Application

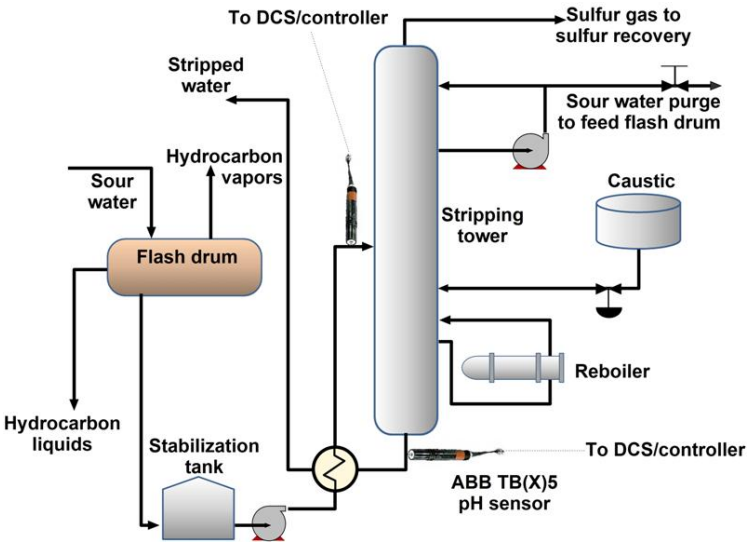
ABB Analytical – pH/ORP
Sour Water Strip Tower

Industry: Oil & Gas

Dealing with sour water

Refineries classify sour water as any water that contains sulfur compounds. Sour crude oil processed by a refinery liberates hydrogen sulfide (H_2S) during various processing steps. When H_2S dissolves in water, sour water is the result. Since sulfur is the main element in sulfuric acid, sour water tends to be acidic, causing corrosion problems within the pipeworks of the refinery.

Sour water may also contain other contaminants, including ammonia, phenols, and even cyanide. The quench tower, fluid catalytic cracking unit (FCCU), steam cracking units, and any of the distillation columns can all produce sour water within the refinery. Removal of the hydrogen sulfide and ammonia involves converting these compounds back to a gaseous form. The ideal pH for stripping hydrogen sulfide is less than 5.5. Ammonia removal requires a higher pH and is best stripped at pH values greater than 10. Because of this issue, some refineries will use two stripper columns to handle each contaminant. If the refinery chooses to use a single stripper column, as in the diagram, then a controlled pH of 8 is generally acceptable to remove both chemicals.



Sour water stripper

In the first stage of the stripping process, called degasification, the refinery pumps the sour water into the flash drum to remove residual hydrocarbons. Hydrocarbon gases usually return to the Sulfur Recovery Unit (SRU) for additional processing. From the flash drum the sour water goes to a stabilization tank.

The purpose of this step is to increase residence time, further separating any leftover liquid hydrocarbons and solids while slowing the flowrate into the stripper. From the stabilization tank the degassed sour water passes through a heat exchanger for preheating prior to entering the stripper column. Steam enters the lower part of the column.

This steam partially originates as condensate that has collected at the bottom of the column and passes through a reboiler before being injected back into the column. As the steam mingles with the sour water it removes any of the dissolved gases.

The steam and gaseous ammonia and hydrogen sulfide flow from the top of the stripper column back to the Sulfur Recovery Unit (SRU) for additional processing. The newly stripped water will then either be used to produce steam in the reboiler or be pumped off to the waste treatment plant or desalter for additional processing.

Measurement challenges

As mentioned earlier, pH control is essential to effectively process both hydrogen sulfide and ammonia. Often the refinery injects caustic into the stripper column to help maintain proper pH values. Some refineries will measure the pH leading into the stripper, but the high concentrations of hydrogen sulfide and ammonia can make this a maintenance intensive application. More often the refinery makes the pH measurement on the stripped-water line coming from the bottom of the stripper, as indicated.

Column temperatures, being 180°F, mean this a high temperature application. Trace amounts of sulfides, ammonia, and cyanides may also collect at this measurement point. These chemicals are well known to poison pH sensor reference junctions by reacting with the silver ions present.

The ABB solution: TB(X)5 pH sensors

As mentioned above, ABB recommends that pH be measured on the condensate collected off the bottom of the stripper column. Pressures at this point are typically less than 20 PSIG (1.3 BAR); but, because of the high temperatures, ABB recommends that this pH measurement be made on a conditioned sample line or fast loop. ABB's Next Step Wood Reference is the best solution for the issues of reference poisoning by sulfide and ammonia attack. Commonly the TB(X)5 sensors will have double or even triple the lifespan of conventional double-junction gel filled pH sensors. The ABB coat-resistant J-glass electrode is the preferred measurement electrode style. These measurements often take place in hazardous areas. Suitable instruments include the ABB TB82PH unit with intrinsic safety barriers or the new APA592 Endura Transmitter with Exd housing.

The TB(X)587 is ideal for retractable installations up to 150 psig (10 BAR).

The TB(X)551 can be mounted into 1-inch tees in sample line installations.

New APA592 Endura Transmitter with Exd housing.

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