



DETECTION OF POLLUTANTS PRESENT IN THE SURFACE WATER OF AYAD RIVER, UDAIPUR, RAJASTHAN

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Abstract: The present study focuses on detection of pollutants in the Ayad River flowing through Udaipur city in Rajasthan (India). Water samples from three different locations of the river were collected and analyzed over a period of three months from June 2020 to August 2020 to determine the water quality on various parameters such as Total Hardness, Total Dissolved Solids, Chloride, Sulphate, Fluoride, Iron, pH, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO) etc. The highest pH value recorded was 8.96, the lowest DO was 1.10 mg/l, and the highest values of COD and BOD were found to be 480.0 mg/l and 162.0 mg/l respectively. It was observed that the water at the location where the industrial effluents were discharged into the river was more polluted as compared to the other two locations with respect to most of the parameters.

Keywords: Agriculture, Ayad River, Pollution, Udaipur, Water quality.

INTRODUCTION

Udaipur is the largest province of Rajasthan Tourism. There are many lakes in the city such as Fateh-Sagar, Udaisagar, Pichola, Badi Lake, Amraighat, and so on. Therefore, this city is often referred to as the 'City of Lakes', 'Venice of the East' and 'Kashmir of Rajasthan'. Ayad River connects the city from the industrial areas to the rural areas. Some researchers including Rathore *et al.* (2014) and Rai and Chouhan (2017) worked on the physicochemical aspects of Ayad river while Sankhla *et al.* (2019) studied the heavy metal toxicity in the water and sediments of this river.

Water is an important part of our ecosystem. The earth is the only planet which has water, one of the most precious natural resource. Water is present

on the earth in the form of fresh water and marine water reserves. The water resource is being used for various purposes such as domestic use, agriculture and fish culture etc. by local communities (Verma and Prakash, 2020). Rivers are vital and vulnerable freshwater ecosystem that are critical for the sustenance of all living beings. However, the declining quality of the water in these systems threatens their sustainability and is therefore a cause of concern. Rivers are waterways of strategic importance across the world, providing main water resources for domestic, industrial, and agricultural purposes. India is gifted with a river system comprising more than 20 major rivers with several tributaries and more than 50% of water resources of India are located in various tributaries of these river systems (Prakash, 2016). Water pollutants including many toxic chemicals badly influence

the aquatic ecosystem (Prakash and Verma, 2021) and disturb the ecological balance. The ecological imbalance badly affects the limnological features, widespread biodiversity and human survival (Ashok, 2017, 2018, 2020).

Several government and non-government organizations are working for improving the quality of water. The present study was conducted on the surface water of Ayad River of Udaipur, Rajasthan. The sole purpose of this analysis was to detect the pollutant levels in water samples

from 3 different locations and to compare the result with the already existing data and the limits set by the CPCB (1992) and Indian standard (IS: 2296) for surface water (BIS, 1992).

MATERIALS AND METHODS

The present study has undertaken with a view to assess the pollutant load from the following three different places of the Ayad River, Udaipur. These places were named as locations A, B and C respectively (Table 1).

Table1: Location of sampling sites.

Sl. No.	Name of location	Location Code	Latitude	Longitude
1.	Kamlodka Doongar	Location A	24°33'57" N	73°48'02" E
2.	Sukhanaka Road Bhoeyonki Pancholi	Location B	24°34'06" N	73°47'19" E
3.	Purohitoki Madri	Location C	24°33'57" N	73°44'37" E

The samples were collected from three different locations of Ayad river, as stated. All three locations were chosen with a different character such as one has apparently clear water with plants growing around the water body (location A), the second having weeds in the water body (location B) and a third near the industrial area where industrial effluents are regularly discharged into the river (location C). The grab sampling method for collecting the samples was used. All samples were collected in 1.5 litres of

sterile polyethylene bottles. First sampling site is the last point of the Ayad river before it drains into Udaisagar lake (Fig.1, Location A). Second site is near a village and agricultural area where many people use this water for farming (Fig.1, Location B). The last sampling site (Fig.1, Location C) is located in the Madri industrial area where industrial wastes are released. The collection of samples was carried out over a period of three months between June 2020 and August 2020.



