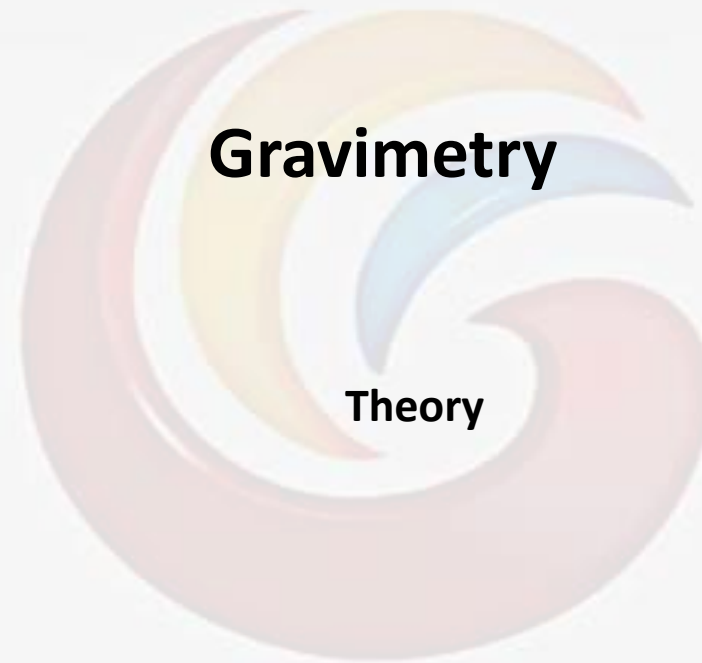


School of Basic and Applied Science

Course Code : MEV303

Course Name: Techniques in E



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Solids Measurement by Gravimetry

□ Objective

- to understand the difference between the various Solids fractions that occur in Water, Effluent and Sludge.
- To know their method of measurement and their importance and applications in Environmental Engineering.

- Gravimetry
- Total Solids
- Suspended Solids
- Settleable Solids
- Fixed and Volatile Solids
- Environmental Significance

Principles of Gravimetry

- Is the analysis “*using gravity*”
- Analysis by weight
 - labour intensive
 - sensitive to procedure
- Analytical balance
 - very sensitive, (0.0001g)
 - keep scrupulously clean

Principal steps

- Preparation of crucible or filter
 - weight or Tare determined
 - repeat to constant weight
- Addition of sample and drying
 - temperature crucial
- Cooling in desiccator
 - sampled must be weighed at room temp.
 - desiccant required
- Weighing to constant weight

Total Solids (TS)

- All solids in the sample (Water or Sludge)
- Sample added to a tared container
- Dried in water bath
 - Then dried at 103 - 105 C
- Cooled, desiccated, weighed
- Not many direct applications
 - measuring combined species
 - usually need to look at specific fractions

Total Dissolved Solids (TDS)

- Filtrate from a specified filter
- Dried at 180 degree C
 - removes water of hydration from salts
 - Used where organic conc low
 - TDS can be related to individual ion species
- Related to number of ions in water
- Therefore related to electrical conductivity (EC)
 - ability of water to carry an electric current
 - units $\mu\text{S}/\text{cm}$ (micro Siemens per cm)
 - $\text{TDS (mg/l)} = \text{EC} \times \text{ratio } 0.55 \text{ to } 0.7$

