

ANALYSIS OF BIOLOGICAL POLLUTION OF VARIOUS WATER SAMPLES

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Abstract:- The pollution sources of heavy metals increase their concentration both at global as well as local levels. Our^{1,2} environment is getting polluted day by day due to the disposal of sewage and industrial waste without proper treatment in a totally unscientific way. The increase in concentration of metals in a localized area reaches sometimes to a significantly higher level and become deleterious to biological populations and human beings. Several disasters of metal poisoning have been recorded from time to time which have caused great ecological damage and lead to a large number of human casualties. Various³ water sources are chosen for present investigation to assess the effect of pollution on water. The sample of water was analyzed for amount of oxygen DO, BOD and COD parameters are also used to know the extent of pollution.

Key Words:- Dissolve oxygen (DO), Biological oxygen demand (BOD), Chemical oxygen demand (COD), pollution, disasters, water sample

Introduction:-

Pollution^{3,4} of water is responsible for a very large number of mortalities and incapacitations in the world. Polluted state of the water^{4,6} resources has led to a steady decline in fisheries and has also affected the irrigated land. Water^{8,9} no longer remains a 'free good'. Availability of clean water is going to become the greatest constraint for development tomorrow. Chemically waste water is composed of organic and inorganic components as well as various gases. BOD provide information about the amount of biodegradable substance present in waste water. BOD, COD, tests are measured of relative oxygen depletion effect of water contamination. Both have been widely adopted as a measure of pollution effect.

DISSOLVED OXYGEN (DO)

All living organisms are dependent upon oxygen in one form or another to maintain the metabolic processes that produce energy for growth and reproduction. The solubility of oxygen in water is directly proportional to its partial pressure. Dissolved oxygen measurements¹⁰ are vital for maintaining aerobic conditions in natural waters that receive pollution matter.

It is desirable to maintain conditions favorable of the growth and reproduction of a normal population of fish and other aquatic organisms. This condition requires the maintenance of dissolved oxygen levels that will support the desired aquatic life in a healthy condition at all times.

BIOCHEMICAL OXYGEN DEMAND (BOD)

Biochemical oxygen demand is defined as the amount of dissolved oxygen consumed by aerobic micro organism in water. The BOD value of a water sample is determined from the amount of dissolved oxygen consumed, when the sample is diluted with dilution water and allowed to stand for 5 days at 20° C.

BOD⁹ is defined as the amount of dissolved oxygen consumed or required when water borne organic matter is decomposed under a specified set of condition through respiratory action of aerobic microorganism in water. The BOD of water sample is usually expressed as mg/L dissolved oxygen 5 days at 20° C. Aerobic microorganism in water utilize organic substance as energy sources for their growth and consume dissolved oxygen to burn and decompose them into inorganic products. This biological action is called the self-purification action of natural action of natural values. If a large amount of wastewater rich in organic matter enters a body of natural water, aerobic microorganism in the water begins to grow actively by consuming the organic matter supplied. During this process, a large amount of dissolved oxygen is also consumed by the respiratory action of the microorganism. However, the solubility of atmosphere oxygen in water is limited oxygen. As a result the aerobic microorganism may die from suffocation. This causes the condition of the water to move in to an anaerobic state in which organic matter is an aerobically decomposed to produce hydrogen sulphide, marsh gas etc.

CHEMICAL OXYGEN DEMAND (COD)

Chemical oxygen demand is widely used to characterize the organic strength of wastewater and pollution of natural waters. The test measures the amount of oxygen required for chemical oxidation of organic matters in the sample water.

One of the chief limitations of the COD¹¹ test is its inability to differentiate between biologically oxidizable and biologically inert organic matter. The major advantage of the COD test is the short time required for evaluation. The determination can be made in about 3 hours. For this reason it is used as a substitute for the BOD test in many instances. The test is widely used in the operation of treatment facilities because of the speed with results can be obtained.

Procedure :-

DISSOLVED OXYGEN(DO):-

The sample was collected in a 300 ml glass stopper bottle and fitted completely. The bottle should be completely filled. Immediately after collection 1 ml of manganese sulphate solution (dissolved 400 g MnSO₄ · 2H₂O in distilled water, filter and dilute in 1 litre) was added by means of pipette, dipping the end of pipette just below the surface of water. 1 ml of alkaline potassium iodide solution (prepared by dissolving 500 g NaOH and 135 g NaI in distilled water and dilute to 1 litre) was added in a similar way.

The bottle was inverted and allowed the precipitate to settle half way.

1 ml of conc. H₂SO₄ was added. The solution was allowed to stand for at least 5 minutes. 100 ml of solution was withdrawn in the conical flask immediately and 0.025N sodium thiosulphate (by dissolving 6.205 g of Na₂S₂O₃ · 5H₂O in 1 liter of distilled water) was added drop by drop from the burette until the yellow color just disappears.