Location – A



Location – B



Location – C

Fig. 1: Sample collection sites on the bank of Ayad River, Udaipur.

All the glass wares such as burette, pipette, conical flask, beaker etc. were prewashed with 10% nitric acid and de-ionized water. The various parameters that determine water quality were analyzed. These include pH, conductivity, Total Hardness, Alkalinity, Chloride, Fluoride,

Phosphate, Nitrate, Total Dissolved Solids, Total Suspended Solids, Oil and Grease, Biochemical Oxygen Demand, Chemical Oxygen Demand and so on. The analysis was done using standard protocols like APHA (2017) and BIS (2012). WHO (2008) has its own criteria and parameters.

RESULTS AND DISCUSSION

The samples collected from these three locations of Ayad River were analyzed and compared with

the permissible limit as set by the IS: 2296 and Central Pollution Control Board (CPCB). The results are shown in the tables 2, 3 and 4.

Table 2: Water Quality Result from Kamlod Ka Doongar (Location A).

S. No	Parameter	Unit	IS:2296		June 2020	July 2020	August 2020
			Class A	Class E			
1.	pH value	--	8.5	8.5	6.90	6.39	8.50
2.	Conductivity	$\mu\text{S/cm}$	--	2250	3540.00	4592.00	5886.00
3.	Total solids	mg/l	--	--	1400.00	1968.00	3024.00
4.	Total Dissolved solids	mg/l	500	2100	1320.00	1866.00	2890.00
5.	Total Suspended Solids	mg/l	--	--	80.00	102.00	134.00
6.	Total Hardness	mg/l	300	--	658.00	800.00	890.00
7.	Chlorides (as Cl)	mg/l	250	600	234.93	364.89	324.90
8.	Fluoride (as F)	mg/l	1.5	--	0.50	0.94	1.10
9.	Sulphate (as SO_4)	mg/l	400	1000	88.62	107.60	160.89
10.	Calcium (as Ca)	mg/l	80	--	72.36	98.00	216.00
11.	Magnesium (as Mg)	mg/l	24.28	--	40.84	54.00	84.00
12.	Alkalinity as CaCO_3	mg/l	--	--	130.00	390.00	590.00
13.	Nitrate (as NO_3)	mg/l	20	--	4.00	13.20	26.84
14.	Copper as Cu	mg/l	1.5	--	0.005	0.005	0.003
15.	Iron as Fe	mg/l	0.3	--	0.19	0.24	1.00
16.	Biochemical Oxygen Demand - 27°C (BOD)	mg/l	2	3	96.42	135.40	162.00
17.	Chemical Oxygen Demand (COD)	mg/l	--	--	180.00	280.00	458.00
18.	Oil & Grease	mg/l	--	--	4.02	6.00	6.28
19.	Dissolved Oxygen	mg/l	6	--	4.30	2.00	1.15
20.	Chromium as Cr	mg/l	0.05	--	0.002	0.004	0.005
21.	Lead as Pb	mg/l	0.1	--	0.051	0.045	0.052
22.	Nickel as Ni	mg/l	--	--	0.032	0.044	0.041
23.	Zinc as Zn	mg/l	15	--	1.012	1.004	1.005
24.	Manganese as Mn	mg/l	0.5	--	0.656	0.678	0.741
25.	Phosphate	mg/l	--	--	11.26	11.56	10.52

Heavy Metals

A monthly variation was observed, wherein it was found that most of the values are higher in the month of August for Location C. The reasons could be the monsoon when the surface water runoff from the Madri industrial area to the

