Application Note

INGOLD
Leading Process Analytics

Reliable Conductivity Measurement
in Chlorine Gas Cooling

Background

Electrolysis of salt brine (water containing NaCl) is the main process for producing chlorine gas used in the chlorination of many different compounds. This, along with sodium hydroxide (caustic soda: NaOH) and hydrogen (H_2) are the chief products of the chlor-alkali process.

Process

The electrolysis of brine solution results in gases of chlorine and hydrogen being liberated at the electrolysis cell's anode and cathode respectively. At the optimal process temperature, 80–90 °C, the generated chlorine gas is saturated with water vapor, but this leads to issues. When chlorine gas is mixed with liquid water, hydrochloric and hypochlorous acid (HCl and HClO) are produced, which are highly corrosive to vessels and pipes. Thus, the gas must be cooled and dried for ease of down-stream processing.

METTLER TOLEDO

Cooling takes place in two stages: In the first, a tube-in-shell or plate-style heat exchanger is used to reduce the temperature of the gas to 40 °C. This is accomplished with plant cooling water. After stage one, a filter is used to separate brine mist in the gas. In the second stage, the chlorine is cooled to 15 °C using chilled water. The ideal end temperature of the chlorine is between 10 – 20 °C. At higher temperatures, too much water vapor enters the drying column, and at lower temperatures chlorine hydrates will begin to crystalize in the cooler causing blockages. Sulfuric acid is used counter-currently in a packed tower to absorb the remaining moisture in the drying units.

Corrosion resistant material is required in the cooling units to ensure corrosion resistance; however, outside these units piping and vessels for the cooling water are commonly made from mild steel. Under ideal circumstances there are no issues with this material selection, but if there are any leaks or compromises seals in the cooling unit, chlorine gas will mix with the cooling water leading to formation of HCl and HClO. These acids are then inadvertently carried throughout the water system, leading to severe corrosion damage throughout the plant.

METTLER TOLEDO solution

Immediate reaction to leak conditions are vital to ensuring long life of piping and vessels, and minimize the high costs of repair and maintenance of corrosion damage. As the presence of chlorine in the water causes an immediate increase in conductivity, in-line conductivity sensors are the simplest method for rapid detection of chlorine ingress, allowing immediate action to be taken.

The InPro® 7100i is the ideal sensor for this application. Its 4-electrodes design ensures an immediate response time to conductivity changes. The 12 mm acid-resistant PEEK shaft is easily installed in various process connections for simple fit-and-forget use. Installed with an M400 2-wire transmitter, conductivity measurements can be included in the plant's DCS for centralized monitoring.

For more information, visit:
www.mt.com/InPro7100

M400 transmitter and
InPro 7100i conductivity sensor

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