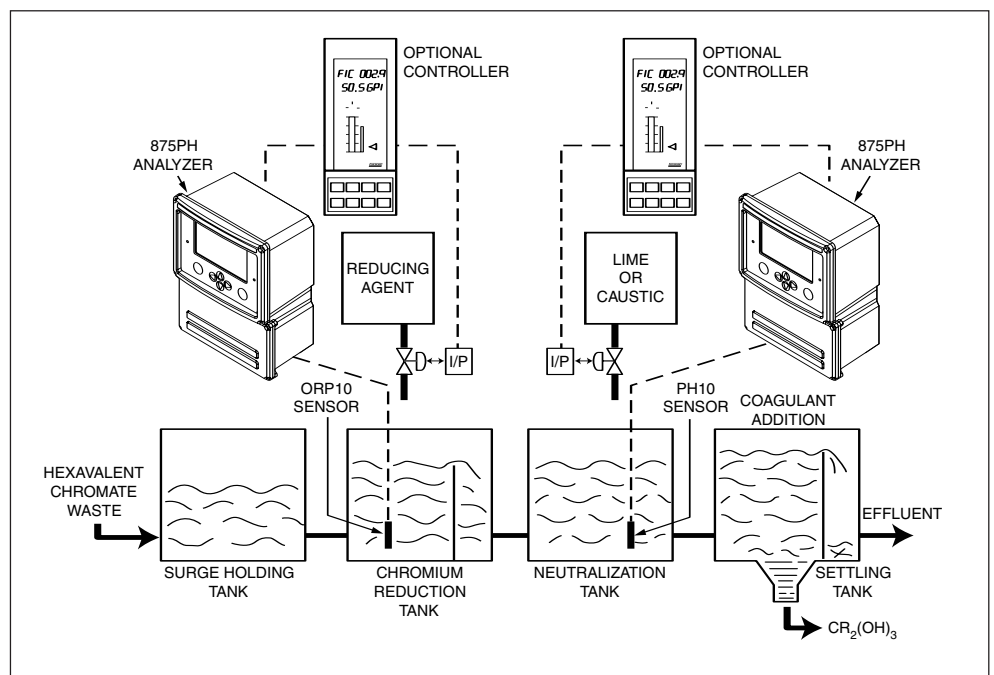


## 875PH Series pH and ORP Electrochemical Analyzers for Control and Monitoring in Chromate Waste Treatment



**DolpHin**

### INTRODUCTION

Chromates used as corrosion inhibitors in the metal plating industry produce highly toxic waste solutions from plating and rinsing procedures. The toxic hexavalent chromate species can be neutralized into a less toxic, insoluble trivalent form which is capable of being precipitated as a hydroxide at a pH value of approximately 8.5.

Three commonly used reducing agents are ferrous sulfate, sodium metabisulfite, and sulfur dioxide. Ferrous sulfate and sodium metabisulfite require a pH adjustment to approximately 2.5 pH for a rapid reduction to occur. Sulfur dioxide gas, however, forms sulfurous acid in solution and typically does not require additional acid. The chemical reactions for these reductions are found in Table 1.

**Table 1 – Neutralization Reactions of Chromium to Trivalent Form Using Different Reagents**

Reagent and ORP (a)	Type of Reaction	Equation
Ferrous Sulfate +500 mV at pH 2	Hydrolysis	$CrO_3 + H_2O \rightarrow H_2CrO_4$
	Reduction	$H_2CrO_4 + 6FeSO_4 + H_2SO_4 \rightarrow Cr_2(SO_4)_3 + 3Fe_2(SO_4)_3 + 8H_2O$
	Precipitation	$Cr_2(SO_4)_3 + 3Ca(OH)_2 \rightarrow 2Cr(OH)_3 + 3CaSO_4$
Sodium Metabisulfite +380 mV at pH 2.5	Hydrolysis	$Na_2 S_2O_5 + H_2O \rightarrow 2NaHSO_3$
	Reduction	$H_2CrO_4 + 3NaHSO_3 + 3H_2SO_4 \rightarrow Cr_2(SO_4)_3 + 3NaHSO_4 + 5H_2O$
	Precipitation	$Cr_2(SO_4)_3 + 3Ca(OH)_2 \rightarrow 2Cr(OH)_3 + 3CaSO_4$
Sulfur Dioxide +165 mV at pH 2.9	Hydrolysis	$SO_2 + H_2O \rightarrow H_2SO_3$
	Reduction	$H_2CrO_4 + H_2SO_3 \rightarrow Cr_2(SO_4)_3 + 5H_2O$
	Precipitation	$Cr_2(SO_4)_3 + 3Ca(OH)_2 \rightarrow 2Cr(OH)_3 + 3CaSO_4$

(a) Nominal ORP potentials versus standard hydrogen electrode (SHE).

