Technical Reference

Beta Unit Conductivity Measurement and Temperature Compensation

CONDUCTIVITY MEASUREMENT

Concentration of a solution is measured by inserting a probe, consisting of two conductive elements into the solution. Conductivity measured between the two elements is directly proportionate to the solution concentration.

A probe with exposed electrodes is called a *conductive* probe. It is rugged and low cost, but requires periodic cleaning to maintain its accuracy. A donut-shaped probe with encapsulated wires is called an *inductive* probe. It requires little or no maintenance, but is costly and less rugged than the conductive probe. Most Beta dispensers and controllers are designed for conductive probes.

The unit of conductivity is the Siemen, but for solutions used for cleaning and sanitizing the conductivity is usually so low that it is in the micro Siemen range (µS or 10^{-6}S). Most of Beta's controllers function in the conductivity range of 660 to 12,800 µS.

The range of 660 to 12,800 µS is very large and difficult to understand. To simplify conductivity settings used in cleaning and sanitizing applications, the Beta Unit (BU) range was developed.

BETA UNITS

Definition

A Beta Unit (BU) is a unit of conductivity. Each BU is a 5% change in conductivity from the previous value.

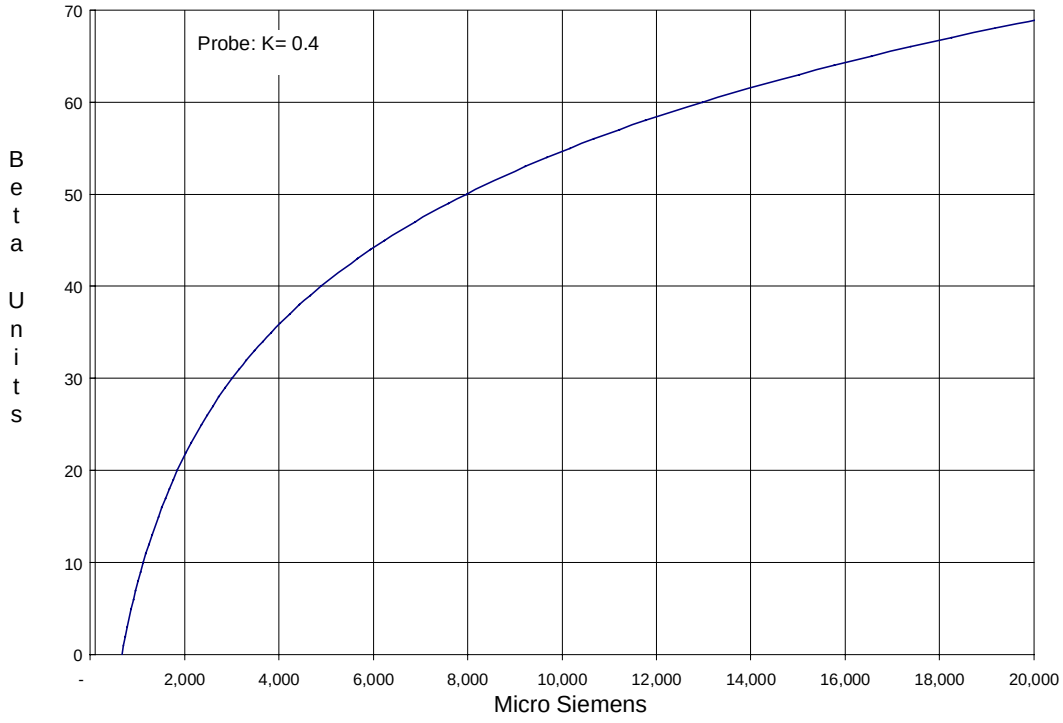
Example: If 30BU= 1gm/litre, then
31BU= 1.05 gm/litre
32BU= 1.103 gm/litre
33BU= 1.158 gm/litre

In this case, the 30BU = 1 gm/litre, but 60BU = 4.3 gm/litre—over four times as much, and NOT the 2 gm/litre it would be were it not compounded.

The change in conductivity from a particular BU to another varies depending on which range of the BU is being used. For example, changing from 10 to 11 BU may give a change of 50µS, but changing from 69 to 70 BU represents a change of 650µS.

A significant advantage of BU is that meaningful changes in concentration can be made by changing the setpoint just a few BU. However, the scale is fine enough to find a setpoint that corresponds to titration benchmarks.

Below is a graph illustrating the algorithmic progression of BU versus microSiemens (conductivity).



Graph: Beta Units/Micro Siemens

WHY IS TEMPERATURE COMPENSATION USED?

Conductivity is affected by the temperature of the solution. The degree of the effect depends on the actual ion being measured, and several other variables. For machine warewash applications, we assume that the predominate ion contributing to the conductivity is either sodium or potassium and in the typical concentrations and temperature ranges used in an machine warewash applications. As such, the average effect is about 1.9%/°C. All of our machine warewash controllers use an equation that approximates 1.9%/°C rate of change. Without temperature compensation, as the solution in the wash tank drops in temperature, the controller will feed extra detergent, and if the temperature rises above the original temperature, the controller will feed less detergent.

EXAMPLE 1

A dispenser (without temperature compensation) is setup when the machine is operating at 65°C for a concentration of 1.5 grams/liter. The wash tank's temperature drops to 50°C. The measured conductivity will also drop by 1.9%°C or 29% which will cause the dispenser to overfeed to 1.9 grams/liter. If the temperature dropped all the way back to room temperature (25°C), the dispenser would feed to a concentration of 2.6 grams/liter. In all cases, the Beta Unit (BU) reading would remain constant, even though the concentration had changed by 73%!

EXAMPLE 2

Temperature compensation allows setting of the setpoint at a titration level before the tank reaches its normal operating temperature. If you initially set the setpoint to 30°C, the dispenser will control to a different concentration once the temperature reaches 65°C. A 1.5 gram/liter concentration, measured at 30°C will end up being only 0.9 grams/liters at 65°C. The BU reading would remain constant.

THE TEMPERATURE COMPENSATION REFERENCE POINT

Note that Beta machine warewash controllers use a reference point of 65°C. With most conductivity-measuring instruments, the reference temperature is set at either 20 or 25°C, because so many measurements are done with room-temperature solutions. Therefore, if the reference temperature is 25°C and the solution is 25°C, then there will be no change in the conductivity reading if the temperature sensor is disconnected and the unit reverts to an uncompensated mode. Because the normal solution in a machine warewash tank is 65°C rather than 25°C, all Beta controllers use 65°C as the reference temperature. As such, if you test the temperature compensation effect of a Beta dispenser with the solution at 25°C, there will be a notable increase in the BU reading with the temperature probe than without.

THE RANGE THAT CAN BE HANDLED

All Beta machine warewash units that measure temperature have a range of 0 to 99°C, and the temperature compensation equation will work over this entire range. The BU range is limited to 70 BU. Therefore, if you're measuring a cold solution (e.g. 10°C), and are getting a reading of 55 BU without temperature compensation, then you will not get a 73 BU reading when the temperature probe is connected as you might expect because the BU range is limited to 70 BU.

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