

## Percent Concentration Control

**Industry:** Refining, Food and beverage, Power, Oil and Gas, Pulp and Paper, Chemical  
**Product:** Inductive Conductivity Meters

### Introduction

There are numerous industrial applications where measurements and/or control of a specific chemical strength of the process is critical for optimizing the production of the end product. These specific concentrations are obtained by mixing a full strength solution with water to achieve the desired percent concentration.

### Concentration

The desired chemical concentration is achieved using a two stage mixing procedure. During the first stage, the flow ratio control unit on the mixing tank is set to provide (x) gallon per minute of the full strength solution and (y) gallons per minute of water. These values are adjusted to produce a concentration value which is slightly weaker than the desired value. This ratio control must include alarm capabilities to indicate "low flow" conditions for both the full strength solution and the water in order to prevent wasted chemicals or hazardous situations.

At the second stage, a conductivity sensor and analyzer function as a "trim control". This combination adds small amounts of full-strength solution to the mixing tank to produce the exact concentration desired.

For example, to produce a 4% caustic solution from a large bulk caustic supply at 50%, the flow ratio controller is adjusted to make a 3% solution and the conductivity information is used to add additional caustic to achieve the 4% concentration.

Conductivity is a very reliable index of the concentration for most acid and base (caustic) solutions. Figure 1 shows the correlation between conductivity and concentration for four common solutions.

For most solutions, there is a peak conductivity value. Before this peak value is reached, conductivity correlates positively with concentration; after the peak, it correlates negatively. So, if the concentration range passes through the peak for that chemical the conductivity value (except the peak value)

represents two different concentration values. Therefore, it is mandatory that any application near the peak of a particular solution be carefully controlled.

### Summary

Conductivity measurement is a reliable indicator of the concentration of most acid or base solutions. In determining the proper loop components for a particular application, the material of construction will be of primary concern. A chemical resistance chart should be consulted (see Table 1), or an application data sheet completed and sent to the factory in order to insure an installation that will be suited for the intended application.

Figure 1

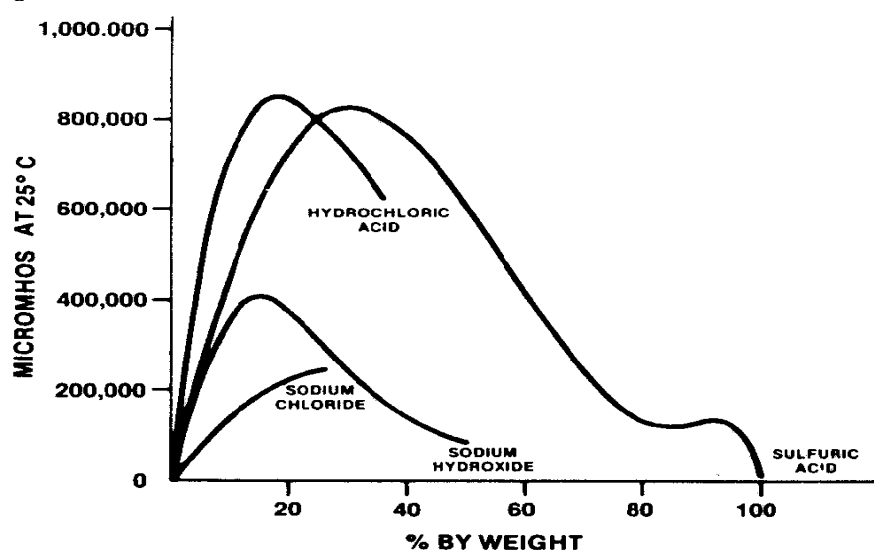


Table 1

	PVC	CPVC	PP	PVDF
Hydrochloric Acid (HCl) @36%	A <sub>3</sub>	A <sub>4</sub>	A <sub>4</sub>	A <sub>5</sub>
Sulfuric Acid (H <sub>2</sub> SO <sub>4</sub> ) @96%	A <sub>3</sub>	A <sub>3</sub>	B <sub>1</sub>	A <sub>3</sub>
Nitric Acid (HNO <sub>3</sub> ) @50%	A <sub>3</sub>	A <sub>3</sub>	B <sub>1</sub>	A <sub>2</sub>
Hydrofluoric Acid (HF) @40%	A <sub>2</sub>	A <sub>2</sub>	A <sub>3</sub>	A <sub>4</sub>
Sodium Hydroxide (NaOH) @50%	A <sub>3</sub>	A <sub>4</sub>	A <sub>3</sub>	X
Sodium Hypochlorite (NaOCl) with 15% Cl <sub>2</sub>	A <sub>3</sub>	A <sub>5</sub>	A <sub>1</sub>	X
Hydrogen Peroxide (H <sub>2</sub> O <sub>2</sub> ) @30%	A <sub>3</sub>	A <sub>2</sub>	A <sub>2</sub>	A <sub>5</sub>



## Product Recommendations

### Transmitter

2-wire conductivity measurement system ISC202  
 4-wire conductivity measurement system ISC450

### Sensor/ Holder

ISC40FS/ISC40FF Insertion of Flow-thru assembly  
 ISC40PR Retractable assembly  
 ISC40G General Purpose Sensor  
 ISC40S Intrinsically Safe Sensor

## Where are the Opportunities

You will find these applications in many industries. Demineralized water systems use caustic and acid solutions to regenerate the resin beds. The vegetable processing industry uses caustic solutions as a cleaning agent. Acid and caustic solutions are used in Clean-In-Place (CIP) systems to remove residue from process equipment without dismantling the systems. Solutions of acid and caustic are used to neutralize waste streams before discharge to municipal systems. Anywhere you find these acid and caustic solutions, you will find someone who is interested in their concentrations. Inductive Conductivity provides a reliable, maintenance free method to monitor, control, and transmit this value.

**Note:** For additional information or assistance on this application, please contact the Yokogawa Analytical Product Marketing.

