Conductivity Measurement in Sulfuric Acid Manufacturing

Process

Sulfuric acid (H_2SO_4) is a strong, heavy acid with a density of 1.84 g/ml and a tendency to generate considerable heat by absorbing moisture from the air. Concentrated sulfuric acid (93 % to 98 %) is used in the manufacture of fertilizers, explosives, dyes, and petroleum products. Sulfuric acid is manufactured using the contact process as shown in Figure 1.

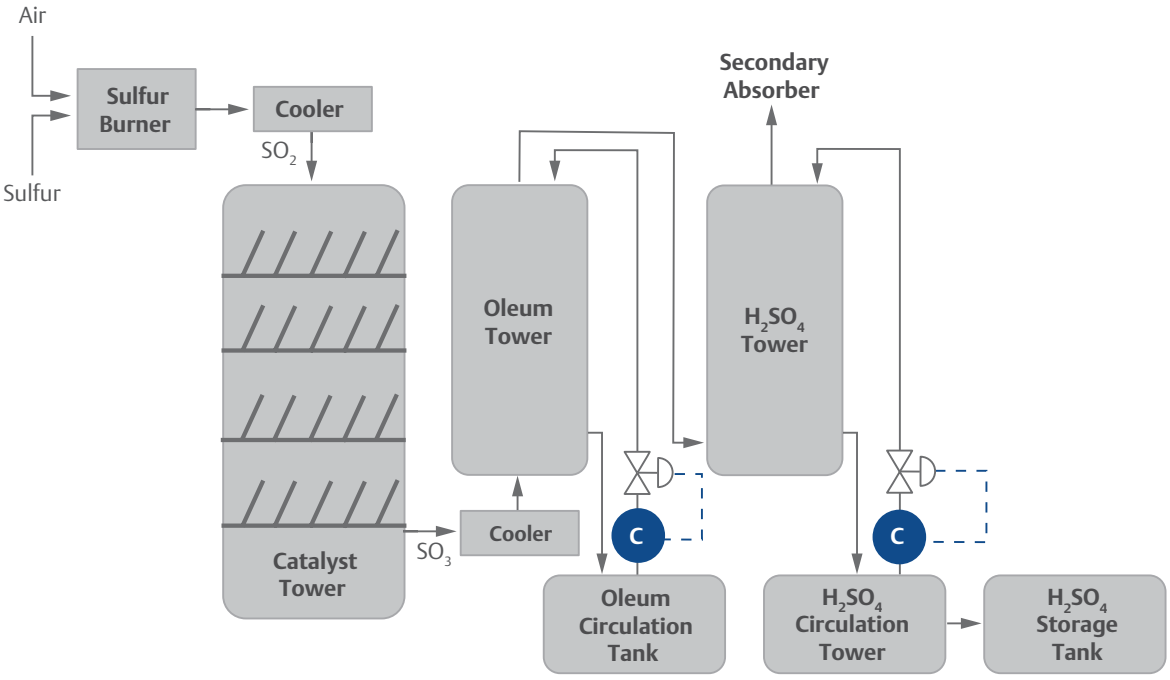
Elemental sulfur (or other sulfur-containing ore) is burned in air to form hot sulfur dioxide gas. The hot gas is cooled to about 400 °C (752 °F) in a waste heat boiler and then passed through two to four stages of platinum or vanadium catalyst to form sulfur trioxide (SO_3) gas. The catalytic reaction generates a lot of heat and is reversible. The catalyst tower is therefore arranged with alternating levels of catalyst and gas coolers to prevent the reverse reaction from occurring at high temperatures.

The product SO_3 gas is further cooled to about 250 °C (482 °F) in a cooler and then absorbed by a recirculating stream of oleum. The recirculation/storage (recycle) ratio is determined by the desired specification of the oleum. Unabsorbed SO_3 gas escaping from the oleum tower is absorbed by a recirculating stream of 98 % to 99 % sulfuric acid. The recycle ratio of the sulfuric acid is also determined by the desired purity of the sulfuric acid product. Environmental regulations frequently require that waste gas from

the sulfuric acid tower pass through another absorbing tower to eliminate harmful emissions that cause acid rain.

The final sulfuric acid product is then sent to storage tanks. Both the storage tanks and process piping in the sulfuric acid plant can be made of stainless steel, providing the sulfuric acid concentration never drops below 95 %. Less concentrated acid is very aggressive and requires exotic construction materials, such as Hastelloy or Teflon lining, for adequate service life.

Figure 1 - Contact Process



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Conductivity Measurement

Electrical conductivity is the most cost-effective technique for measuring oleum and sulfuric acid purity, which are critical parameters used to control process conditions and safeguard the process equipment.

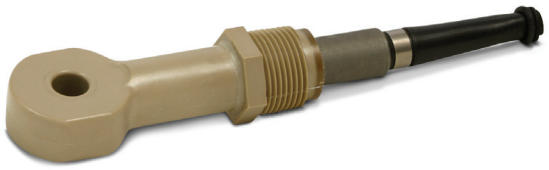
Generally, one conductivity measurement is placed within the oleum tower recirculation line and a second conductivity measurement is placed in the final recirculation line between the last sulfuric acid tower and the circulation tank.

The Emerson Solution

Traditional contacting conductivity sensors are a poor choice for this application because their metal electrodes are corroded by the sulfuric acid. Instead, the best choice for most sulfuric acid manufacturing applications is the Rosemount™ 228 Toroidal Conductivity Sensor. This sensor has no metal wetted parts and is available in a chemically resistant Tefzel body that is designed to withstand the corrosive sulfuric acid.

The Rosemount 228 is compatible with all Rosemount liquid analysis transmitters including the Rosemount 56 Dual Channel Transmitter which offers dual sensor inputs, a large full-color display, and built-in measurement and troubleshooting tips and the Rosemount 5081 Explosion Proof Transmitter which features a rugged aluminum enclosure for the harshest industrial environments.

All Rosemount liquid analysis transmitters can convert from conductivity units to percent sulfuric acid or oleum concentration, an important requirement for sulfuric acid manufacturing applications. Rosemount transmitters are pre-programmed with the conductivity-to-concentration conversion for the 96 % to 100 % sulfuric acid range. Measurements above 100 % sulfuric acid are usually based on conductivity values only. Rosemount transmitters can also generate percent concentration equations based on custom data for applications such as oleum concentration monitoring.



Rosemount 228 Toroidal Conductivity Sensor

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