Udaisagar Lake. More or less similar results were obtained by Rathore *et al.* (2014), Rai and Chouhan (2017) and Sankhla *et al.* (2019) while analyzing the water of the Ayad River for pollutants. They observed that the concentration of heavy metals to be slightly higher or at the

borderline of the permissible limits. Human health is directly affected by the consumption of polluted water, sediment, fishes, fruits, vegetables, plants etc. Sankhla *et al.*, 2019 noticed that industrial wastes, E-waste, sewage, anthropogenic sources are the reasons behind the

contamination and the toxicity of the Ayad River, which has led to the pollution of drinking water in nearby areas. Diseases like neurotoxicity and carcinogenicity are basically related to the contamination of heavy metals such as lead, chromium and nickel, prevalent in such areas.

Table 3: Water Quality Result from Sukhanaka Road Bhoeyon Ki Pancholi (Location B).

S. No	Parameter	Unit	IS:2296		June 2020	July 2020	August 2020
			Class A	Class E			
1.	pH value	--	8.5	8.5	6.84	6.50	8.92
2.	Conductivity	$\mu\text{S/cm}$	--	2250	3496.00	4622.00	5895.00
3.	Total solids	mg/l	--	--	1404.00	1972.00	3020.10
4.	Total Dissolved solids	mg/l	500	2100	1326.00	1870.00	2882.10
5.	Total Suspended Solids	mg/l	--	--	78.00	102.00	138.00
6.	Total Hardness	mg/l	300	--	680.00	810.00	900.00
7.	Chlorides (as Cl)	mg/l	250	600	214.93	354.89	314.90
8.	Fluoride (as F)	mg/l	1.5	--	0.84	1.39	1.00
9.	Sulphate (as SO_4)	mg/l	400	1000	95.60	110.20	164.92
10.	Calcium (as Ca)	mg/l	80	--	70.12	92.00	224.00
11.	Magnesium (as Mg)	mg/l	24.28	--	40.36	52.36	81.60
12.	Alkalinity as CaCO_3	mg/l	--	--	140.00	400.00	590.00
13.	Nitrate (as NO_3)	mg/l	20	--	4.21	14.60	24.74
14.	Copper as Cu	mg/l	1.5	--	0.035	0.035	0.039
15.	Iron as Fe	mg/l	0.3	--	0.47	0.50	0.85
16.	Biochemical Oxygen Demand - 27°C (BOD)	mg/l	2	3	96.82	138.30	160.12
17.	Chemical Oxygen Demand (COD)	mg/l	--	--	182.00	292.00	440.00
18.	Oil & Grease	mg/l	--	--	4.08	4.90	6.30
19.	Dissolved Oxygen	mg/l	6	--	4.35	2.70	1.10
20.	Chromium as Cr	mg/l	0.05	--	0.003	0.003	0.004
21.	Lead as Pb	mg/l	0.1	--	0.054	0.051	0.058
22.	Nickel as Ni	mg/l	--	--	0.053	0.058	0.056
23.	Zinc as Zn	mg/l	15	--	3.965	3.214	3.652
24.	Manganese as Mn	mg/l	0.5	--	0.005	0.005	0.007
25.	Phosphate	mg/l	--	--	22.48	23.48	22.99

pH Value

According to water quality standards, the pH limits should be 6.0 - 8.5. In the present study, the

pH values were within limits in all the three locations in the months of June and July. However, authors recorded pH values as 8.50,

8.92, and 8.96 in the month of August 2020 from locations A, B, and C respectively. Studies have shown that the sample is alkaline. Reasons for

higher values in the month of August could be the consequence of the monsoon with an increase in the surface run off.

Table 4: Water Quality Result from Purohito Ki Madri (Location C).

