A STUDY ON EFFECT OF PHYSIOCHEMICAL ANALYSIS OF WATER EFFLUENTS COLLECTED FROM DIFFERENT SITES OF DRAVYAVATI RIVER, JAIPUR

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Abstract

In this study, Dravyavati River samples were collected from three sites in various seasons (summer, rainy and winter). The objective of this study is to determine the water quality index for the Dravyavati River water of Jaipur City and its industrial area. The river water samples have been analyzed for some physicochemical parameters like pH, electrical conductivity (EC), total suspended and total dissolved solids (TSS and TDS), total solids (TS), total alkalinity (TA), total hardness (TH), chloride (Cl-) and fluoride (F-). In order to statistically determine the present water quality status and index, 19 parameters were evaluated, including pH, color, total dissolved solids. electrical conductivity, total alkalinity and total hardness. The obtained results are compared with World Health Organization and Indian standard drinking water specification IS: 10500-2012. In general the current investigation found that most parameters were at a level indicating pollution.

Key Words: Water pollution, Physico-chemical parameters, Industrial area, WHO

Introduction

Water is an essential resource for sustaining the abundance of life on the planet. It is available in three states – gas, liquid and solid – in most places in the world. Water also plays an important part on shaping the physical appearance of the world, in its role in weathering, erosion and sedimentation (Jelic et al, 2011). Human practices in managing water have important consequences in terms of soil erosion and possible pollution of water bodies downstream from human activities and habitation (Shyamala et al, 2008).

Pollution of standing and flowing bodies of water (ponds, lakes, streams and rivers) depletes the resources available to protect and sustain life, and affects the health and welfare of all life forms that rely on water (Bundela et al, 2012). Water is directly used for drinking water, irrigation in farming, and process engineering in industrial applications (Patil and Patil, 2010). Secondarily, it is used to sustain the life of aquatic food sources and as a recreation resource. Generally, pollution is the direct consequence of the casual or intentional release of dramatically increased amounts of naturally occurring substances that overwhelm a downstream environment, or by the casual or intentional release of synthetic compounds (Mutlu, and Uncumusaoğlu ,2016). These discharges of domestic, agricultural or industrial wastes affect any downstream reservoir of water, whether standing or flowing. This study focuses on the wastewater impact on the Dravyavati River, which receives inflows from upstream human (rural and urban) settlements, as well as from agricultural and industrial sources (Rajput et al, 2017). Various methodologies were employed to measure pollution levels in this river throughout the calendar year (Tüfekci et al,2007).

Methodology

Temperature: - The temperature was recorded with the help of mercury thermometer.

pH: - pH is the most significant factor determining the corrosive nature of water. The lower the numerical pH value, the more corrosive the water. pH is completely correlated with total alkalinity and electrical conductance (Gupta, 2009). Different factors change the pH of water. Higher pH values observed suggest that the equilibrium between carbon dioxide and carbonate-bicarbonate is affected by changes in physicochemical conditions (Karanth, 1987).

EC (Electrical Conductivity):- Ten different parameters – temperature, alkalinity, pH, , hardness, total solids, total dissolved solids, COD, calcium, chloride and iron – correlate so well with electrical conductance that EC alone can be used as a rapid check on the quality of underground drinking water, and can certainly be applied to the water quality management of other areas . A cc meter is used to measure the resistance between two platinized electrodes. Calibration is achieved by comparing to a standard KCl solution.

Alkalinity: - It is composed primarily of carbonate and bicarbonate. Alkalinity stabilizes pH; alkalinity, pH and hardness affect the toxicity of water. Simple titration with dilute hydrochloric acid in the presence of phenolphthalin or methyl orange will allow determination of alkalinity, as reflected in the presence of carbonate or bicarbonate .

Dissolved Oxygen:- Dissolved oxygen is a crucial parameter. Its presence in a body of water is a direct and indirect indicator of critical conditions, including photosynthesis, bacterial activity, availability of nutrients, stratification, etc. As time in summer passes, the rise in ambient temperature causes the level of microbial activity to increase, and the level of dissolved oxygen to decrease (Moss, 1972). The combination of higher temperatures and longer-lasting bright sunlight influences the concentration of soluble gases (O_2 and CO_2). The longer days of intense sunlight also seem to accelerate phytoplankton activity in photosynthesis, consuming CO_2 and evolving O_2. This may account for the observed increase in oxygen recorded in summer months (Krishnamurthy, 1990).

Carbonate: - The presence of carbonate is indicated when pH levels reach 8.3. Its presence can be determined by titration with hydrochloric acid using phenolphthalein as an indicator, or potentiometrically. Below a pH level of 8.3, carbonate will convert to an equivalent amount of bicarbonate.