1 ml of starch indicator was added and the addition of the thiosulphate was continued until the blue colour disappears. The ml of thiosulphate used was recorded.

1 ml of 0.025 N Na₂S₂O₃ = 1 mg DO/L

The dissolved oxygen in ppm = 2 × volume of thiosulphate

BIOCHEMICAL OXYGEN DEMAND (BOD) :-

BOD is an index of water quality source. It is directly proportional to the amount of organic matter in water. Therefore, BOD is the most fundamental and most important of the parameters used to determine the extent of the pollution of river and other public water.

The sample was neutralized to pH around 7.0 if it is highly alkaline or acidic. Two BOD bottles were filled with this water sample and 1 ml of allyl thio urea solution was added in each bottle. The dissolved oxygen in one bottle is estimated immediately by Winkler's method. The other bottle was incubated at 20°C for 5 days

The other bottle was incubated at 20°C for 5 days in BOD incubator and dissolved oxygen was estimated by Winkler's method.

CHEMICAL OXYGEN DEMAND (COD)

In the same manner a blank consisting of distilled water, equal in volume to that of the sample was refluxed together with the reagents.

$$COD \text{ as mg/L} = (A - B) \times N \times 8000 / m\ell \text{ of sample}$$

Result and discussion:-

ANALYSIS OF SAMPLES

The observed values of DO, BOD & COD in water samples of ten stations are given in Table – 1.01 to 1.10 The average values of DO, BOD & COD in different seasons of water samples of various stations are given in Table – 1.11.

S. No.	Period	DO mg/L	BOD mg/L	COD mg/L
1	Winter-03	5.7	0.12	3.6
2	Winter-04	5.1	0.08	3.2
	Average	5.4	0.10	3.4
1	Summer-03	4.9	0.11	3.3
2	Summer-04	5.3	0.13	3.9
	Average	5.1	0.12	3.6

S. No.	Period	DO mg/L	BOD mg/L	COD mg/L
1	Winter-03	5.7	0.06	2.0
2	Winter-04	6.5	0.04	1.6
	Average	6.1	0.05	1.8
1	Summer-03	6.5	0.06	1.7
2	Summer-04	6.3	0.02	1.3
	Average	6.4	0.04	1.5

S. No.	Period	DO mg/L	BOD mg/L	COD mg/L
1	Winter-03	4.1	0.33	5.5
2	Winter-04	4.5	0.45	6.1
	Average	4.3	0.39	5.8
1	Summer-03	4.4	0.31	5.0
2	Summer-04	5.2	0.45	5.4
	Average	4.8	0.38	5.2

S. No.	Period	DO mg/L	BOD mg/L	COD mg/L
1	Winter-03	8.1	0.7	1.1
2	Winter-04	7.5	0.3	0.5
	Average	7.8	0.05	0.8
1	Summer-03	7.8	0.06	0.7
2	Summer-04	8.6	0.10	1.3
	Average	8.2	0.08	1.0

S. No.	Period	DO mg/L	BOD mg/L	COD mg/L
1	Winter-03	3.9	0.22	4.6
2	Winter-04	4.7	0.38	5.6
	Average	4.3	0.30	5.1
1	Summer-03	4.6	0.26	4.5
2	Summer-04	5.0	0.32	4.9
	Average	4.8	0.29	4.7

S. No.	Period	DO mg/L	BOD mg/L	COD mg/L
1	Winter-03	4.1	0.44	6.6
2	Winter-04	4.9	0.60	8.0
	Average	4.5	0.52	7.3
1	Summer-03	4.3	0.47	6.7
2	Summer-04	4.9	0.55	7.1
	Average	4.6	0.51	6.9

S. No.	Period	DO mg/L	BOD mg/L	COD mg/L
1	Winter-03	4.8	0.04	1.1
2	Winter-04	5.0	0.06	1.5
	Average	4.9	0.05	1.3
1	Summer-03	5.4	0.05	1.3
2	Summer-04	5.0	0.03	0.9
	Average	5.2	0.04	1.1

S. No.	Period	DO mg/L	BOD mg/L	COD mg/L
1	Winter-03	4.0	0.29	4.7
2	Winter-04	3.8	0.25	5.1
	Average	3.9	0.27	4.9
1	Summer-03	4.1	0.25	4.3
2	Summer-04	4.7	0.27	4.9
	Average	4.4	0.26	4.6

S. No.	Period	DO mg/L	BOD mg/L	COD mg/L
1	Winter-03	4.0	0.18	3.7
2	Winter-04	4.2	0.26	4.7
	Average	4.1	0.22	4.2
1	Summer-03	4.8	0.31	5.1
2	Summer-04	4.4	0.21	4.3
	Average	4.6	0.26	4.7

