Conductivity Measurement in Chemical Concentration Control

Process

Numerous industrial processing applications require solutions of a specific chemical strength. In these applications, the target concentration is typically achieved by diluting a full-strength chemical solution with water. This dilution often occurs in a two-step batch process as illustrated in Figure 1.

First, a flow ratio controller is used to meter a specific ratio of water and full-strength solution into a mixing tank. The flow-ratio controller is set to produce a concentration slightly weaker than that which is desired. The flow-ratio controller should also warn operators if either the full-strength solution or the water lines stop flowing.

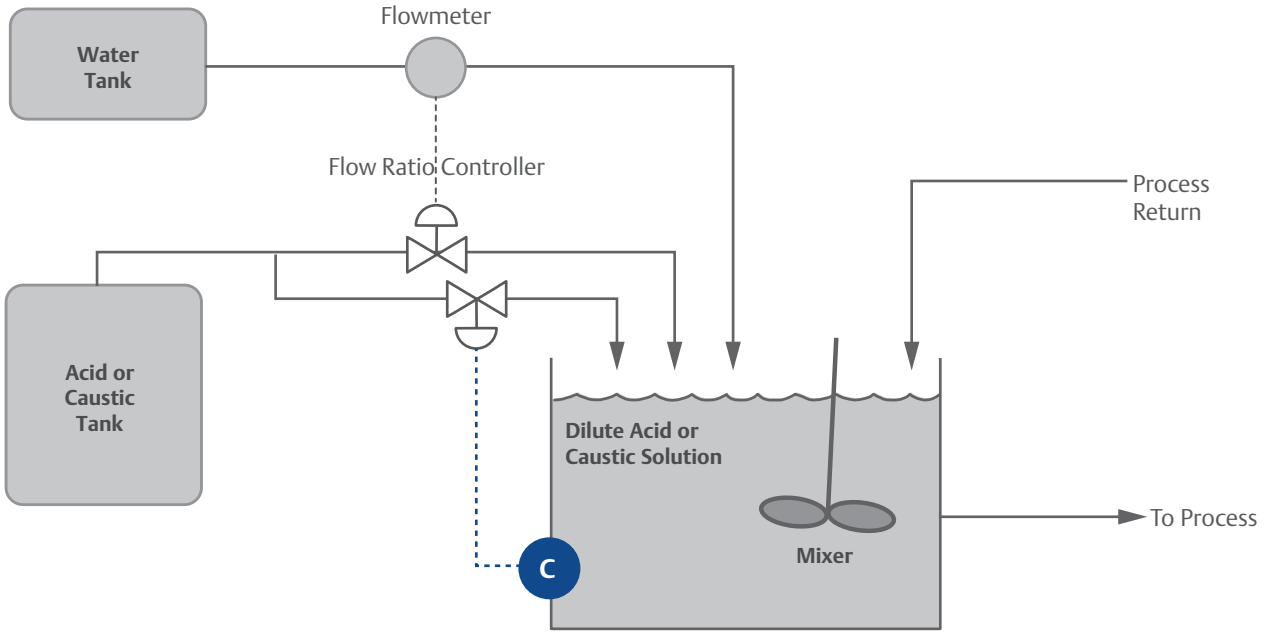
Second, a precise control valve receiving input from a conductivity sensor functions as a “trim control.” It adds a small amount of full-strength solution to the mixing tank to produce the exact concentration desired.

For example, to make a 35 % caustic solution from a large bulk caustic supply at 50 %, the flow ratio controller is adjusted to make a 30 % solution and the conductivity measurement is used to add additional caustic to make the 35 % solution.

Conductivity Measurement

Conductivity is an economical and widely used index of concentration for most acid, base, and salt solutions. To accurately interpret conductivity measurements, however, it is important to understand the range of concentrations that may be possible at the measurement point. A good conductivity application will have a significant change in reading over the possible concentration range and only one concentration value for any given conductivity reading.