Bicarbonate:- Titration with hydrochloric acid is also used to measure bicarbonate, with methyl orange as an indicator. Below pH 4.0, methyl orange will turn yellow, and the carbonic acid will evolve carbon dioxide + water.

Biochemical Oxygen Demand (BOD):- BOD could characterize the degree of organic material contamination in water, specified in mg/L BOD indicates the quantity of dissolved oxygen required to decompose organic compounds biochemically and also oxidize certain inorganic materials .(eg., iron, sulfites).

Chemical Oxygen Demand (COD):- COD can also characterize the degree of organic material contamination in water, specified in mg/L. COD inidates the quantity of dissolved oxygen required to cause chemical oxidation of the organic material in water. BOD and COD are both key indicators of the environmental health of a surface water supply. They are commonly utilized in waste water treatment but rarely in general water treatment.

Ammonia:- A Nesler reagent is used to make a color complex measured spectroscopically at a wavelength of 425 nm. The reaction environment is alkaline, and water hardness causes severe interference.

Calcium:- It is measured by complexometric titration with a standard solution of EDTA using a Patton and Reeder indicator under the pH conditions greater than 12. A fixed volume of 4N sodium hydroxide is added. Comparison of the titre (EDTA solution) to the known sample volume indicates the calcium concentration in the sample.

Magnesium: - It is also measured by complexometric titration with a standard solution of EDTA using Eriochrome black T as indicator under buffered conditions of pH 10.0. The buffered solution is made from ammonium chloride and ammonium hydroxide. The solution resists pH variations during titration.

Sodium: - A flame photometer is used to measure sodium. A known concentration of sodium (from 1 to 100 mg/l) is used to calibrate the instrument. Samples with a higher concentration of sodium are diluted with distilled water, and the observed values are corrected for the dilution factor.

Chloride: - Chloride is measured by titration. A known sample volume is mixed with a standard silver nitrate solution with dissolved potassium chromate, or an eosin/fluorescein solution in alcohol. The former generates a red compound with silver as soon as the chloride precipitates; The latter is an indicator of adsorption.

Table 1:- Physicochemical Analysis of Water Samples Collected in Summer Season (May to June)

Sr no	Parameter	Site1	Site2	Site3	Permissible limit (as per Indian standard)
P1	Temperature (°C)	19	21	23	-
2	Color	Grey	Dirty Green	Green	-
3	Electrical conductivity (ds/m)	1.65	1.68	2.88*	2
4	pH	7.35	7.52	3.18	6.5-8.5
5	Dissolved oxygen (mg/l)	less than 0.5	less than 0.5	less than 0.5	4-5
6	Total Hardness (mg/l)	376	383	752	2000
7	Acidity(mg/l)	129	52	1118*	400
8	Alkalinity (mg/l)	592	663*	less than 1	600
9	Ammonia (mg/l)	49.95*	52.2*	15.8*	5.0
10	Bi carbonate (mg/l)	7	7	0	8.5
11	Biochemical Oxygen Demand (B.O.D.) (mg/l)	307.31	367.25*	526.56*	350
12	Carbonate (mg/l)	2	1	2	180
13	(C.O.D.) (mg/l)	848.6*	809.9*	2095.5*	250
14	Chloride (mg/l)	23	18	32	1000
15	Magnesium (mg/l)	40.01	26.78	72.55	100
16	Nitrate (mg/l)	20.15	21.38	156.23*	100
17	Nitrite (mg/l)	0.01	0.02	below 0.01	1
18	Sodium (mg/l)	14	11	16	5
19	Calcium(mg/l)	6.18	6.39	16.63	200

Table 2:- Physicochemical Analysis of Water Samples Collected in Rainy Season (July to August)

Sr no	Parameter	Site1	Site2	Site3	Permissible limit (as per Indian standard)
1	Temperature (°C)	10	9	10	-
2	Color	Grey	Dirty green	Pink	-
3	Electrical conductivity (ds/m)	1.6	1.64	2.54*	2
4	pH	7.01	7.3	3.49	6.5-8.5
5	Dissolved oxygen (mg/l)	0	less than 0.5	less than 0.5	4-5
6	Total Hardness (mg/l)	364	376	732	2000
7	Acidity(mg/l)	112	42	1102*	400
8	Alkalinity (mg/l)	585	644*	less than 1	600
9	Ammonia (mg/l)	48.84*	49.94*	14.9*	5.0
10	Bicarbonate (mg/l)	6	7	0	8.5
11	Biochemical Oxygen Demand (B.O.D.) (mg/l)	309.64	369.84*	527.01*	350
12	Carbonate (mg/l)	2	1	2	180
13	(C.O.D.) (mg/l)	844.3*	806.9*	2062.2*	250
14	Chloride (mg/l)	22	15	28	1000
15	Magnesium (mg/l)	38.64	26.24	67.88	100
16	Nitrate (mg/l)	19.44	21.1	148.86	100
17	Nitrite (mg/l)	0.01	0.03	below 0.01	1
18	Sodium (mg/l)	13	10	16	5
19	Calcium(mg/l)	6.22	6.41	18.81	200

