EWCE-332
Environmental Engineering Sessional

Credit 1.5

Department of Environmental, Water Resources, and Coastal Engineering

Experiment No. 4

Determination of TS, TDS and TSS in water

INTRODUCTION

- **Total solids** is a measure of the suspended and dissolved solids in water.
- **Total Suspended Solids** (TSS) are solids in water that can be trapped by a filter.
- **Total Dissolved solids** refer to any minerals, salts, metals, cations or anions dissolved in water – the portion that passes through the filter.

Total solids are nothing but summation of total dissolved solids and total suspended solids

- The term '**solids**' is generally used when referring to any material suspended or dissolved in water or wastewater that can be physically isolated either through filtration or through evaporation.

- Solids can be classified as either filterable or non filterable. Filterable solids may either be settleable or non-settleable. Solids can also be classified as organic or inorganic.

- Total solids is the term applied to the material residue left in the vessel after evaporation of a sample and its subsequent drying in an oven at a defined temperature.

In environmental engineering, solids are measured in -

- Drinking water
- Polluted water
- Domestic and industrial wastewater
- Sludge produced in treatment processes



Total Solids

Total solids of the sample is the matter left behind after drying a sample of water at 103-105 °C.

- The residue remaining upon evaporation
- All matter except water
- Metal salts, inorganic salts, organic material, insoluble salts, soluble salts, etc.

Suspended vs Dissolved

- TSS are the part of the sample that may be caught with a 0.45 μm filter

- TDS are the part of the sample that will pass through the filter

- In drinking water:

- Mostly dissolved (inorganic salts, dissolved organics)
- Range: 20-1000 mg/L
- As TDS↑ hardness ↑

ENVIRONMENTAL SIGNIFICANCE

- Potable water should not contain more than 1000 mg/L of TDS
- For drinking water use, dissolved solids < 500 mg/L is most desirable
- Excessive scaling in water pipes, water heaters, boilers and household appliances.
- Total solids affect water clarity. Higher percentage of solids decrease the passage of light through water
- Imparts taste to water
- Adverse impacts on irrigated crops, plants and grasses

THEORY ON EXPERIMENTAL METHOD

- When water with solids is kept at 103 - 105^{o}C for 24 hours, the water gets evaporated and the solids either in dissolved state or in suspended state remain as residue.
- A rapid assessment of the dissolved solids content of water can be obtained by specific conductance measurements.

- **Conductivity** of a substance is defined as 'the ability or power to conduct or transmit heat, electricity, or sound'.
- Pure water is not a good conductor of electricity. Because the electrical current is transported by the ions in solution, the conductivity increases as the concentration of ions increases. Thus conductivity increases as water dissolved ionic species.

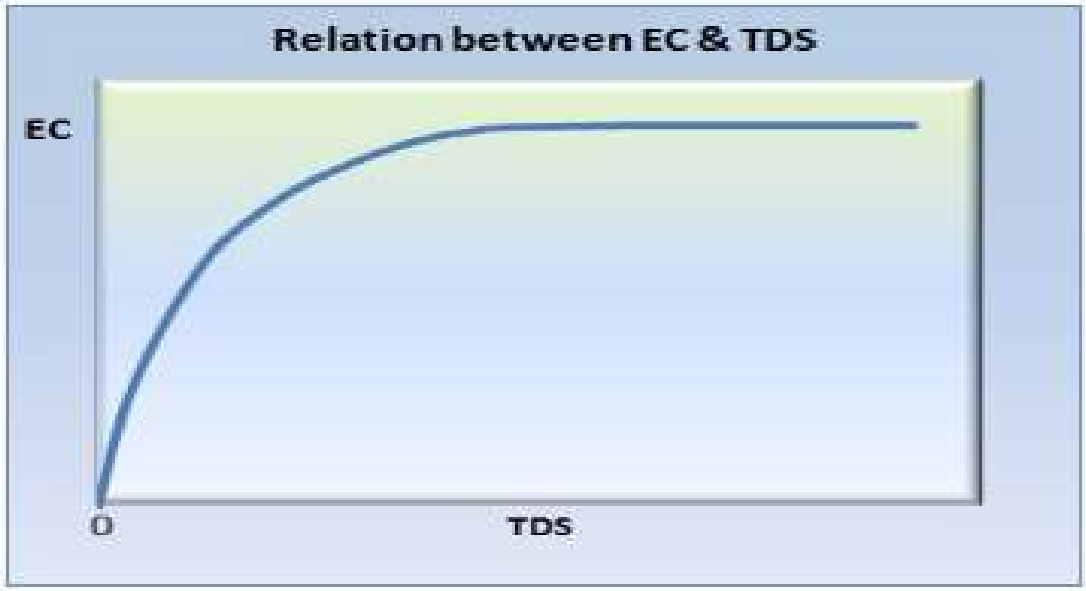
- The electrical conductivity of the water depends on the water temperature: the higher the temperature, the higher the electrical conductivity would be. The electrical conductivity of water increases by 2-3% for an increase of 1 degree Celsius of water temperature. Many EC meters nowadays automatically standardize the readings to 25^{o}C.

- Since the electrical conductivity is a measure to the capacity of water to conduct electrical current, it is directly related to the concentration of salts dissolved in water, and therefore to the Total Dissolved Solids (TDS). Salts dissolve into positively charged ions and negatively charged ions, which conduct electricity.
  Since it is difficult to measure TDS in the field, the electrical conductivity of the water is used as a measure.

- The electrical conductivity of the water can be determined in a quick and inexpensive way, using portable meters.

- Distilled water does not contain dissolved salts and, as a result, it does not conduct electricity and has an electrical conductivity of zero.

- Nevertheless, when the salt concentration reaches a certain level, electrical conductivity is no longer directly related to salts concentration. This is because ion pairs are formed. Ion pairs weaken each other's charge, so that above this level, higher TDS will not result in equally higher electrical conductivity.



- EC can be converted to TDS using the following calculation:
- TDS (mg/L) = 0.64 X EC (µS/cm)
- This relation provides an estimate only.

Measurement of TS:
Total Solids, TS (mg/L) = [Solid residue(mg) / volume of sample taken(mL)] x 1000

Measurement of TDS:
Total Dissolved Solids, TDS (mg/L) = [Solid residue(mg) / volume of sample taken(mL)] x 1000

Measurement of TSS:
Total Suspended Solids, TSS (mg/L) = TS(mg/L) – TDS(mg/L)