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MONTHLY VARIATION IN BIOLOGICAL OXYGEN DEMAND IN SEWAGE TREATMENT PLANT

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ABSTRACT:

BOD being a bioassay test is greatly influenced by factors like toxicants, poor seeding, etc. For periodical checking of these factors, use a mixture of 150mg glucose and 150mg glutamic acid per liter as a standard check solution. Determine the 3 days 27^{0}C BOD of 2 percent dilution of the glucose glutamic acid standard checks solution as per above procedure. If the BOD value of the check is outside the range of 200 $\pm$ 37 mg/L, reject any BOD determination made with the seed and dilute water and seek the cause of the problem.

Key words: - *Bioassay test, Glutamic acid, BOD*

INTRODUCTION:

Bacteria and other microorganisms are responsible for the decomposition of the organic matter present in the waste water (Lenore et.al.,2005, EPA). Organic waste like leaves, dead plants, manures, sewage is present in the waste water which will be finally broken down by the bacteria and the microorganism. During this process the oxygen that is dissolved in the water is consumed by the microorganisms and bacteria, leading a scarcity of oxygen for other aquatic organisms of the water body (Kemula *et.al.*, 1950, Garcia *et.al.*, 1999, Titze *et.al.*, 2008). BOD is an amount of the oxygen used by microorganisms to decompose the waste (Hammer. 1975). If waste present in water body is high the BOD level will be high and vice versa. Phosphates and nitrates present in water body also lead to the higher level of BOD. Nitrates and phosphates are the plant growth boosters which will lead to speed growth of aquatic plants. Faster the growth of plants faster will be the death and more organic waste for decomposition will be available in water body. This will result in a higher BOD level. When the BOD will increase the Do will decrease & due to depletion of DO in water, aquatic life may not survive. When BOD levels are high, organisms that are more tolerant to low dissolved oxygen level such as macro invertebrates (i.e. leeches and sludge worms) may be abundant and grow luxuriantly. While Organisms having requirement of higher oxygen levels (i.e. caddisfly larvae and mayfly nymphs) will disappear and not survive

BOD determination is considered to be an empirical test in which standardized laboratory procedures are used to determine the relative oxygen requirements of polluted water, waste water, and effluent. The test can be applied widely in measuring waste loads to treatment plants and in evaluating the BOD-removal efficiency of treatment plant. The can test measures the molecular oxygen utilized during a specified incubation period for the BOD (carbonaceous demand) and the amount of oxygen used to oxidizing the inorganic material

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such as ferrous iron and sulfides. It can also measure the amount of oxygen used to oxidize reduced forms of nitrogen (nitrogenous demand) unless their oxidation is prevented by an inhibitor. The seeding and dilution procedures provide an estimate of the BOD at pH 6.5 to 7.5.

Organic nitrogen is defined functionally as organically bound nitrogen in the tri-negative oxidation state. It does not include all organic nitrogen compounds. Analytically, organic nitrogen and ammonia can be determined together and have been referred to as "Kjeldahl nitrogen," a term that reflects the technique used in their determination. Organic nitrogen includes such natural materials as proteins and peptides, nucleic acids and urea, and numerous synthetic organic materials. Typical organic nitrogen concentrations vary from a few hundred micrograms per litre in some lakes to more than 20 mg/L in raw sewage.

Total oxidized nitrogen is the sum of nitrate and nitrite nitrogen. Nitrate generally occurs in trace quantities in surface water but may attain high levels in some groundwater. In excessive amounts, it contributes to the illness known as methemoglobinemia in infants. A limit of 10 mg nitrate as nitrogen/L has been imposed on drinking water to prevent this disorder. Nitrate is found only in small amounts in fresh domestic wastewater but in the effluent of nitrifying biological treatment plants nitrate may be found in concentrations of up to 30 mg nitrate as nitrogen/ L. It is an essential nutrient for many photosynthetic autotrophs and in some cases has been identified as the growth-limiting nutrient.

Nitrite is an intermediate oxidation state of nitrogen, both in the oxidation of ammonia to nitrate and in the reduction of nitrate. Such oxidation and reduction may occur in wastewater treatment plants, water distribution systems, and natural waters. Nitrite can enter a water supply system through its use as a corrosion inhibitor in industrial process water. Nitrite is the actual etiologic agent of methemoglobinemia. Nitrous acid, which is formed from nitrite in acidic solution, can know to be carcinogens. The toxicological significance of nitrosation reactions in vivo and in the natural environment is the subject of much current concern and research.

