

Chlorine Scrubber Sodium Hydroxide Control with Oxidation Reduction Potential



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Powell Oxidation Reduction Potential Instrumentation is the best available technology for the indication and control of sodium hydroxide concentrations for chlorine scrubbers on the market today. Powell technology has been successfully applied to chlorine scrubbing for over 50 years. Chlor-alkali productions plants such as Occidental Chemical and Olin Chemical in the United States, Sasol LTD in South Africa, Orica in Australia, Carbocloro in Brazil, Occidental in Chile and many other throughout the world use proprietary Powell Oxidation Potential Electrodes for this application.

When the correct electrode installation has been made using the Powell ORP electrodes, the silver/platinum electrode pair produce a millivoltage signal output according to the following formula:

 $E = E^{\circ} - \frac{0.0591}{2} \log \frac{(OCI^{\cdot}) (H^{+})^{2}}{CI^{\cdot}}$

Where E° is the standard oxidation potential for the reaction.

Since the electrode potential is primarily a function of the hydrogen ion concentration, a sharp inflection is noted at the reaction end point similar to that obtained by pH measurements.

Experience has shown that typical millivoltages in a chlorine scrubber starting with a typical 21% sodium hydroxide and reacting with chlorine will produce the following approximate mVDC signals with respect to the remaining sodium hydroxide versus the weight percent sodium hypochlorite. Data is shown in Table 1.



Table 1	Та	b	e	1
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Remaining Sodium Hydroxide vs Weight Percent Sodium Hypochlorite			
Wt. % NaOH	Wt. % NaOCI	ORP mVDC*	
21.34	0.00	0	
19.90	1.12	288	
18.47	2.31	311	
16.93	3.45	330	
15.49	3.50	345	
14.22	5.54	358	
12.88	6.81	372	
11.44	8.01	384	
9.90	8.88	396	
8.49	10.25	410	
7.00	11.27	424	
5.38	12.67	441	
3.95	13.59	460	
2.31	15.13	488	
1.48	15.58	507	
0.81	15.99	535	
0.42	16.44	561	
*Millivoltage Direct Current			

Using the above data, the Oxidation Reduction Potential Curve with the 21% by weight sodium hydroxide starting point can be represented as a graph, as shown in Figure 1. Using the proprietary Powell ORP electrodes any chlorine scrubber can be continuously or batch controlled at high sodium hydroxide levels as required by individual design of the scrubber.

Powell's customers have successfully controlled by using continuous and automatic control sodium hydroxide levels at typical levels such as 12% by weight with excellent results. Many customers chose to operate the scrubbers at much lower levels of sodium hydroxide such as 1.5% using Powell ORP electrodes either by batch or continuous.

If the system is automated with the application of automatic sodium hydroxide supply valves in conjunction with the ORP electrodes, process upsets can be easily and quickly managed.

On batch chlorine scrubbers, the ORP electrodes are used to provide information and alarms to inform the operators when to change batch sodium hypochlorite tanks in the scrubbing operation.



Problems with pH or Wetted ORP Electrodes

A common misapplication is to use a pH or wetted ORP electrode measurement in a scrubber using strong caustic (10-22% w/w NaOH). A typical pH/ORP sensor will have a shortened life due to the caustic dehydrating the pH glass. The electrolyte, used as a barrier fluid to protect the silver element of the negative electrode, can be poisoned in strong oxidizing solutions. The poisoning of the electrolyte can lead to a chemical attach of the silver element rendering the pH/ORP sensor useless.

Excess Caustic Measurement with pH

When a scrubber or hypochlorite production unit is charged with strong caustic (10-22% w/w NaOH), the initial caustic concentration is off scale (greater than 14 pH). The pH versus excess NaOH curve follows a strong acid/strong base titration curve, which results in a reading that only drops back on-scale near the point of complete depletion of the caustic, followed by a sudden drop at the depletion point. This makes the end point difficult to control with pH measurement.

Best ORP Technology

The Powell Oxidation Reduction Potential (ORP) Electrode utilizes platinum for the measuring electrode and silver for the reference electrode. The unit has proven itself for 50 years and over 1000 applications of service in chlorine scrubbing, sodium hypochlorite production, chlorine and bleach neutralization, and the ferric chloride industries and is suitable for use in any halogen chemical service including scrubbers, neutralization tanks, vent stacks, and batching tanks. Powell ORP Electrodes are available for 1" to 18" pipe sizes, and are known for their long service life. The Powell ORP Electrodes have been designed for simple installation and maintenance. They are easy to install and repair. There are many types of installation methods to chose depending on the design of the chlorine scrubber.

