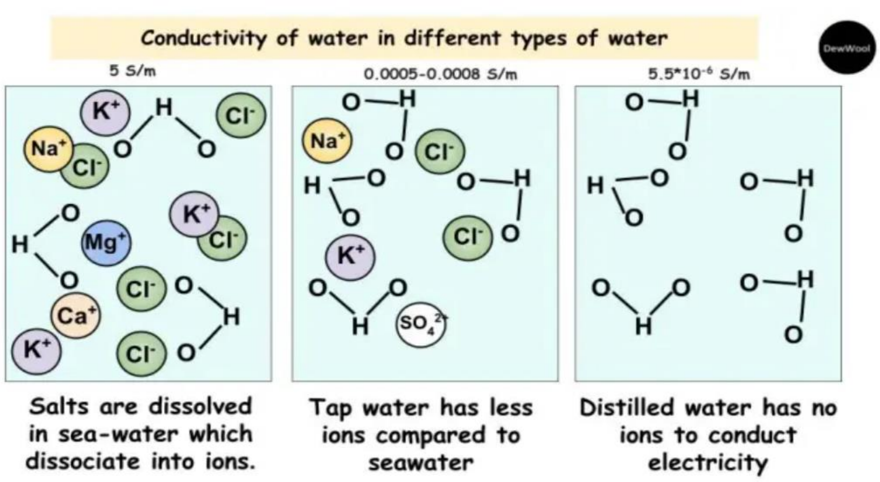
Comparison between EC and TDS for water samples taken from springs, rivers, and wells.

I. Electrical Conductivity (EC).

Electrical conductivity measures the capacity of water to transmit an electrical current. This capacity is directly related to the concentration of salts in the water. The presence of ions in the water enables it to conduct electricity. Salt dissolved in water dissociate into ions and increase the conductivity of the solution. The conductivity is also affected by the temperature and concentration of the solution. When chemicals or salts dissolve in water as negative and positive charge ions, these free ions in water conduct electricity, therefore electrical conductivity depends upon the concentration of ions. Conductivity is less for pure water (therefore it's not a good conductor of electricity).



The unit of measurement is **microsiemens per cm (µS/cm)**.

(1µS/cm = 1 µmho/cm), (1 dS/m = 1 mS/cm) ,(1 dS/m = 1 000 µ S/cm),

(1000 µ S/cm = 1 mS/cm)

Factors Affecting the Electrical Conductivity of Water.

1. **The concentration of dissolved ions.**

   An electrolyte consists of dissolved ions (such as Na^+ and Cl^-) that carry electrical charges and can move through water. Water with more ions present can conduct a greater amount of current. This is because conductivity increases as water dissolves more ionic compounds due to the ions transporting an electrical current in the solution.

2. **Ion valence.**

   Different ions have different abilities to transmit charge. Inorganic ions tend to conduct electricity well. This depends on factors such as the charge of the ion, its size, and its tendency to interact with water molecules. Organic substances tend to make poorer electrolytes than inorganic substances largely because they have a relatively weak tendency to dissociate into ions.

3. **Temperature.**

   This is a relatively small, but significant effect. Because ions can move faster in warmer water, the conductivity of water increases with rising temperature. For this reason, electrical conductivity is always reported at a reference temperature of 25°C. **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°C, if it does not, the measurement of the water EC should be taken at 25°C.

EC taken in the field temperature is converted using the following formula:

$$\mathbf{EC_{(25)} = EC_{(t)} - 0.02\,(T-25)\,EC_{(t)}}$$

Where: $\mathbf{EC_{(25)}}$ = Electrical Conductivity at 25 ^{0}C in (µS/cm).

$\mathbf{EC_{(t)}}$= Electrical Conductivity at field temperature in (μ S/cm),

T= field temperature

Electrical conductivity measurement:

Turn on the EC meter and calibrate the probe using a standard solution of known conductivity (To make accurate measurements, a conductivity instrument is usually calibrated using potassium chloride (KCl) solutions of known concentration Typically, a standard composed of 0.01 M KCl is used, which has a conductivity of (1412 µS/cm at 25°C). Be sure to washing the probe completely before and after calibration using deionized water. EC meters should be calibrated before each use (not between each sample itself) or when measuring a large range of EC.

Submerge the probe into the sample and wait until the EC reading on the meter stabilizes, Record the measurement when the EC reading is stable.

Correct the measured EC value of sample according to the temperature conversion factor which exist in a special table.