S. No	Parameter	Unit	IS:2296		June 2020	July 2020	August 2020
			Class A	Class E			
1.	pH value	--	8.5	8.5	6.84	6.50	8.92
1.	pH value	--	8.5	8.5	6.90	6.42	8.96
2.	Conductivity	$\mu\text{S/cm}$	--	2250	3540.00	4650.00	5952.00
3.	Total solids	mg/l	--	--	1392.00	1998.00	3027.52
4.	Total Dissolved solids	mg/l	500	2100	1320.00	1892.00	2890.64
5.	Total Suspended Solids	mg/l	--	--	72.00	106.00	136.88
6.	Total Hardness	mg/l	300	--	660.00	790.00	870.00
7.	Chlorides (as Cl)	mg/l	250	600	209.93	359.89	329.90
8.	Fluoride (as F)	mg/l	1.5	--	0.74	0.61	0.96
9.	Sulphate (as SO ₄)	mg/l	400	1000	99.68	110.69	160.32
10.	Calcium (as Ca)	mg/l	80	--	74.00	98.00	212.00
11.	Magnesium (as Mg)	mg/l	24.28	--	40.12	50.12	81.60
12.	Alkalinity as CaCO ₃	mg/l	--	--	130.00	390.00	580.00
13.	Nitrate (as NO ₃)	mg/l	20	--	4.60	13.50	30.54
14.	Copper as Cu	mg/l	1.5	--	0.254	0.254	0.254
15.	Iron as Fe	mg/l	0.3	--	0.98	0.22	0.94
16.	Biochemical Oxygen Demand - 27°C (BOD)	mg/l	2	3	98.20	140.00	160.00
17.	Chemical Oxygen Demand (COD)	mg/l	--	--	180.00	284.00	480.00
18.	Oil & Grease	mg/l	--	--	4.15	5.80	6.08
19.	Dissolved Oxygen	mg/l	6	--	4.40	2.80	1.30
20.	Chromium as Cr	mg/l	0.05	--	0.342	0.342	0.342
21.	Lead as Pb	mg/l	0.1	--	0.986	0.988	0.991
22.	Nickel as Ni	mg/l	--	--	0.701	0.751	0.625
23.	Zinc as Zn	mg/l	15	--	4.321	4.896	4.049
24.	Manganese as Mn	mg/l	0.5	--	1.421	1.321	1.254
25.	Phosphate	mg/l	--	--	65.56	65.53	65.32

Class A – Drinking water without conventional treatment but after disinfection.

Class E – Water for irrigation, industrial cooling, and controlled waste disposal

Dissolved Oxygen

The analytical results of the DO values of the samples in all months of the three locations showed lower surface water quality standards. These values below the standards have an adverse impact on the aquatic organisms. Studies have shown that when the DO falls, the life of the aquatic organisms is threatened. Authors recorded DO as 4.30 mg/l, 4.35mg/l and 4.40 at locations A, B and C, respectively in the month of June 2020.

Oil and Grease

As per surface water standard IS: 2296, the prescribed limit of the oil and grease is 0.1 mg/l and the samples of three months data crossed the prescribed limit with a maximum of 6.30 mg/l at location B in the month of August 2020, 6.08 mg/l at location C in the month of August 2020 while 6.00 mg/l and 6.28 mg/l at location A in the month of July 2020 and August 2020 respectively. The maximum value recorded was 6.30 mg/l at location B in the month of August 2020. A comparison of these results with the standard indicates that the Ayad River is highly polluted.

Alkalinity

Authors found the maximum alkalinity values as 590 mg/l, 590 mg/l and 580 mg/l at locations A, B and C respectively in the month of August 2020 and these results were close to the permissible limit of drinking water standard.

Fluoride

In the present study, the fluoride concentration was higher at location B than the other two locations (Fig. 2). It was also observed that the value from August 2020 samples is higher in location A in comparison to other locations B and C. This data is much closer to the standard limits. Authors recorded the maximum value as 1.39 mg/l at location B in the month of July 2020. The fluoride content of the water in the Ayad river is lower than the recommended level. It implies that the people consuming water from this river would need to take fluoride supplementation in their diet to avoid the effects of deficiency of fluoride like dental caries (Schamschula and Barmes, 1981).

