Biochemical Oxygen Demand

A bioassay test, involving measurement of oxygen consumed by micro-organisms while stabilizing biologically decomposable organic matter under aerobic conditions

Need

- To determine the pollution load of waste water
- The degree of pollution in water sources
- Self purification capacity of sources
- Designing of treatment facilities
- Efficiency of waste water treatment methods

Methodology

Principle

- The BOD test is based upon determinations of dissolved oxygen
- It can be measured directly
- In general, a dilution procedure is applied.

Procedure

Preparation of dilution water

- Aerate the required volume of D.W. by bubbling compressed air for 1-2 days to attain D.O. saturation
- Add 1 ml each per litre of dilution water
  Phosphate buffer
  Magnesium sulphate
  Calcium chloride
  Ferric chloride
- Mix well
- In case, waste not expected sufficient bacterial population, add seed (2 ml settle sewage / litre of dilution water)

Determination of D.O.

i) Samples and ii) Blank, on initial and after 5 days

- 2 ml $MnSO_4$ + 2 ml Alkali-iodide-azide+stopper immediately
- Mix well + allow the ppt. to settle
- Add 2 ml concentrated $H_2 SO_4$ + mix well till ppt. dissolve
- Take 203 ml (correspond to 200 ml) sample in a conical flask
- Titrate against sodium thiosulphate (0.025 N) till pale yellow colour + starch solution + blue colour + titrate till colourless

Observations

D_0 = D.O. in sample on 0^{th} day

D_1= D.O. in sample on 5^{th} day

C_0 = D.O. in Blank on 0^{th} day

C_1 = D.O. in Blank on 5^{th} day

$C_0 - C_1$ = D.O. depletion in dilution water alone

$D_0 - D_1$ = D.O. depletion in sample + dilution water

$(D_0 - D_1) - (C_0 - C_1)$ = D.O. depletion due to microbes

Calculation

1 ml of 0.025 N sodium thiosulphate = 0.2 mg of Oxygen

$$\text{D.O. in mg/l} = \frac{(0.2 \times 1000) \times \text{ml of thiosulphate}}{200}$$

B.O.D. in mg/l $(D_0-D_1) - (C_0-C_1)$ mg **X** Decimal fraction of sample used

Results

B.O.D. 5 days at 20^0 C = mg/l

Interferences

- Ferrous ion
- Ferric ion
- Nitrate
- Microbial mass
- High suspended solids
  - Lack of nutrients in dilution water
  - Lack of acclimated seed organisms
  - Presence of heavy metals
  - Presence of toxic materials

Bacteriological Analysis

Bacteria

Single cell microscopic organisms lacking chlorophyll

Coliform group

Contamination

- **Insanitary condition of surrounding area**
- **Unhygienic practices**
- **Discharge/seepage of sewage and domestic wastewater**

Need

- **Impact on water quality**
- **Potability for human consumption**
- **To prevent water-borne diseases**
- **To assess the quality of raw and treated water**
- **Specially to detect Faecal Contamination**

Bacteriological analysis : mainly includes estimation of

- **Total coliforms**
- **Faecal coliforms**

Methodology

Approved techniques generally used as per "Standard Methods for the examination of water and wastewater”

- **.Membrane Filter (MF)**
- **Multiple Tube Dilution (MTD)**

MF-technique

Principle

Biochemical reactions are used to detect the various groups of micro-organisms

MF-technique - Merits

- **Results in 24 hours (MTD - 48 to 96 hours)**
- **Larger volume of samples can be tested (MTD - less volume)**
- **Results with greater precision (MTD - MPN)**
- **Require less laboratory space (MTD – More space)**
- **Easy processing (MTD – Tedious)**
- **Useful during normal and emergencies (MTD – Difficult in emergencies)**

Limitations : Samples with more turbidity

Colour

- Coloured water is not acceptable for drinking (Aesthetic as well as toxicity reasons)
- Industrial wastewater require colour removal before discharge into water courses

Definition

- The term colour means true colour that is the colour of water from which turbidity has been removed. True colour of water is due to dissolved material
- Apparent colour is due to suspended matter as well as due to substances on solution removed by filtration

Unit for Measurement of colour

- Unit for colour measurement is based on platinum cobalt scale

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Methods for Colour Measurement

Visual Comparison Method

- Colour of the sample is determined by visual comparison with known concentration of coloured colutions prepared by diluting stock platinum cobalt solution
- OR properly calibrated glass coloured disk is used for comparison
- This method is useful for potable water and water in which colour is due to naturally occuring materials
- This method is not applicable to most highly coloured industrial wastewater

Spectrophotometric Method

- This method is applicable to potable and waste both domestic and industrial
- In this method light absorbed or transmitted is measured at dominant wavelength of a particular hue of sample
- Spectrophotometer should have an effective operating range from 400 to 700 nm before measurement remove turbidity either by filtration or by centrifuging

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- Colour hues for dominant wavelengths ranges are