pH Measurement in Sour Water Stripping

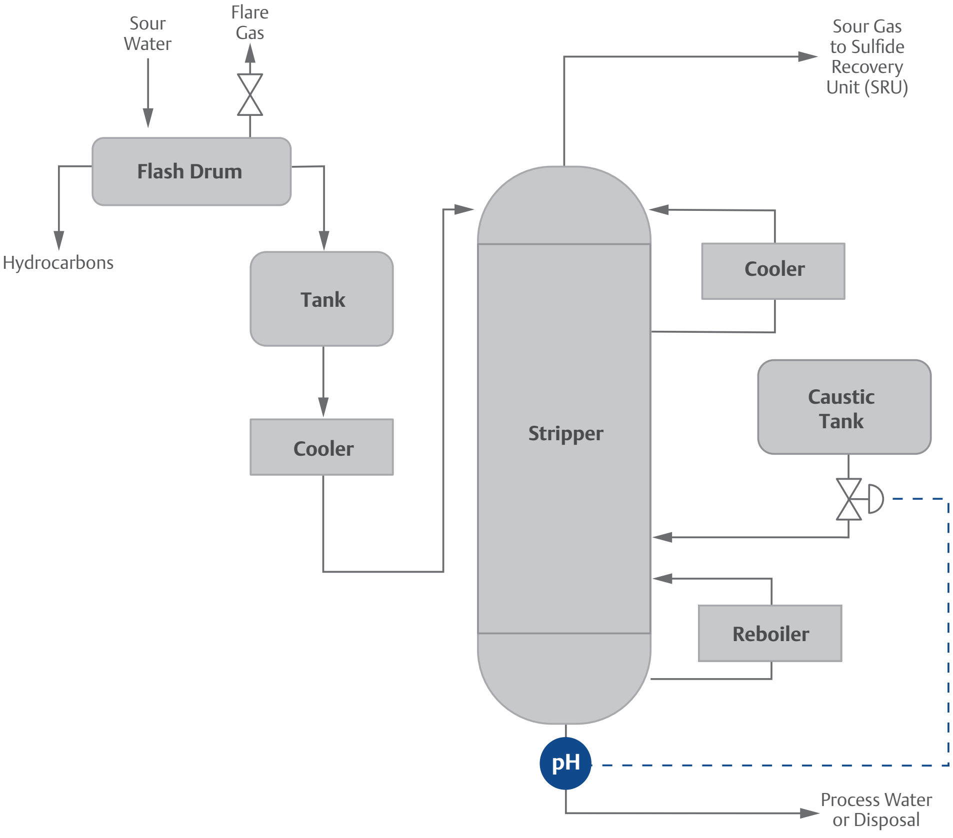
Process

Refineries that process crude oil utilize various unit operations to remove sulfur from the oil as hydrogen sulfide. Hazardous sulfur-containing gas, often called sour gas, is formed as a byproduct of these operations. Before this gas can be safely returned to the environment, residual sulfur is scrubbed from the gas by contacting it with water. However, this scrubbing process produces water that contains hydrogen sulfide as well as other contaminants such as ammonia. This water is referred to as sour water and must undergo treatment before it can be safely released or re-used.

The process for removing hydrogen sulfide (H_2S) and ammonia (NH_3) from this sour water is called stripping. The stripping process (Figure 1) uses a gas stream to force both the hydrogen sulfide and ammonia out of solution and into the gas phase for further treatment. Although air stripping can be used, steam stripping (which liberates more hydrogen sulfide due to higher temperatures) is typically required in refinery sour water treatment to meet specifications for the stripped water.

Gas stripping requires that the hydrogen sulfide and ammonia are both present in the gaseous form. This presents a challenge because the ideal pH for stripping hydrogen sulfide is below 5 while the ideal pH for stripping ammonia is above 10. Although the optimal strategy would be to use two separate stripper towers, economics usually dictates a compromise and a pH of around 8 provides adequate removal of both gases. This target pH value is maintained by continuously injecting caustic into the stripper. The caustic is injected near the bottom of the stripper to improve the ammonia stripping efficiency while still allowing hydrogen sulfide stripping to occur more efficiently near the top.

Figure 1 - Sour Water Stripping Process



pH Measurement

Measuring pH in sour water is a challenge for most pH sensors. The high temperatures needed to facilitate removal of hydrogen sulfide and ammonia lead to accelerated degradation of the pH-measurement electrode. In addition, hydrogen sulfide can poison and plug the sensor by precipitation with the silver ions in the reference electrode. Ammonia and cyanide can also poison the reference by forming a complex with silver ions. These measurement problems can be so severe in sour water that certain pH sensors may become unstable within one day.

EMERSON

The Emerson Solution

The Rosemount™ 3500P pH Sensor is the ideal sensor for monitoring sour water because it features a high temperature glass measuring electrode and is available with a poison-resistant electrolyte that reacts with the sulfide before it can damage the reference. The double junction design uses two layers of porous junctions to separate the process chemicals from the silver reference and allows the outer reference solution to be conveniently refilled with a preloaded syringe. The Rosemount 3500P design includes a titanium solution ground for complete diagnostics of the reference and glass portions of the sensor. This sensor is available with the convenient VP connector and is offered in a retractable metal housing (Rosemount 3400), which allows sensor removal without shutting the process down.

The Rosemount 3500P pH sensor is compatible with all Rosemount liquid analysis transmitters including the Rosemount 5081 Explosion Proof Transmitter which features a rugged aluminum enclosure for the harshest industrial environments and diagnostics that can be used to alert the user to sensor coating or breakage.

Rosemount 3500 pH Sensor

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