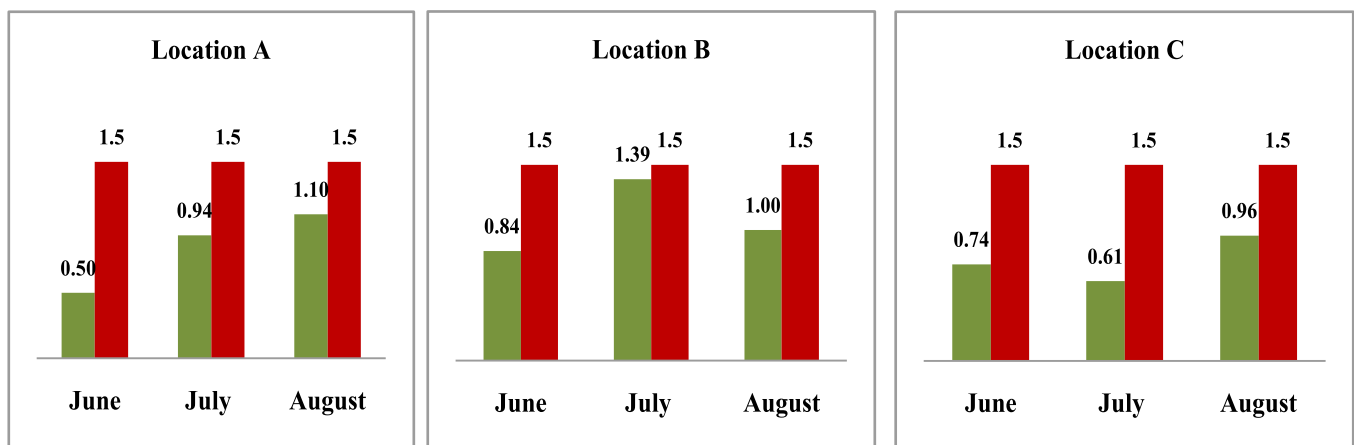


Fig. 2: Fluoride values in the samples at locations A, B and C with respect to the standard limits.

■ Recorded value ■ Standard limit ❖ All values and limits are in mg/l.

Total Dissolved Solids

As per the IS 2296 (class A) the limit of TDS is 500 mg/l and authors observed that the total dissolved solids are much higher than the prescribed limits. The highest concentration recorded was 2890.64 mg/l at location C in the month of August 2020. Since its TDS is too high hence the Ayad river is highly polluted (Fig. 3).

Total Hardness

As per the analysis of surface water of the Ayad River it was observed that total hardness is found to be higher in all the locations every month. According to IS: 2296, the hardness should not be more than 300 mg/l for drinking purpose hence samples from all the 3 locations are not found fit for drinking purposes (Fig. 4).

