

Cyanide Destruction Monitoring with pH and ORP

BACKGROUND

Mining and electroplating processes generate waste materials containing alkaline, rare earth metals, and other heavy metals such as iron, nickel, zinc, cadmium, copper, silver, and gold. The wastes often contain cyanide, a deadly poison. Federal and State regulatory agencies require that cyanide discharge be below 0.5 ppm, and further tightening may be forthcoming. Therefore, the best policy is to totally destroy the cyanide before discharging the waste.

OVERVIEW OF THE CYANIDE DESTRUCTION PROCESS (Figure 1)

One of the most effective means to treat these waste materials is to destroy the cyanide with chlorine.

This process is accomplished in two stages:

1. Cyanide is oxidized to cyanate, using pH and ORP control.
2. Cyanate is oxidized to nitrogen and carbon dioxide, harmless gases, that can be safely discharged into the environment. This stage also uses pH and ORP control.

OXIDATION OF CYANIDE TO CYANATE

In the first reaction tank, the pH of the waste is measured and caustic (NaOH at 50% strength) is automatically injected to raise the pH to 10 or higher.

The oxidation reduction potential (ORP) of the waste is measured, and chlorine gas (Cl₂) is automatically injected to raise the ORP to 400 mV or higher.

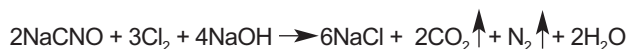
The following reaction occurs, taking from 5 to 10 minutes:



DESTRUCTION OF CYANATE TO NITROGEN AND CARBON DIOXIDE

In the second reaction tank, the pH of the waste is measured, and acid is injected to lower pH to 7-8. This process takes 2 to 5 minutes. In the third reaction tank, the ORP of the waste is measured and chlorine gas (Cl₂) is automatically injected to raise the ORP to 600 mV or higher (Meanwhile the pH controller maintains the set-point at 7-8, correcting for any acidity created by the addition of the chlorine gas).

The following reaction occurs, taking 10 to 15 minutes:



The cyanide is eventually converted to harmless materials by the above reaction and the waste can be discharged.

INSTRUMENTATION:

pH and ORP levels in this area can be simultaneously monitored with the three input model 1057 Analyzer. This reliable multi-parameter instrument includes three isolated current outputs (and optional alarm relay board) that can be used to adjust the feed of chlorine, caustic, and acid as needed. The model 1057 Analyzer performs continuous sensor diagnostics to notify the user when the sensor is coated or the glass electrode has broken.

The PERpH-X[®] model 3500 sensor with forward and reverse facing threads is convenient to install and use in the reaction tanks. The PERpH-X[®] design includes a replaceable reference junction and several customized SOLUTIONS are available for long life in difficult environments. A separate sensor is required for ORP measurement, but up to three sensor cables can be connected to a single model 1057 analyzer. The poison resistant model 3500PR sensor is recommended for this application as some levels of cyanide may be present at startup or under upset conditions.

PERpH-X[®] is a registered trademark of Rosemount Analytical.

INSTRUMENTATION

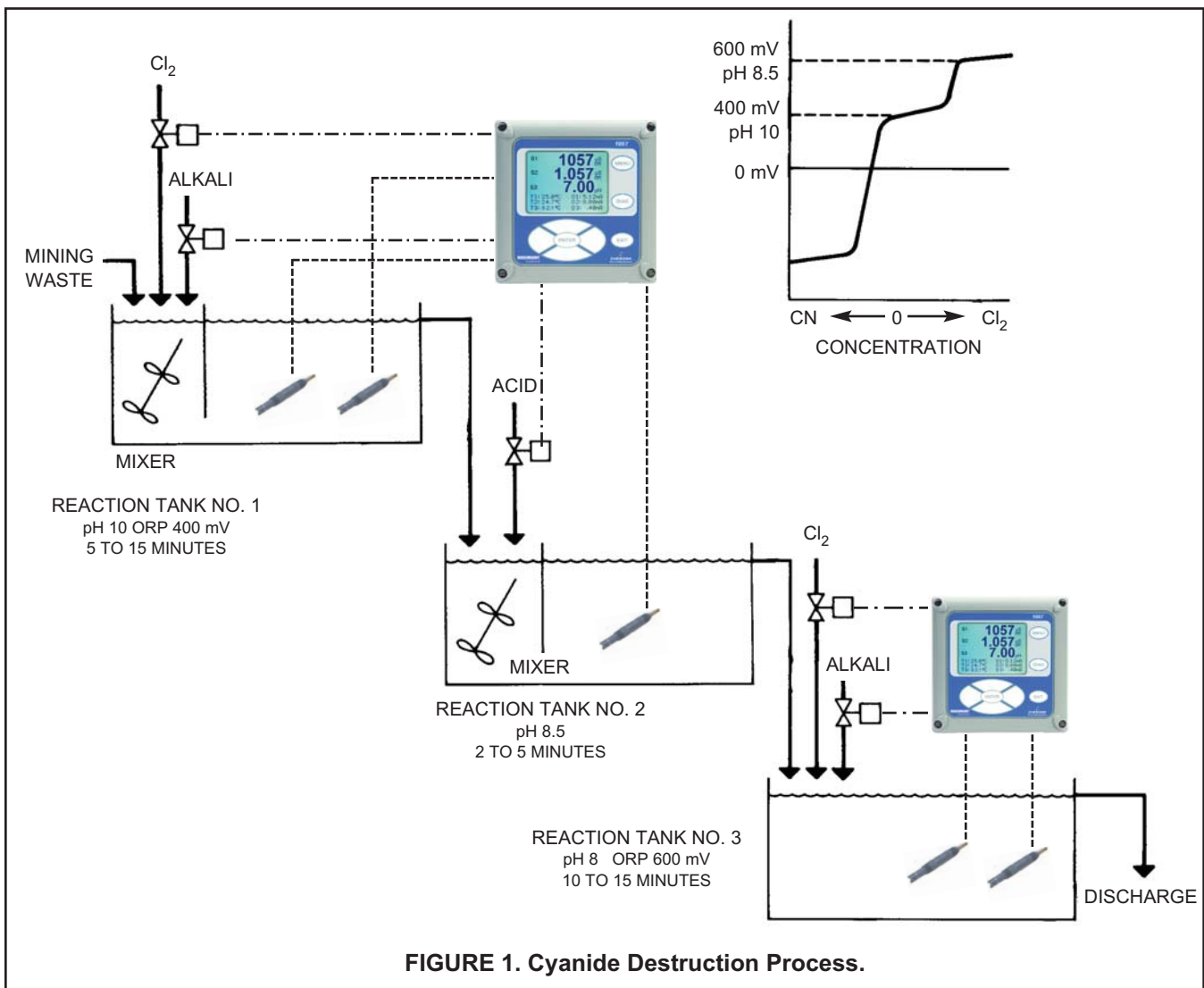
Model 1057 pH/ORP Three-Input Analyzer

- **LARGE DISPLAY** – easy-to-read process measurements.
- **EASY TO INSTALL** – modular boards, removable connectors, easy to wire power, sensors, and outputs.
- **INTUITIVE MENU SCREENS** with advanced diagnostics and help screens.
- **SEVEN LANGUAGES** English, French, German, Italian, Spanish, Portuguese, and Chinese.



Model 3500 High Performance pH and ORP Sensors

- **Fast, Accurate, & Stable Measurement**
- **VP Quick Connect Cable or Integral Cable**
- **Integral preamplifier option**
- **Long lasting rebuildable reference**
- **Custom SOLUTIONS** available for extended lifetime



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