

TOTAL DISSOLVED SOLIDS VS TOTAL DISSOLVED SALTS

The term TDS is usually taken to mean Total Dissolved Solids, but the method used may actually be measuring Total Dissolved Salts. There is a subtle difference, which in most cases may not be important but in some cases could be quite critical.

Methods used for TDS

True Total Dissolved Solids (APHA 2540C)

The usual method for Hill Labs is: Weigh a large beaker, add, say, 4-500 mL water and evaporate to dryness in an oven (note that it takes two days to carefully dry down 4-500 mL water, without boiling, and this generates a lot of water vapour).

The weight of the beakers used is about 150 g. A 3 dp balance would be working at around 150.001 g, for a difference of 0.001. 3 dp balances have an 'error' in the last figure, so one is really pushing things. A 4 dp balance is not usually that good for weights over 100 g. Our detection limit of 10 mg/L is determined by the usual method of analysing a minimum of 9 samples over several days and calculating the DL from the standard deviation of results using a standard formula.

From the Electrical Conductivity

There are other methods for determining "Total dissolved salts" [not the same as Total Dissolved Solids – see below]. One is by determining the conductivity and then applying a 'calculation factor', eg 0.67, which is site dependent. This factor should be determined experimentally for each site, but a figure about 0.67 is often used as a compromise. If we applied this factor to our EC detection limit of 1 mS/cm we would have a 'Salts' (our term for this test) DL of about 1.3. We are happy to offer this as an alternative, and there would be no charge if we were already measuring the conductivity as quoted in our anion/cation suite.

By Calculation

Another method is to add up the contribution from all the species determined [APHA 1030 E]. There are only a limited number of ionic species specified for the calculation (eg iron is NOT included) so again this would not give the complete picture. We do carry out this calculation as part of our in-house QC checks on all samples where there is enough data.

But NEITHER of these last two methods will determine non-ionic species, and both are at best only estimates. For example neither method would account for dissolved tannins, protein, carbohydrate, metals, etc. Although these may be negligible in the samples under consideration, one should be aware of this, and they can be significant in trade wastes and effluents.

Reference

Electrical Conductivity and Total Dissolved Solids – What is Their Precise Relationship?/.

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Summary

The ability of RO plants to consistently produce water within the usual 500 mg/L WHO guidelines is a major factor in determining the longer term success of the plant, and is a principal criterion for guarantee and contractual obligations. However, since total dissolved solids (TDS) is not easily measured, except under controlled conditions in reputable laboratories, a common alternative is to utilise the simple permeate electrical conductivity (EC) reading and multiply by a standard correction factor (typically 0.7) to obtain the required TDS result. This paper demonstrates the considerable problems, both theoretical and practical, associated (but generally not appreciated) with these apparently simple measurements and shows that just one simple linear conversion factor cannot be suitable throughout the range of waters encountered in the desalination industry, but that several different K factors ranging from 0.50 to 0.75 need to be used for increasingly saline waters. The apparent simplicity of the TDS and EC measurements are shown to be illusory and much care is needed before taking contractual actions based upon these results.

Keywords: *desalination, reverse osmosis, distillate, permeate, water quality measurement, electrical conductivity, total dissolved solids, water chemistry.*

Introduction

Much confusion exists throughout water industry over this very simple but important question. It may come as a surprise to some workers in the desalination industry to find there is unfortunately no simple precise relationship between these two parameters although workers in every field of water studies from physical chemistry through electrochemistry, hydrochemistry, soil and irrigation science, hydrology, geochemistry to marine chemistry each claim to have the best approximation.

What they are actually using is a tolerable empirical approximation which appears to hold good within the range of ion concentrations and salinities that their particular subject deals with.

Engineers, preferring a simple onsite rule of thumb, often simply take the factor of 0.7 so often found on the fixed scales of commercial electrical conductivity – total dissolved solids (EC-TDS) meters and think little more about it.

The consistent use of just one K factor (typically 0.7), even though this is the average value between possible extremes of 0.5 to 0.9, can lead to errors of up to 30% in TDS estimation from just this one theoretical simplification alone.

Why lift the lid from this particular can of worms?

The need for greater accuracy in estimating TDS from EC results rather than using one simple factor to cover all cases is becoming increasingly important due to:

- i. Tighter new plant design criteria and specifications
- ii. Plant operation efficiency calculations
- iii. Contractual specification and guarantee requirements
- iv. WHO and local health requirements for potable water quality