

## The Advantages of Percent Concentration Control

Industry: Refining, Food & Beverage, Power, Oil & Gas, Pulp & Paper, Chemical

Product(s): Inductive Conductivity Process Liquid Analyzer

### Application

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.

### Process

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.

### Challenges

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

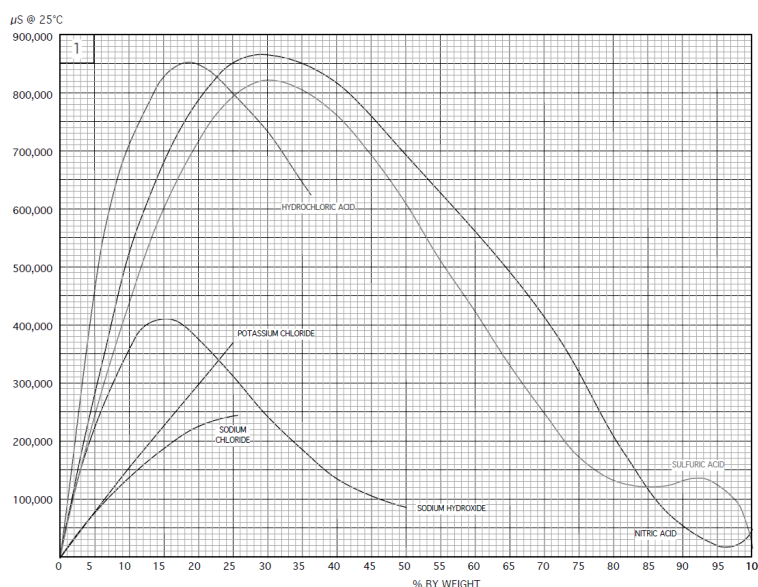


Figure 1. Chemical concentration curve, example.

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.

## Solution

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 Figure 2 as example), or an application data sheet completed and sent to the factory in order to ensure an installation that will be suited for the intended application.

			Material							
			PVDF (Kynar)	S.S. 316	VITON	PEEK	PP	PVC	PFA	
			Temp. °C % Conc.	20 60 100	20 60 100	20 60 100	20 60 100	20 60	20 60	20 60 100
Inorganic acid	Sulfuric acid	10	000	XXX	000	000	00	0X	000	
		50	000	XXX	000	00X	00	00	000	
		95	0X -	XXX	000	- - -	X -	XX	000	
		fuming	- - -	- - -	000	- - -	- -	- -	000	
	Hydrochloric acid	10	000	- - -	000	00X	00	0X	000	
		sat.	000	- - -	- - -	00X	00	00	000	
	Nitric acid	25	00X	XXX	00X	000	00	0X	000	
		50	00X	XXX	- - -	XXX	X -	0X	000	
		95	0X -	000	- - -	- - -	- -	- -	000	
	Phosphoric acid	fuming	- - -	000	- - -	- - -	- -	- -	000	
		25	000	- - -	000	000	00	0X	000	
		50	000	XXX	000	000	00	00	000	
Organic acid	Hydrofluoric acid	95	000	000	XX -	000	00	00	000	
		40	000	- - -	000	- - -	00	0X	000	
		75	000	- - -	000	- - -	00	XX	000	
	Acetic acid	10	000	00X	- - -	000	00	0X	000	
		glacial	0X -	00X	- - -	00X	0X	XX	000	
		Formic acid	80	000	XXX	- - -	XXX	00	0-	00X
		Citric acid	50	000	000	000	000	00	00	000

O = can be used, X = shortens useful life, - = cannot be used

**Note:** Information in this list is based on our general experience and literature data and given in good faith. However Yokogawa is unable to accept responsibility for claims related to this information.

Figure 2. Chemical compatibility chart, example.

## Key Advantage & Recommendations

One sensor that will measure the entire conductivity range. Since the sensor is non-contacting it is not affected by chemical attack and requires less overall maintenance.

### Conductivity Measurement System:

#### Process Liquid Analyzer:

- 2-wire FLEXA Inductive Conductivity Analyzer
- 4-wire FLXA402 Inductive Conductivity Analyzer

#### Sensor Selection:

ISC40G General Purpose Sensor

ISC40S Intrinsically Safe Sensor

- Available in PEEK and PFA material for more aggressive chemicals



**Note:** For additional information on this application contact the local Yokogawa Process Liquid Analyzer Department