by aquatic organisms. It is one of the important factors that serve as an indicator of pollution of water body. Highest pH value of the sample was recorded as 8.76 at station-8 and that of minimum 7.63 at station-7. The difference in the pH value of the sample might be due to fact that the accumulation of domestic sewage. Similar findings were also made by Patil (1982).

Total Dissolved Solids

The term TDS describes all solids (usually mineral salts) that are dissolved in water. Desirable limit of TDS is 500 mg/l (ICMR, 1975). TDS of the water sample varied from 146 ppm to 274 ppm. Variations of dissolved solids in water could affect conductivity measurements, but provides no indication of the relative quantities of the various components. There is a relationship between conductivity and total dissolved solids in water. As more dissolved solids are added, water's conductivity increases (McNeely *et al*., 1979).

Chloride(cl)

Chloride concentration is one of the most indicators of water pollution (Munawar, 1970). It is one of the major anions found in water and are generally combined with calcium, magnesium or sodium. During the study period Chloride value ranged from 12.38-44.56 mg/l. Chloride content of different Indian rivers were studied by various workers. Singh (2010) reported chloride 8.2 to 81.5 mg/l in river Ganga. Singh and Hasnain (1999) noted chloride 1.2-62.8 mg/l in Damodar river basin. Koshy and Nayar (1999) found chloride 110-176.6 mg/l in river Pamba. Sharma and Pande (1998) reported chloride ranges from 12-24 mg/l for winter, 10-40 mg/l during summer and 10 to 18 mg/l during rainy seasons in river Ramganga at Moradabad (U.P.). Raised value of chloride at station-7 is due to mixing of municipal sewage and domestic waste in river water. Similar observation was made by Dwiwedi and Odi (2003) from Dickrong river.

Biochemical Oxygen demand(B.O.D.)

BOD is the amount of oxygen required by the bacteria in stabilizing the decomposable organic matter. The aim of BOD test is to determine the amount of bio chemically oxidizable carbonaceous matter (Gupta *et al*., 2003). During the study BOD measured in the range of 4.16 to 19.2 mg/l. Maximum BOD was recorded at station-7 which could be due to the

influence of sewage. Higher values of BOD and lower values of DO indicate more amount of organic matter present in sewage (Vaishali, 2005).

Chemical Oxygen Demand (C.O.D.)
Chemical oxygen demand (COD) is a measure of the oxidation of reduced chemicals in water. It is commonly used to indirectly measure the amount of organic compounds in water. In the present study COD varies from 10.4 to 46 mg/l. The maximum value of COD 46 mg/l was observed at station-7 which indicates to increase the pollution level of the river Khan. Koshy and Nayar (1999) found that the river Pamba receives large quantities of hospital and domestic wastes which may contribute to the high COD level.

Phosphate(PO_4)
Phosphate determination is useful in measuring the water quality since it is an important plant nutrient and play a role of a limiting factor among all other essential plant nutrients (Dugan, 1972). During the present study minimum orthophosphate 0.112 mg/l was recorded at station-4 while maximum 0.546 mg/l was noted at station-9. Rajeshwari and Saraswathi (2009) reported phosphate concentration in Tungbhadra river varied from 0.001 to 2.1 mg/l and contamination is mainly due to washing clothes with detergents.

Alkalinity
Total alkalinity is caused by bicarbonates, carbonates, OH ions, borates, silicates and phosphates (Kataria *et al.*, 1995). Alkalinity is a measure of buffering capacity of water and is important for aquatic life in a freshwater system because it equilibrates the pH changes that occur naturally as a result of photosynthetic activity of phytoplankton (Kaushik and Saksena, 1989). Total alkalinity values in the present observations fluctuated from 98 to 248 mg/l. Minimum total alkalinity 112 mg/l was observed at station-1 while maximum 226 mg/l at station-9. Upadhyay and Rana, (1991) were reported the higher value of alkalinity indicates the pollution ofriver water by sewage.

Total Hardness($CaCO_3$)
Total hardness is the parameter of water quality used to describe the effect of dissolved minerals (mostly Ca and Mg), determining suitability of water for domestic, industrial and drinking purposes and attributed to presence of bicarbonates, sulphates, chloride and nitrates of calcium and magnesium (Taylor, 1949). Total hardness varies from 104 to 212 mg/l all selected sampling sites. The maximum total hardness was recorded at station-9 may be attributed to the mixing of domestic sewage and industrial effluents into the river water (Radhakrishnan *et al.* 2007).

Sulphate(SO_4)
Sulfate is second to bicarbonate as the major anion in hard water reservoirs. Sulfates (SO4--) can be naturally occurring or the result of municipal or industrial discharges. When naturally occurring, they are often the result of the breakdown of leaves that fall into a stream, of water passing through rock or soil containing gypsum and other common minerals, or of atmospheric deposition. Point sources include sewage treatment plants and industrial discharges such as tanneries, pulp mills, and textile mills. Runoff from fertilized agricultural lands also contributes sulfates to water bodies.

Sodium(Na) &Potassium(K)
Potassium and sodium are the mainly arising from the weathering of rocks, sewage, etc.Potassium was found to range from 50.50 mgl^{-1} to 178.00 mgl^{-1} during the study period. The minimum (50.50 mgl^{-1}) was observed in February and maximum (178.00 mgl^{-1}) was in June month (Figure 4) with the average value of 84.17±5.87. These results also find support from a far and Sultana (2008) for water quality of Ganga River. Similarly, the sodium content in water samples ranged from 50.00 to 178.00mgl^{-1}. The minimum value of sodium in the river was (50.00 mgl^{-1}) in the month of April and maximum (178.00 mgl^{-1}) in June with the average value of 96.53±7.94. Sodium was found within the recommended limits of WHO (1993).

Nitrate(NO_3)
Nitrate represents the end product of oxidation of nitrogenous matters and its concentration may depend on the nitrification and denitrification activities of micro-organisms. Domestic sewage contains very high amount of nitrogenous compounds. Atmospheric nitrogen fixed into nitrates by the nitrogen fixing organism is also a significant contributor to nitrates in the water (Trivedy and Goel, 1987). In the present investigation, nitrate content varied between 0.542 mg/l to 4.824 mg/l throughout.

Conclusions

The chemical data of the river Khan supports the biological evaluation of the pollution. The average concentration of oxidizable organic matter IS high for sampling stations I and II. The present study reveals that the water quality of river Khan is deteriorated. It was due to directly mixing of the domestic sewage and industrial effluents in river Khan. To improve the quality of water, sewage treatment plants are essential. Therefore the discharged of effluents before treatment and other waste into the River Khan should be controlled and enforced.

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