Table 3:- Physicochemical Analysis of Water Samples Collected in Winter Season (December to January)

Sr no	Parameter	Site1	Site2	Site3	Permissible limit (as per Indian standard)
1	Temperature (°C)	6	7	7	-
2	Color	Grey	Dirty Green	Pink	-
3	Electrical conductivity(ds/m)	1.63	1.69	2.8*	2
4	pH	7.28	7.48	3.42	6.5-8.5
5	Dissolved oxygen (mg/l)	0	less than 0.5	less than 0.5	4-5

6	Total Hardness (mg/l)	370	380	740	2000
7	Acidity(mg/l)	120	50	1110*	400
8	Alkalinity (mg/l)	590	650*	less than 1	600
9	Ammonia (mg/l)	49.84*	50.4*	15.4*	5.0
10	Bi carbonate (mg/l)	6	7	0	8.5
11	Biochemical Oxygen Demand (B.O.D.) (mg/l)	308.33	368.75*	526.67*	350
12	Carbonate (mg/l)	2	1	2	180
13	(C.O.D.) (mg/l)	844.8*	806.4*	2073.6*	250
14	Chloride (mg/l)	22	17	29	1000
15	Magnesium (mg/l)	38.88	26.73	68.04	100
16	Nitrate (mg/l)	19.8	21.3	149.64*	100
17	Nitrite (mg/l)	0.01	0.03	below 0.01	1
18	Sodium (mg/l)	13	10	15	5
19	Calcium(mg/l)	6.2	6.4	17.6	200

Sampling Procedure

Samples were collected from the Dravyavati River, in different seasons (Summer, Table 1, Rainy, Table 2; and Winter, Table 3). Sterilized glass bottles were used to collect water samples. A 100 ml water sample was collected at each of the selected locations. Multiple physico-chemical parameters, like temperature, color, pH, TDS ,BOD, COD, dissolved oxygen, alkalinity, and other characters were analyzed by standard methods.

Result and Discussion

Analysis of the data showed the differences between water samples. The Tables summarize the results from waste water and adjacent soil. Considered together, the three Tables show identical patterns of seasonal contamination in the Dravyavati River system, but the differences in the Tables do differ by location. For example, every site sampled in every season shows the following anomalies:

- Ammonia is 3 to 10 times the permissible standard, with sites 1-2 recording 10x and site 3 recording 3x;
- COD is 3 to 8 times the permissible standard, with sites 1-2 recording 3x and site 3 recording 8x;
- Sodium is 2 to 3 times the permissible standard in all sites.

More limited (less pervasive) contamination is detected for:

- Alkalinity, where, in all seasons, sites 1 & 3 are passable, but site 2 is 10% above the limit, and
- BOD, where, in all seasons, site 1 is passable, site 2 slightly exceeds the standard, and site 3 doubles it.

Finally, site 3 is clearly an outlier, representing the most diverse contamination. Sites 1 & 2 are uniformly within permissible limits, but at site 3:

- Electrical conductivity is 1.5x the standard;
- Acidity is 2.5x the standard; and
- Nitrate is 1.5x the standard.

Considering all 3 sites of physicochemical analysis together, in all seasons, Site 3 was more polluted.

Conclusion: - The analysis of the water quality parameters of water from 3 different sites of Dravyavati River Jaipur in the city shows that the pH, chloride ion, total hardness and calcium values are well within the permissible limits. The TDS of water was well above the desirable limit and the average of acidity, BOD, COD, Ammonia, Alkalinity and Nitrate exceeded the desirable limits which are due to improper drainage system of the dyeing facilities. Compared to all 3 sites of physicochemical analysis, Site 3 was more polluted.

The results of the present study show that the water in Dravyavati River requires treatment to minimize the contamination, especially the alkalinity. The values of correlation coefficients and their significance levels will help in selecting the proper treatments to minimize the contaminations of Dravyavati River water. There is an increasing awareness among the people to maintain the water at the highest possible level of purity; this study should prove udseful in achieving this goal.

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