Ammonia is present naturally in surface water and wastewater. Ground water has low ammonia concentration generally is low in because it adsorbs to soil particles and clays and is not leached readily from soils. It is produced largely by deamination of organic nitrogen-containing compounds and by hydrolysis of urea. At some water treatment plants ammonia is added to react with chlorine, in order to form combined chlorine residual. Ammonia concentrations encountered in water vary from less than 10 µg ammonia nitrogen/L in some natural surface and groundwater to more than 30 mg/L in some wastewaters. (Kjeldahl J. 1883, Morgan, G.B. 1957).

MATERIAL & METHODS

Method: Iodometric Method (Ref.: IS 3025, Part 44, 1993, Reaffirmed 1999**)**

BOD test is based on mainly bioassay procedure, which measures the dissolved oxygen consumed by microorganisms while assimilating and oxidizing the organic matter under aerobic conditions. The standard test conditions include incubating the sample in an airtight bottle, in dark at a specified temperature for specific time.

CALCULATIONS

When sample is Undiluted

BOD, mg/L = DO before incubation – DO after incubation When dilution water is not seeded

BOD, mg/L = DO before incubation – DO after incubation When dilution water is not seeded

$$BOD, mg/L = \frac{D1 - D2}{p} \times 1000$$

When dilution water is seeded

$$BOD, mg/L = \frac{D1 - D2 - (B1 - B2)f}{p} \times 1000$$

Where

D1 = Initial DO of sample in mg/L

D2 = DO of sample after incubation in mg/L

B1 = DO of seed control before incubation in mg/L B2 = DO of seed control after incubation in mg/L

f = ratio of seed in diluted sample to seed in control; [Volume (ml) of seed in diluted sample/volume of seed in seed control]

f may be used only when seed correction is to be applied. p = Sample volume (in ml) diluted to 1 litre with dilution water.

Glucose Glutamic Acid Check

RESULT & DISCUSSION

Biochemical oxygen demand is a test which determines the amount of organic material in wastewater by measuring the oxygen consumed by microorganisms in decomposing organic constituents of the waste. The higher the BOD, the more oxygen will be demanded from the waste to break down the organics. The BOD test is most commonly used to measure waste loading at treatment plants and in evaluating the efficiency of wastewater treatment. Sewage containing high BOD create environmental and health problems. Organic pollution is harmful to fish as it tends to reduce the amount of dissolved oxygen in water and BOD also interferes in aquatic life. It defines the strength of domestic wastes and industrial wastewaters.

In investigation period BOD varied from 103.63 to 238.70 in the influent and 8.19 to 35.78 in the effluent water. The minimum value was observed in month of September year 1 while maximum value was observed in the month of May year 3 in the inlet water of sewage treatment plant. The minimum value was observed in month of September year 1 while maximum value was observed in the month of May year 3 in the final treated effluent water of sewage treatment plant. (Refer Table No.1)

CONCLUSION:-

During rainy season i.e. from August and September the water body gets maximum nutrients along with optimum condition of temperature and ph by which spurt in the density of the micro-organisms. The minimum value in September year 1 may be due to luxuriant growth of micro-organism. During May i.e. summer season the concentration of water increases due to vaporization which will create a negative impact on the growth of some of the micro-organisms. It may be the reason why we get maximum BOD value during the summer period.

Note-BOD is expressed as mg/L, 3 days at 27oC and is rounded off as follows:

1. 0-10 mg/L upto 1st decimal

2. Above 10 whole number.

REFRENCE:

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Table No. 1: BOD value showing upper limit and lower limit in influent and effluent of 3 years

MONTH	RANGE	BOD year 1		BOD year 2		BOD year 3	
		Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
January	Upper limit	199	20	176	20	220	19
	Lower limit	148	16	110	8	170	16
February	Upper limit	220	24	168	19	250	22
	Lower limit	152	16	148	15	160	15
March	Upper limit	174	18	172	24	260	28
	Lower limit	156	16	150	16	170	16
April	Upper limit	250	26	197	20	260	20
	Lower limit	146	12	162	15	210	16
May	Upper limit	258	22	210	20	290	60
	Lower limit	142	10	173	15	190	16
June	Upper limit	190	18	204	20	250	19
	Lower limit	98	8	132	15	160	16
July	Upper limit	164	18	154	19	220	18
	Lower limit	104	6	118	15	130	15
August	Upper limit	157	12	156	20	194	28
	Lower limit	90	5	112	13	132	15
September	Upper limit	126	14	168	22	186	22
	Lower limit	72	6	136	16	140	15
October	Upper limit	132	18	168	20	182	19
	Lower limit	98	8	140	16	146	15
November	Upper limit	150	20	175	22	188	22
	Lower limit	112	10	152	14	152	15
December	Upper limit	136	18	164	18	206	19
	Lower limit	112	8	152	12	152	15