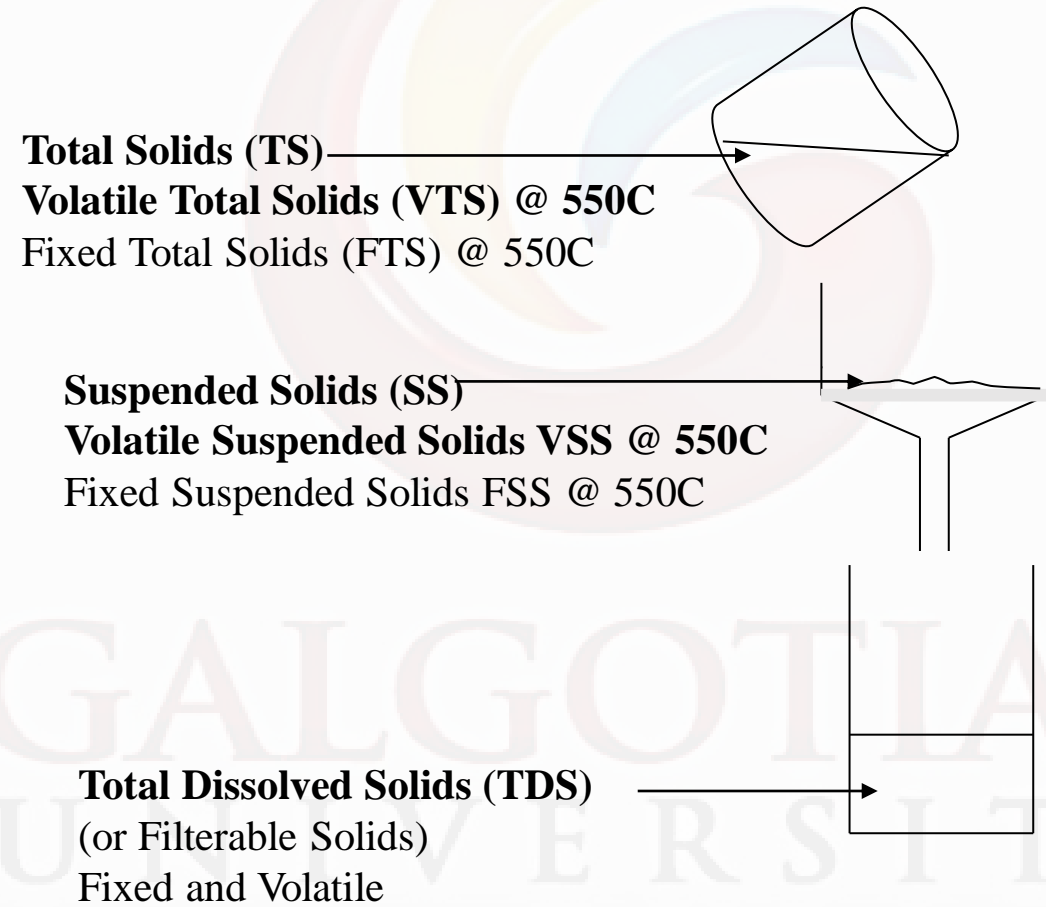
Suspended Solids (SS)

- Particulate matter in suspension
- Subject to error
- Glass fibre filter washed, dried and Tared
 - choice of filter crucial and arbitrary
 - anything trapped on filter = '*suspended*'
 - anything passing filter = '*dissolved*'
- Drying Temperature 103 - 105 C
 - less loss of organic matter, more retention of water
- Very Important Parameter
 - indicates suspended organic matter content of a treated wastewater (30 mg/l)
 - related to turbidity

Fixed and Volatile Solids

- **Measure of organic (volatile) and inorganic (fixed)**
- **Use sample residue of SS, TDS or TS)**
 - to give FSS, VSS etc.
- **Place in muffle furnace 550 C (temp crucial)**
 - Organic matter oxidised is the volatile solids
$$\text{C}_2\text{H}_5\text{NH}_2 + \text{O}_2 \longrightarrow \text{CO}_2, \text{H}_2\text{O}, \text{NO}_2$$
 - Inorganic matter remains - called **Fixed Solids**
(except MgCO_3 decomposes at 350 C to $\text{MgO} + \text{CO}_2$)
(ammonium bicarbonate is also volatile)
- **Volatile Suspended Solids (VSS) used in design and control of wastewater treatment.**
 - indication of the mass of microorganisms
 - e.g. $F/M \text{ ratio} = \text{BOD}/(\text{VSS} \times \text{HRT})$
 - regulating mean cell-residence time

Solids in Water



Settleable Solids (of Sludge)

- **The solids which settle in Imhoff cone in 60 minutes.**
 - report as **ml/litre** (direct reading)
- **Alternatively, The difference between Total Solids content before and after 1 hour settling.**
 - Report as **mg/litre**
- Used in assessing settleability of activated sludge
- Sludge Volume Index (SVI)

$$SVI = \frac{V_s}{M_s}$$

V_s is volume of settled sludge (ml/l)
 M_s is suspended solids (g/l)

Typical Activated sludge has SVI of 50 - 100 ml/g

Environmental Significance

- **Water Supply**

- In clean water, Dissolved Solids = Total Solids
- Desirable range for Total Solids
 - 50 - 500 mg/l (Max 1000 mg/l)
- Measurement of TDS by conductance is simple
- Suspended Solids estimation by Turbidity.

Environmental Significance

- **Polluted Water and Wastewaters**
 - Assessment of river pollution (Suspended Solids, Settleable Solids)
 - Final Effluent - Consent to discharge (Suspended Solids)
 - Industrial Wastewater
 - Total Solids (fixed, shows suitability for AD)
 - Total Solids (Volatile, = Organic load, c.f. COD, TOC, shows aeration requirements in AS)
 - Settleable Solids - Design and performance of Sedimentation units (SVI of AS liquor).

Environmental Significance

- **Sludges**

- Total and Volatile Solids give a good indication of Total and Volatile Suspended Solids (dissolved matter is negligible)
 - Design and operation of sludge treatment processes:
 - consolidation tanks (thickening)
 - Filter-press
 - Incineration
 - stabilisation by Anaerobic Digestion.

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