S. No.	Period	DO mg/L	BOD mg/L	COD mg/L
1	Winter-03	7.3	0.10	2.1
2	Winter-04	6.9	0.06	1.7
	Average	7.1	0.08	1.9
1	Summer-03	7.9	0.09	1.5
2	Summer-04	7.3	0.05	1.3
	Average	7.6	0.07	1.4

Station	DO		BOD		COD	
	Winter	Summer	Winter	Summer	Winter	Summer
1	5.4	5.1	0.10	0.12	3.4	3.6
2	6.1	6.4	0.05	0.04	1.8	1.5
3	4.3	4.8	0.39	0.38	5.8	5.2
4	7.8	8.2	0.05	0.08	0.8	1.0
5	4.3	4.8	0.30	0.29	5.1	4.7
6	4.5	4.6	0.52	0.51	7.3	6.9
7	4.9	5.2	0.05	0.04	1.3	1.1
8	3.9	4.4	0.27	0.26	4.9	4.6
9	4.1	4.6	0.22	0.26	4.2	4.7
10	7.1	7.6	0.08	0.07	1.9	1.4

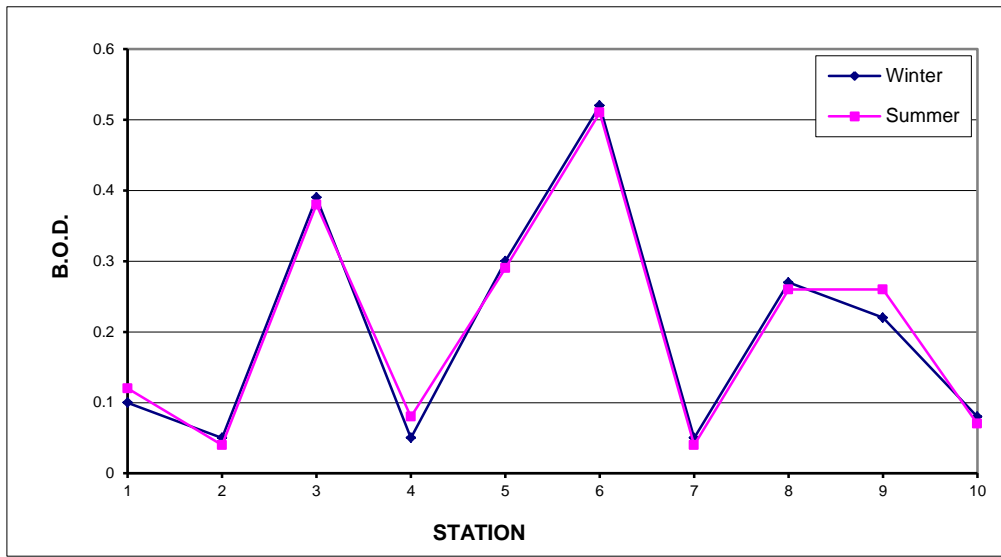


Figure 1: Variation of BOD

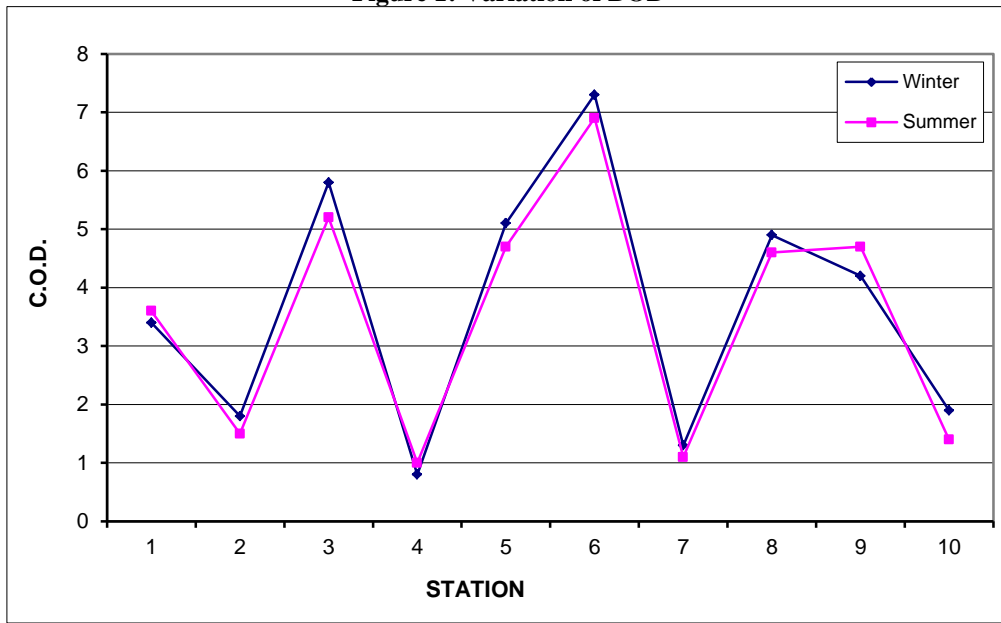


Figure 2: Variation of COD

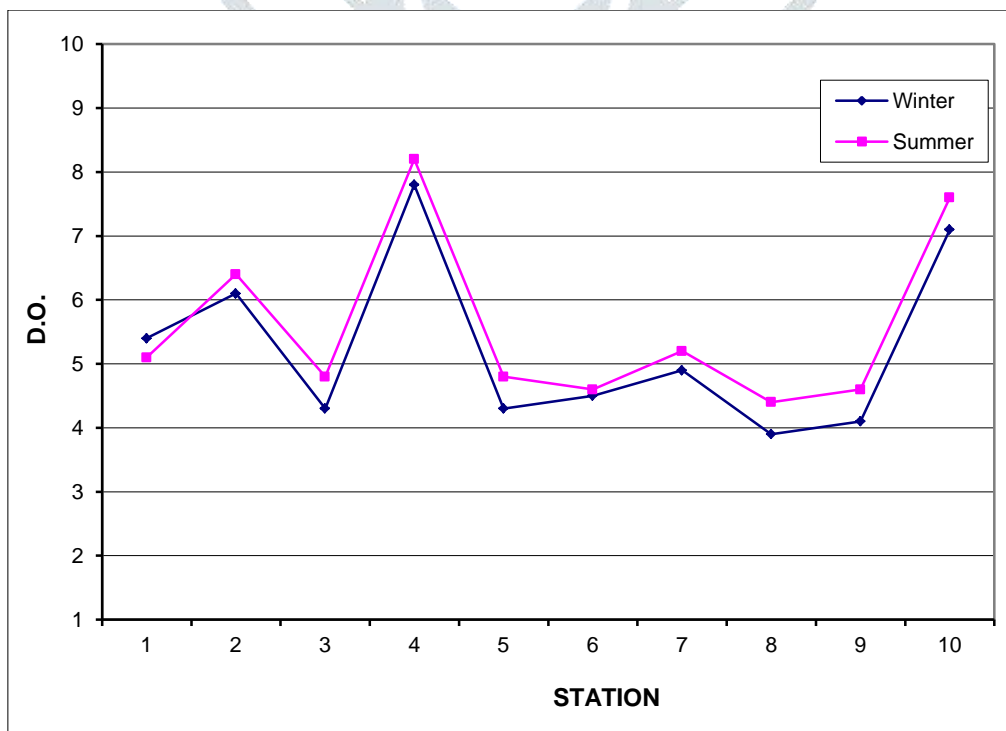


Figure 3: Variation of DO

RESULTS AND DISCUSSION:-

Bio-chemical analysis data does not reveal clearly the extent of pollution in water, hence demand analysis was under taken. Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were determined using standard methods of analysis. The analysis data obtained are summarized in Table - 1.01 to 1.10. Table – 1.11 contents average data of DO, BOD and COD in different seasons i.e. winter and summer. In order to assess the seasonal variation station wise graphs were plotted for DO, BOD and COD.

(1) DO (Dissolve oxygen):

All living organism depends on oxygen to maintain metabolic process that produce energy. As soon as wastes are discharged in a body of water, the dissolve oxygen starts getting utilize for aerobic stabilization of organic matter. The DO very low to saturation indicates high degree of biological pollution.

A perusal of Table – 1.11 reveals that DO values fluctuate between as low as 3.9mg/L. (Station - 08) to high as 8.2 mg/L. (Station 4). It is clear from Graph – 1.01 that DO value are greater in summer season and least in winter season but at Station 1 DO in winter was more than summer. As per prescribed specification DO should not less than 2 mg/L for survival of fishes. To increase the amount of DO the process of diffused aeration was performed and observed that within five minutes the amount DO was increase to 6.2 mg/L from 2.0 mg/L. Spray aerator can also be used for increasing the amount of DO.

(2) BOD and COD:-

BOD is the oxygen consumed by bacteria in decomposing organic matter. The BOD test is widely used to determine the pollution strength of domestic waters in terms of oxygen that they will required if discharge into natural water courses. It gives information about bacterial pollution load. High value (more than 3) indicates bacterial pollution. In present studies the BOD values ranging from .04 to .52 mg/L.

COD characterized the pollution of natural waters and measures the amount of oxygen requires for chemical oxidation of organic matter into CO₂ and water. COD values in present studies fluctuated for various stations. COD indicates that most of the samples have less than 10 mg/L COD.

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