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DEPARTMENT OF CHEMISTRY

Chemical Oxygen Demand

COD is defined as the number of milligrams of Oxygen required for the oxidation of both biologically and chemically oxidizable impurities present in 1000 ml of waste water using strong oxidizing agent like $K_2Cr_2O_7$.

Determination of COD

Aim: To estimate the amount of **Chemical Oxygen Demand** present in the supplied sewage sample by redox reaction.

Apparatus: Round bottom flask, water condenser, Burette, pipette, conical flasks and funnel.

Chemicals: Potassium dichromate, 1:1 sulphuric acid, mercuric sulphate, silver sulphate and ferrous ammonium sulphate (FAS) and ferroin indicator.

Theory:

Chemical Oxygen Demand represents the total amount of oxygen required to oxidize all oxidizable impurities present in a sample of sewage wastes. COD is always greater than BOD since in COD measurement, both biodegradable and non-biodegradable load are completely oxidized. The difference in COD and BOD is equivalent to the quantity of biologically resistant organic matter.

COD is a satisfactory quantitative method for measuring total organic load. It is preferable to BOD as the results are reliable. COD is a rapidly measurable parameter and needs 2 hours for completion.

Procedure:

1. **Sample Titration:**

A definite known volume (‘**Vs**’ ml) of **sewage sample** was pipetted out into a round bottom flask. A **definite known excess of $K_2Cr_2O_7$** was pipetted out into the same round bottom flask. To the reaction mixture, one test tube of **1:1 H_2SO_4** containing **$HgSO_4$** and **Ag_2SO_4** was added ($HgSO_4$ prevents Cl^- ion interference and Ag_2SO_4 catalyzes the oxidation of organic compounds). The round bottom flask was fitted with a **water condenser** and the reaction mixture was **refluxed for 2 hours**.

DEPARTMENT OF CHEMISTRY

The above reaction mixture was cooled and transferred into a conical flask. Now, **4-5 drops** of **ferroin indicator** was added and the **reaction mixture** turns into **blue-green colour**. The **reaction mixture** was **titrated** against **ferrous ammonium sulphate** taken in the burette until a **sharp colour changes from blue-green to red-brown.** Note down the burette reading (**'A'** ml**)**.

Burette Level	**Burette Reading**
Final level	
Initial level	
Difference	**…'A' ml**

2. **Blank Titration:**

Same volume of **$K_2Cr_2O_7$** was pipetted out into a conical flask. To this, one test tube of **1:1 H_2SO_4** containing $HgSO_4$ and Ag_2SO_4 and **4-5 drops** of **ferroin indicator** were added and the **reaction mixture** turns into **blue-green colour.** This **reaction mixture** was **titrated** against **ferrous ammonium sulphate** taken in the burette until a **sharp colour changes from blue-green to red-brown.** Note down the burette reading (**'B'** ml**)**.

Burette Level	**Burette Reading**
Final level	
Initial level	
Difference	**…'B' ml**

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Calculation:

Volume of sewage sample taken = '**Vs**' ml

Normality of reaction mixture (sewage sample) in terms of COD = **Ns**

Volume of FAS consumed in sample titration = **A** ml.

Volume of FAS consumed in blank titration = **B** ml.

Volume of $K_2Cr_2O_7$ consumed in satisfying COD in terms of FAS solution = $\mathbf{V_{FAS}}$ = (**B-A**) ml

Normality of FAS solution = $\mathbf{N_{FAS}}$

Chemical Oxygen Demand (COD):

$\mathbf{V_{FAS}}$ = (**B-A**) ml

$V_S N_S = \mathbf{V_{FAS}} N_{FAS}$

$$\mathbf{N_S = V_{FAS} N_{FAS} / V_S}$$

Chemical Oxygen Demand of sewage sample = **COD** = Normality of reaction mixture (sewage sample) in terms of COD x Equivalent weight of Oxygen x 1000 ppm

$$\mathbf{COD = N_S \times 8 \times 1000\ ppm.}$$