

# METTLER TOLEDO APPLICATION NOTE

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## pH And ORP Control For Removing Chrome From Plant Effluent

### BACKGROUND

The law requires that toxic substances be removed from plant effluent before it is discharged. Chemical solutions used in chrome plating and some metal treating operations contain hexavalent chromium ( $\text{Cr}^{+6}$ ), which is highly toxic to plants, animals, and humans. Traditionally, many treatment systems have chemically reduced  $\text{Cr}^{+6}$  to the trivalent state ( $\text{Cr}^{+3}$ ) before discharging the effluent.  $\text{Cr}^{+3}$  is now considered toxic, and further treatment to remove the  $\text{Cr}^{+3}$  is required. Both pH and ORP measurements play an important role in the two-step process of chrome removal.

### THE PROCESS

#### *Step 1: Reduction of Hexavalent Chromium*

Wastewater flows to the first reaction tank, where the pH is measured and sulfuric acid is automatically injected until a pH value of 2 is achieved. A pH set point of 2 is chosen as the most cost-effective. The reaction time is just a few minutes, and a lower pH for an even faster reaction would require considerably more acid.

At the same time, the oxidation reduction potential (ORP) of the solution is measured, and

liquid or gaseous sulfur dioxide ( $\text{SO}_2$ ) is automatically injected until an ORP value of approximately 280 mV is achieved. Reactions occur that reduce hexavalent chromium to trivalent chromium ( $\text{Cr}^{+6}$  to  $\text{Cr}^{+3}$ ).

#### *Step 2: Chromium Hydroxide Precipitation*

In the second reaction tank, the pH is raised to 8.5 by the addition of an alkaline solution (ammonia or caustic soda). As a result, the  $\text{Cr}^{+3}$  precipitates in the form of chromium hydroxide.

The precipitation is in slurry form due to agitation in the tank. The slurry flows to a settling chamber, where the chromium precipitate settles at the bottom and the clear, chromium-free water flows over the tank on route to a sewer (Figure 1).

### INSTRUMENTATION

pH control in Steps 1 and 2 is usually done with the Model 2100 pH/ ORP Analyzer.

The recommended sensors are the Xerolyt<sup>®</sup> pH and ORP electrodes. For chrome applications, platinum should be used for the ORP electrode material.

## PRODUCTS

### 2100 pH/ ORP Analyzer

- Detachable front panel and plug-in terminals for ease of installation
- All functions accessible through the keypad for increased ease of use
- Continuous sensor and transmitter diagnostics to monitor performance
- FM certification for Class I, Div 1 & 2 Environments and CSA General Purpose Approval
- 3 year warranty

### Xerolyt® pH and ORP Electrodes

- Patented Xerolyt solid polymer reference system maintains a stable potential for accurate and repeatable pH measurement and low maintenance
- Open junction eliminates reference clogging and extends sensor life
- High pressure resistance eliminates requirement for pressurizable housing
- Xerolyt solid polymer is particularly suitable for use in emulsions, suspensions, heavily contaminated or sulfide-containing media, and solutions with high concentration of suspended solids

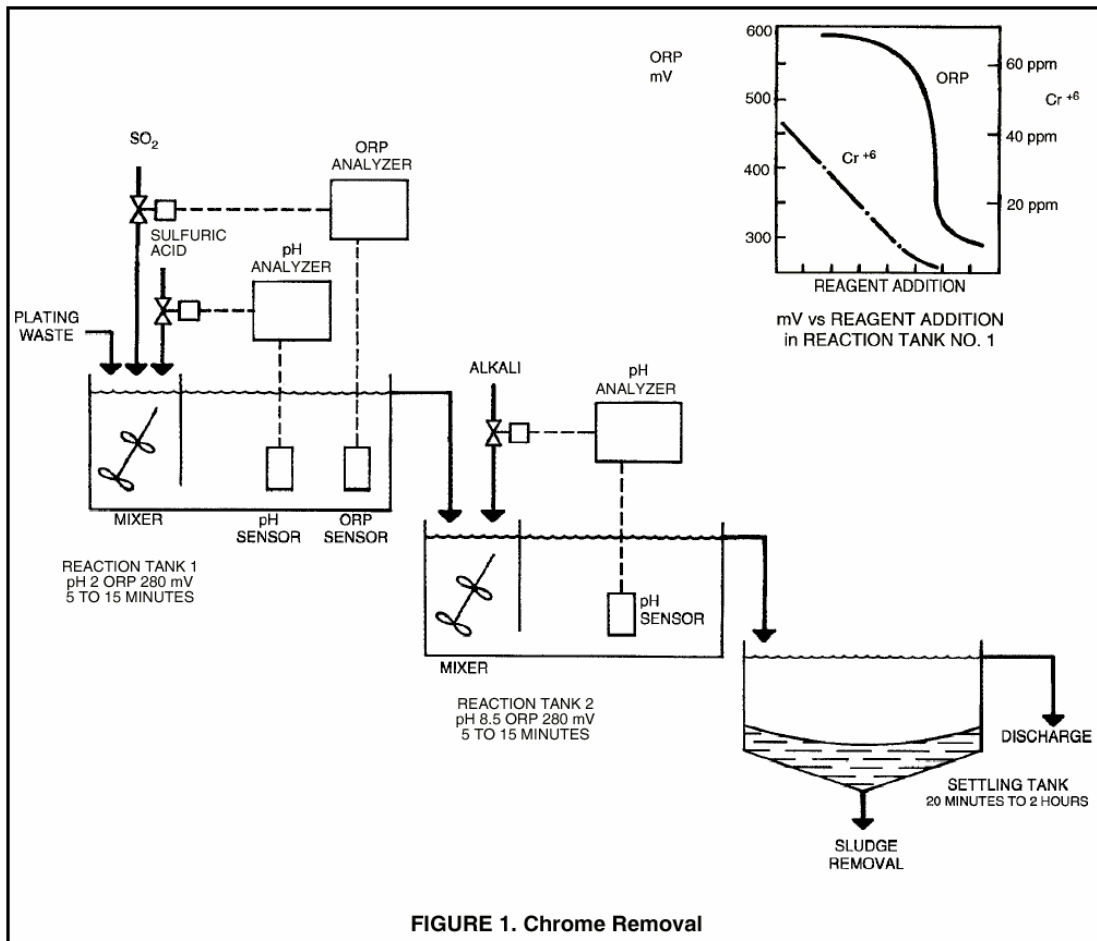


FIGURE 1. Chrome Removal

Ref: RA ADS 3300-02