$\mathbf{EC_{25} = EC_t \times \mathit{f}T}$ $\quad\quad$ fT = Temperature conversion factor

II. Total dissolved solids (TDS).

Total dissolved solids (TDS) are the measure of all organic and inorganic substances dissolved in a given liquid. There are several different uses for TDS: it can measure pollution levels in lakes and rivers or mineral levels in drinking water, for example, and also has agricultural applications in irrigation.

Measuring TDS:

The two principal methods of measuring total dissolved solids are **conductivity** and **gravimetry**.

1.Using an Electrical Conductivity Meter.

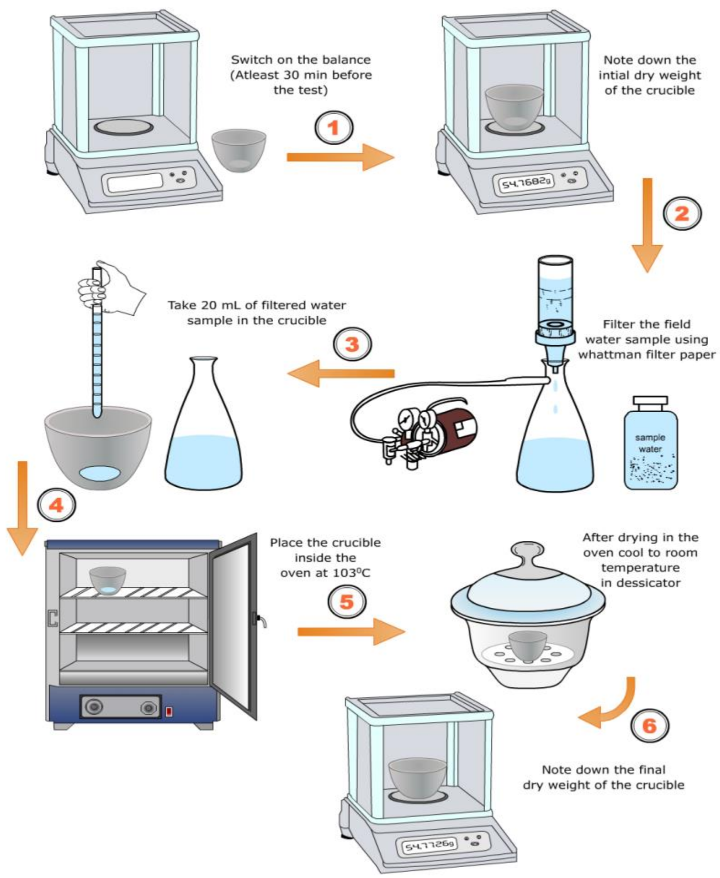
A measurement of conductivity (which is quick and easy) can be used to estimate TDS (which is more expensive and time-consuming to measure directly). The general equation for estimating TDS from conductivity is as follows:

$$\textbf{TDS (ppm)} = 0.64 \times \textbf{EC} (\mu S/cm) = 640 \times \textbf{EC} (dS/m)$$

2. Gravimetric method.

Gravimetric methods are the most accurate and involve evaporating the liquid **solvent** and measuring the mass of residues left. This method is generally the best, although it is time-consuming.

Procedure chart of gravimetric method



Calculation

Description		Weight(g)
Weight of the clean porcelain evaporating dish(g)	W1	
Weight of the dish and the residue (g)	W2	
Weight of residue (g)	W	
Volume of the sample(ml)	V	
Total Dissolved Solids(mg/L)	TDS	

Classified water according to Electric Conductivity (EC) and (TDS) .

1. **Scofield's classification (1935).**

Water class	EC µmhos cm^{-1} at 25 °C	Total salts ppm	Na^{+} %	Cl^{-} (mmol$_c$ l^{-1})	SO_4^{2-} (mmol$_c$ l^{-1})
Very good	< 250	< 175	< 20	< 4	< 4
Good	250-750	175-525	20-40	4-7	4-7
Can be used	750-2000	525-1400	40-60	7-12	7-12
Use with caution	2000-3000	1400-2100	60-80	12-20	12-20
Harmful	> 3000	> 2100	> 80	> 20	> 20

2.Train classification (1979)

Train classified irrigation water depending on TDS into four classes as follow:

TDS (ppm)	Comments
500	Use in irrigation no hazard
500-1000	Not suitable for sensitive crop
1000-2000	Usage it need to experience
2000-5000	Use for tolerance plant to salinity