Measurement of Salinity

Australian Water Quality Centre

Sampling Requirements:

- 600mL PET bottles
- No air gap
- Transport & store at 4^{0}C

Measurement of Salinity/Total Dissolved Solids

Background

The Australian Drinking Water Guidelines (ADWG) state that "based on taste, total dissolved solids in drinking water should not exceed 500 mg/L."

Salinity is a measure of the total concentration of inorganic ions (salts) in a water sample. The major species include calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), chloride (Cl), bicarbonate (HCO3) and sulphate (SO4). Other contributions can be made from silica, organic matter (hence the use of the term "solids" rather than "salts"), fluoride, iron, manganese, nitrate, nitrite and phosphate.

There is some confusion over the reporting of the total dissolved substances in waters. Commonly used terms include "total dissolved salts", "total dissolved solids", "salinity", "filterable residue" and "total dissolved salts by evaporation". These all have units of mg/L. Conductivity reported as EC units (microsiemens /centimetre or µS/cm) at 25^{o}C is an indirect measurement of salinity.

There are essentially five ways to estimate the salt content of a water sample. Measurement by density and refraction are now rarely used by general water laboratories and the other three are listed below.

Electrical conductivity measurements are the most commonly used, both in the laboratory and in the field.

1. Complete chemical analysis – sum of the major cations (Ca, Mg, Na, K) + major anions (Cl, HCO3 (expressed as CO3), SO4 + any other significant ions.

The term used by AWQC for this is DSC (Dissolved Salts Calculated, mg/L), also known as "summation of ions".

2. Estimation from electrical conductivity (EC) measurements and the application of an empirical formula to convert from conductivity to total dissolved salts.

The term used by AWQC is Total Dissolved Solids (TDS mg/L) by EC.

3. Evaporation of a known volume of a filtered sample and weighing the residue.

The term used by AWQC is TDS by evaporation (mg/L). This is also known as "filterable residue".

Option 1 is the most expensive but in natural waters will give the most accurate result; option 2 is the easiest and most convenient while option 3 is generally more useful in higher salinity samples.

Oceanographers use a standard known as the Practical Salinity Scale (PSS-78), introduced in 1978 and based on conductivity. This approach has not been used at AWQC, instead relying on the empirical formula or algorithm which was based on the results from the detailed analysis of many hundreds of samples ranging from rainwater through surface, ground waters to seawaters and higher. Sample conductivity readings were plotted against DSC data to obtain this relationship.

Conductivity measurements are based on the contributions of individual ionic species. Consequently, one can have two samples with the same salinity as measured by DSC but with different conductivities because while the total salts are the same, the relative amounts of individual ion species can be different.

To get a better conductivity/salinity relationship for a particular water type (eg Coorong samples) rather than using the generic algorithm, a unique relationship can be generated by plotting conductivity measurements against DSC.

The measurement of conductivity is performed by using a conductivity cell and a meter. The newer type of conductivity cell has a 4-pole arrangement that gives enhanced performance, particularly at higher conductivities. For example, a probe calibrated at 718 µS/cm will give a reading of 112,300 µS/cm for a 111 900 µS/cm standard (error of only 0.4%) and the upper limit is claimed to be 500 000 µS/cm.

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