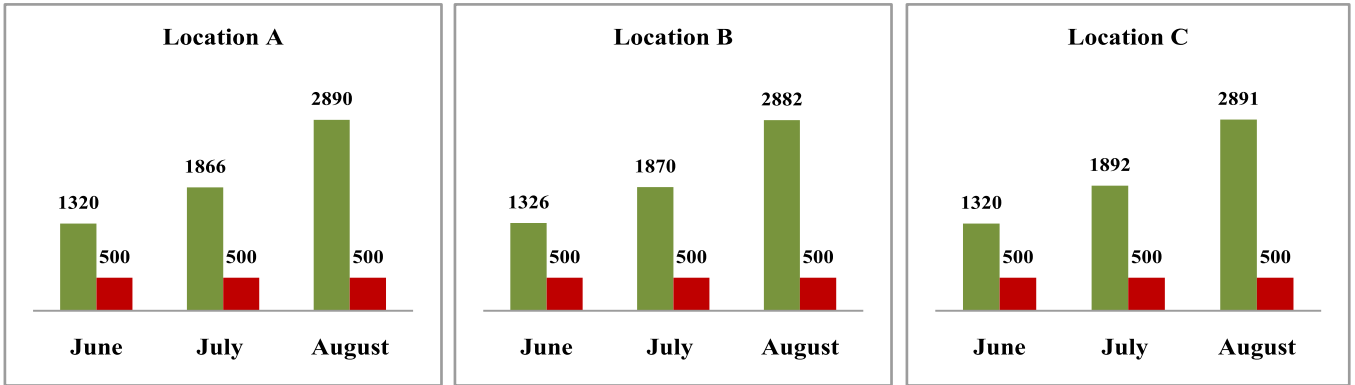


Fig. 3: TDS values in the samples at locations A, B and C with respect to the standard limits.

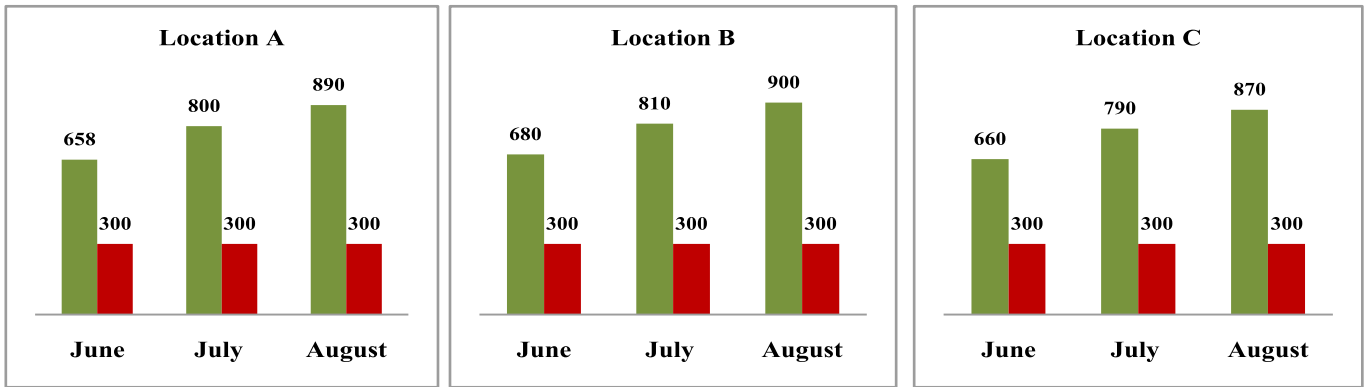


Fig. 4: Total hardness values in the samples at locations A, B and C with respect to the standard limits.