Figure 1 - Two-Step Batch Dilution Process

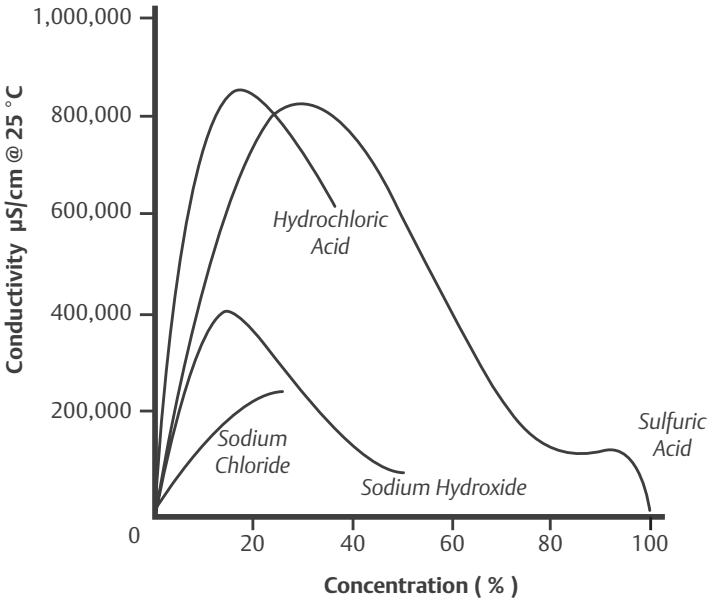


EMERSON

Generally, the conductivity of a solution increases with ion concentration. However, some exceptions arise for highly concentrated solutions. For example, the conductivity of caustic (NaOH) solutions decreases as concentration increases over 15 %.

In many cases, the relationship between conductivity and concentration for solutions of a single substance in water has been measured and can be referenced in a chart such as Figure 2. Conductivity versus concentration charts for many common solutions are available in Emerson's Conductance Data for Commonly Used Chemicals.

Figure 2 - Conductivity of Some Common Solutions



In mixtures, the total conductivity is usually close to the sum of the conductivity of each component of the mixture. However, the presence of significant amounts of certain substances (iron, copper, and some sugars, for example) can decrease the measured conductivity.

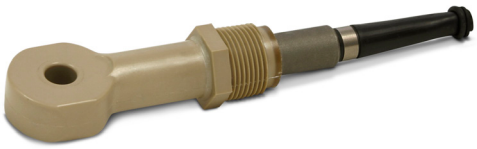
The relationship between ion concentration and conductivity also changes with temperature and therefore it is frequently stated at a reference temperature of 25°C (77°F). Temperature correction is specific to the application and can be very important when extreme and/or changing temperatures are likely.

The Emerson Solution

Chemical concentration control applications can be hard on conductivity sensors. High concentrations of acid or caustic can corrode the metal electrodes on contacting conductivity sensors. In many concentration control applications, such as cleaning solutions, the acid or caustic solution is recycled back to the concentration control mixing tank for re-use. This can lead to the accumulation of solids in the solution which can coat or plug the electrodes on contacting conductivity sensors, resulting in an unreliable measurement.

The Rosemount 228 Toroidal Conductivity Sensor is an excellent solution for most concentration control applications because it offers superior corrosion and coating resistance compared to contacting conductivity sensors. The Rosemount 228 is available in a chemical-resistant PEEK or ETFE (Tefzel™) body and a variety of mounting configurations. Rosemount also offers solutions for applications with special requirements such as the Rosemount 225 Toroidal Conductivity Sensor for sanitary processes, the Rosemount 226 Toroidal Conductivity Sensor with extra-large bore size, and the Rosemount 242 Flow Through Toroidal Conductivity Sensor.

All Rosemount conductivity sensors are compatible with all Rosemount Liquid Analysis transmitters, including the Rosemount 56 Dual Channel Transmitter which offers dual sensor inputs, a large full color display, built-in measurement and troubleshooting tips, and special features for measuring percent concentration using a conductivity sensor.



Rosemount 228 Toroidal Conductivity Sensor

Emerson.com/RosemountLiquidAnalysis

Linkedin.com/company/Emerson-Automation-Solutions
Twitter.com/Rosemount_News
Facebook.com/Rosemount
YouTube.com/user/RosemountMeasurement

00800-0200-4222 Rev AA

ROSEMOUNT™

EMERSON™