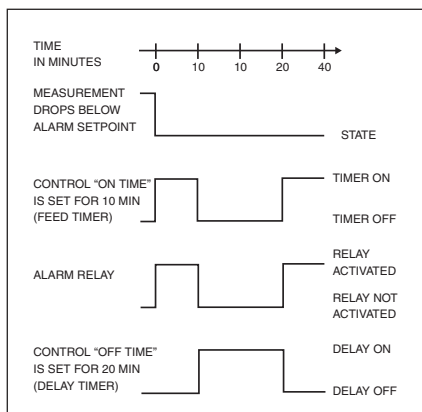


Figure 1. On/Off Control Using "On-Time" and "Off-Time" Parameters

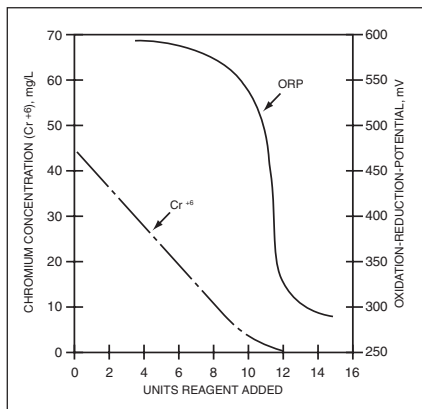


Figure 2. Chromium Reduction with Sodium Metabisulfite



Foxboro  
 Foxboro, MA 02035-2099  
 +1-508-549-2424  
 1-888-FOXBORO  
 Fax: 1-508-549-4999  
[www.foxboro.com/instrumentation](http://www.foxboro.com/instrumentation)

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The pH and ORP (oxidation-reduction potential) monitoring and control of reagent addition can easily be accomplished using 875PH pH/ORP electrochemical analyzers and DolpHin sensors, regardless of which reducing agent is utilized.

### DESCRIPTION

The 875PH pH/ORP analyzer is one of a family of Foxboro electrochemical analyzers. The analyzer can be configured to read out in units of pH or mV. Two analog outputs are standard. One connection may be to a recording device, and the second to a controller for reagent additions.

Alternatively, the alarm relays may be used to control pumps for reagent additions. Dual, independent, Form C dry alarm contacts, rated at 5 A at 250 V ac, 2 A at 30 V dc, nonincendive, are provided. The alarms can be configured to operate with a concentration dead band, or with timed actuation and delay. When the alarm is actuated, a reagent pump begins feeding reagent into the reaction vessel. The reagent neutralizes the hexavalent chromium, or adjusts the pH. When this period is completed, a second timer prevents the alarm from reactivating, thus allowing time for adequate mixing. The timers can be set for up to 99 minutes. After the sequence is completed, if the instrument is still in an alarm state, the feed timer and delay timer repeat the sequence until the control value is reached. The relationship is illustrated in Figure 1.

The sensor choice is also very important in the neutralization process. The correct choice of process sensor materials and installation hardware greatly enhances reliability of the measurement. DolpHin pH and ORP sensors are available with compatible body, measuring and reference electrode parts, O-rings, and accessories for every step of the neutralization process. Gold ORP measuring electrodes have been found superior to platinum in chrome reduction procedures. Figure 2 illustrates the ORP potential observed during chromium reduction using sodium metabisulfite (SHE reference).

Choosing 875pH analyzers, DolpHin sensors, and accessories provides the user with an on-line analysis package demonstrating a price/performance value that is hard to beat.

### ANALYSIS PACKAGE BENEFITS

- Provides Real-Time Analysis
- Reduces Process Handling and Hazards
- Reduces Chemical Reagent Waste

### 875PH ANALYZER FEATURES

- Initialization Diagnostics
- Front Panel Security Access
- Front Panel Keypad
- Dual Outputs
- Dual Alarms with Dead Bands or Time Actuation
- Sensor Diagnostics

### TYPICAL INDUSTRIAL USERS

- Plating Industry

### REFERENCE DOCUMENTS

For additional information and detailed specifications, refer to the following Product Specification Sheets:

- PSS 6-1A1 E 875PH Series Electrochemical Analyzers
- PSS 6-1C3 A DolpHin PH10 and ORP10 Sensors and Accessories for pH and ORP Measurements