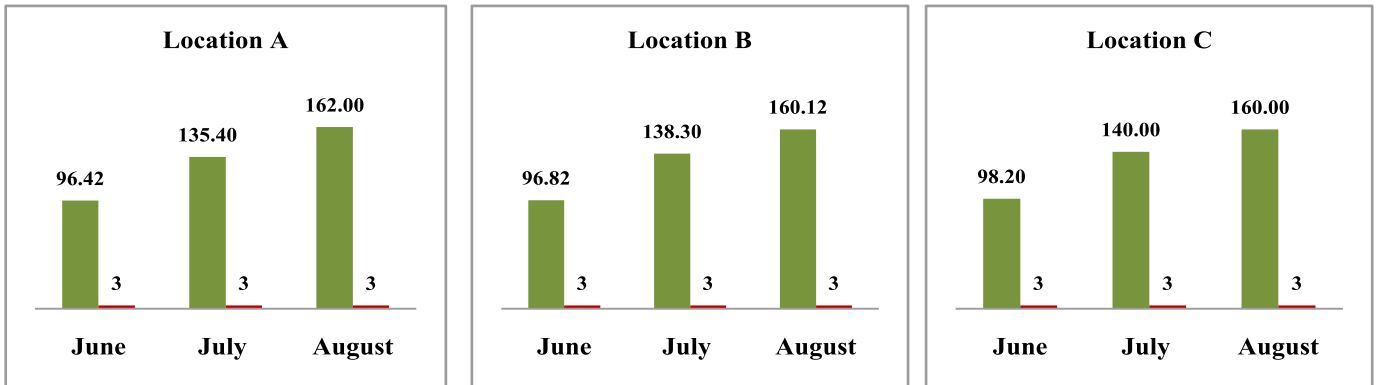


Fig. 5: BOD values in the samples at locations A, B and C with respect to the standard limits.

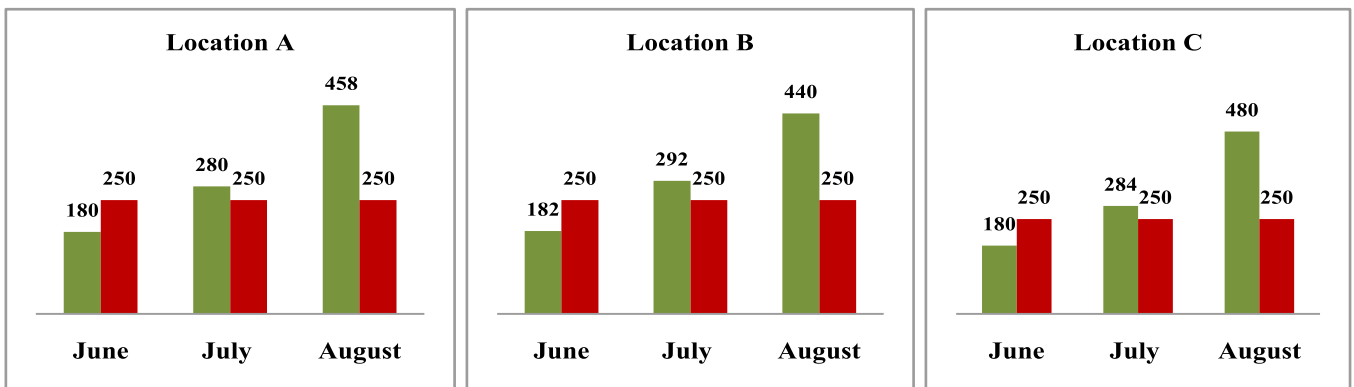


Fig. 6: COD values in the samples at locations A, B and C with respect to the standard limits.

■ Recorded value
 ■ Standard limit
 ❖ All values and limits are in mg/l.

Biochemical Oxygen Demand

The BOD was highest to the level of 162.0 mg/l at location A in August 2020 and the lowest 96.42 mg/l at location A in June 2020 (Fig. 5). As per the surface, water quality standard, the limit is 2 mg/l and 3 mg/l. All samples had a high BOD than the standard limits, which indicates that the surface water is highly polluted and not suitable for aquatic organisms. The Ganga River is less polluted as its maximum BOD of is 3.90 mg/l (Joshi *et al.* 2009).

Chemical Oxygen Demand

In the present study, authors found COD values more than 250 mg/l in all the locations in the months of July and August, 2020 (Fig. 6). This value is higher than the value of standard limits. The River Ganga has comparatively better position having COD between 4.58 mg/l and 13.72 mg/l (Joshi *et al.* 2009). Thus, it can be said that Ayad river is highly polluted and its water is not good for human consumption, aquatic organisms, and animals.

CONCLUSION

Authors found that most of the physicochemical values of Ayad river were above the prescribed standards, so the river water is not suitable for drinking, domestic and agriculture purposes. The magnitude of problem faced by Ayad river was due to discharge of solid and liquid municipal wastes without any treatment leading to gross pollution of the aquatic resource. Thus, there is an urgent need to undertake effective practical and meaningful conservation measures for sustainable conservation of the river.

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