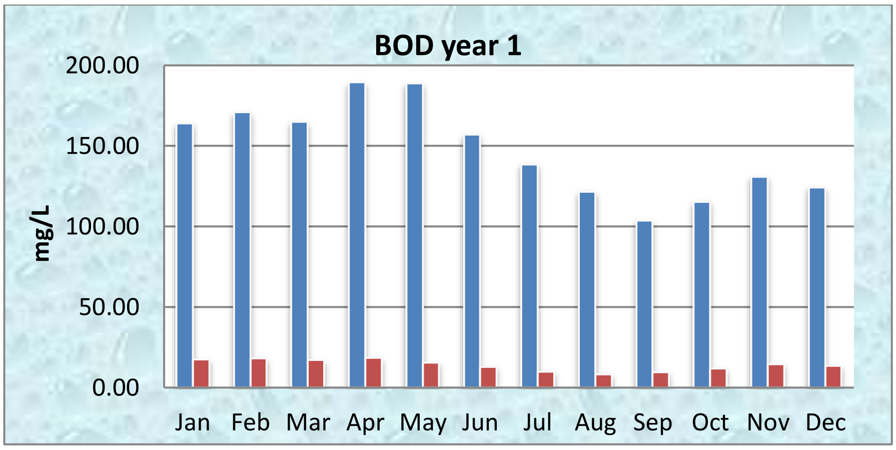

Figure No. 1 : BOD of each month showing the mean value in influent and effluent of year 1

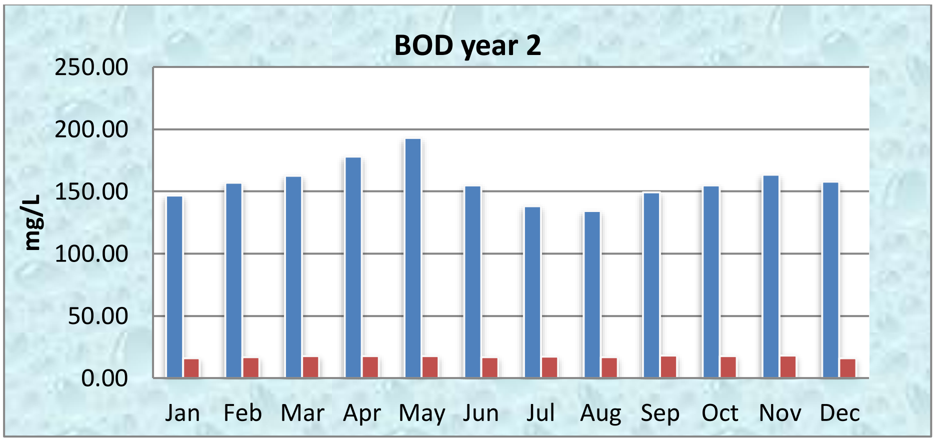

Figure No. 2: BOD of each month showing the mean value in influent and effluent of year 2

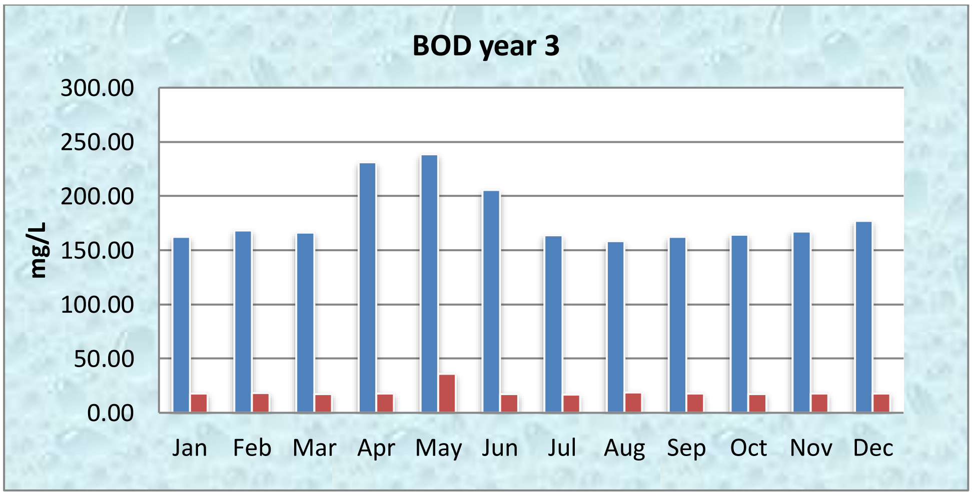

Figure No. 3: BOD of each month showing the mean value in influent and effluent of year 3