

pH and ORP Control for Removing Chrome from Plant Effluent

BACKGROUND

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

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 setpoint 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 sulfur dioxide (SO_2), sodium sulfite, or sodium metabisulfite is automatically injected until an ORP value of approximately 280 mV is achieved. Reactions occur that reduce hexavalent chromium to trivalent chromium (Cr^{+6} to Cr^{+3}).

Step 2: Chromium Hydroxide Precipitation

In the second tank, the pH is raised to 8.5 by the addition of an alkaline solution such as ammonia or caustic (NaOH). Chromium, and some other metals, form hydroxides that do not dissolve well in water, so a precipitate is formed. The precipitate, although heavier than the water, does not drop to the bottom due to agitation in the tank. The mixed slurry flows to a settling tank, where the trivalent (Cr^{+3}) chrome settles to the bottom and the clear chromium-free water flows over the tank for further treatment. Chemicals known as coagulants are sometimes added to the second reaction tank to help form larger particles and aid in sludge removal.

INSTRUMENTATION

Model 1056 Analyzer

- MULTI-PARAMETER INSTRUMENT – single or dual input. Any combination of pH/ORP/ISE, Resistivity/Conductivity, Chlorine, Oxygen, Ozone, Turbidity, Flow.
- LARGE DISPLAY – easy-to-read process measurements.
- SEVEN LANGUAGES: English, French, German, Italian, Spanish, Portuguese, and Chinese.
- HART AND PROFIBUS DP Digital Communications



PERpH-X pH/ORP Sensors

- HIGH TEMPERATURE DESIGN
Increases sensor life when used in elevated temperature applications.
- FAST, ACCURATE & STABLE
- RUGGED & VERSATILE
RYTON CONSTRUCTION
- LONG LASTING REBUILDABLE
REFERENCE can be customized with different chemical formulations.



INSTRUMENTATION

pH and ORP measurements in these reaction tanks are complicated by the presence of chrome and sulfur dioxide, which can poison the sensor reference under certain circumstances. The refillable model 3500 sensor provides for a long life under these conditions and uses a syringe to refill the reference chamber with a highly viscous reference gel. The contaminated reference can be removed and the sensor protected against process intrusion. The model 3500 sensor design includes a titanium solution ground for continuous

diagnostics of potential problems with the pH, ORP, or reference parts of the sensor when used with an Emerson Plantweb analyzer such as the model 1056. pH and ORP control in these applications may be conducted using alarm relays and a simple on/off control scheme such as available in the dual sensor Model 1056 Analyzer. Alternatively, the 4-20mA current output can be used directly for proportional control, or sent to a distributed control system as needed.

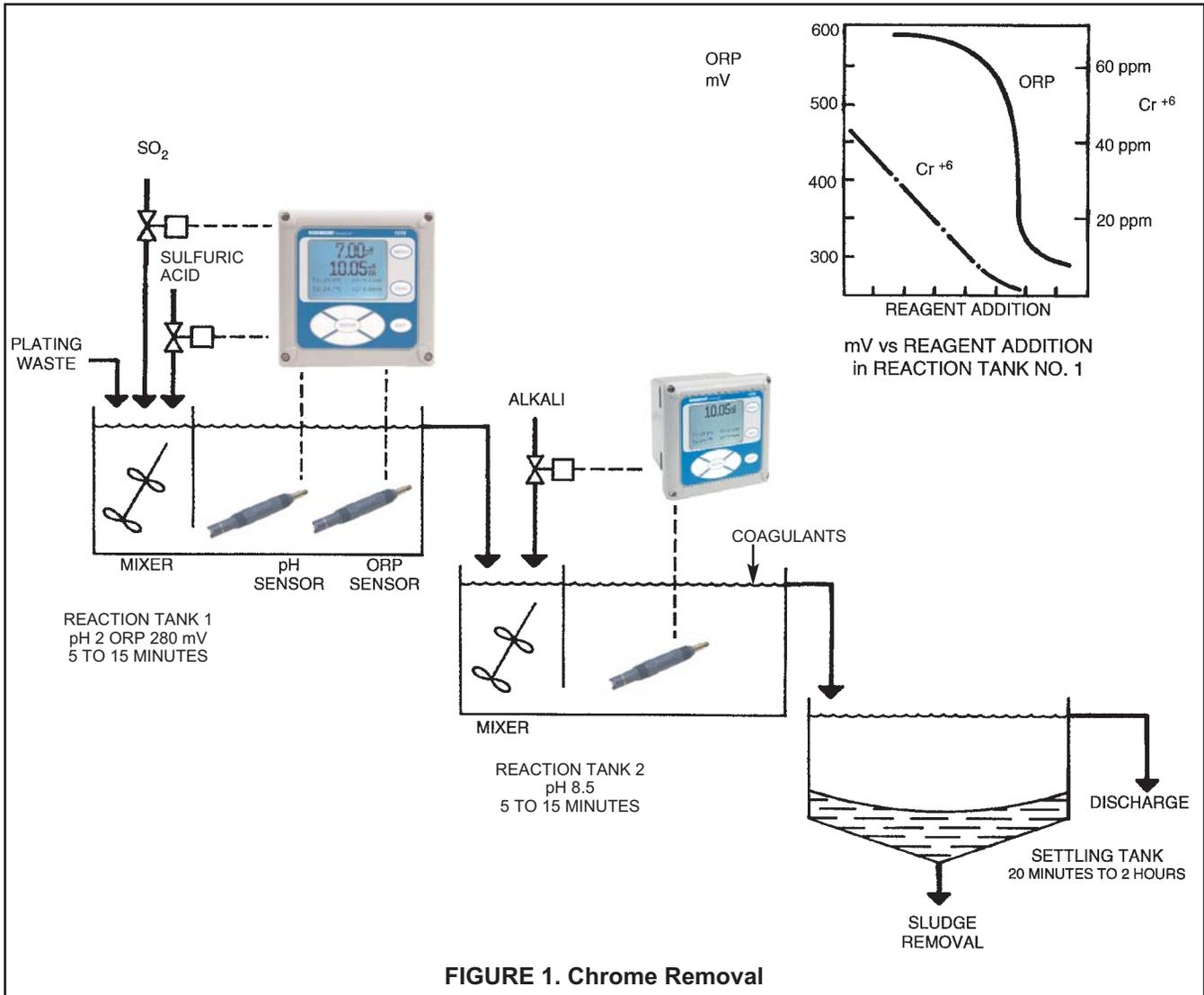


FIGURE 1. Chrome Removal

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