

With the rising price of petroleum, hi-sulfur crude oil is increasing used to meet global demand. Various operations in refining process of this oil releases sulfur in the form of Hydrogen Sulfide (H_2S). In gas form, H_2S is referred to as “sour gas”, and when carried by water, it is referred to as “sour water”. H_2S is both poisonous and flammable, so its handling and removal from process streams is considered both an economic and safety requirement.

“Stripping” the H_2S from water utilizes a gas stream to force the H_2S and Ammonia (NH_3) out of solution and into the gas phase. This stream is processed by a sulfur recovery unit to separate the sulfur from the water, allowing the water to be re-used as process water, or released to wastewater treatment.

The Process

In the first stage, sour water is processed through a “flash drum” to remove hydrocarbon vapors. These vapors are burned off while the remaining liquid is pumped to a stabilization tank. At the stabilization tank any residual liquid hydrocarbons are removed. By removing the maximum amount of hydrocarbons from the sour water

stream, better control can be maintained in the stripper tower. The sour water stream is pre-heated via a heat exchanger and pumped the top of the stripper tower. Steam introduced at the bottom of the tower, rises through the water, and removes any dissolved gases. The steam is usually recirculated from a reboiler to reduce total water consumption. H_2S , NH_3 , and steam rise in the column and cool near the top to $180^\circ F$. Below-spec temperature at the top can allow the formation of ammonium salts that will foul process lines.

Stripping requires that both ammonia and sulfides exist in their gaseous form. The ideal value for stripping H_2S is $\leq 5pH$, since above this reading sulfide primarily exists as ions (HS^- , or S_2^{2-}). Unfortunately, ammonia stripping requires the reading to be $\geq 10pH$ to avoid the formation of ammonium (NH_4^+) that cannot be stripped. For this reason, many facilities employ two dedicated stripping towers. If only one stripping tower is available, a control point around $8pH$ allows adequate, if not complete removal of both gases. The injection of caustic at the bottom of the tower improves the removal of ammonia while still allowing sulfide removal at the top.

Sour Water Stripper Process

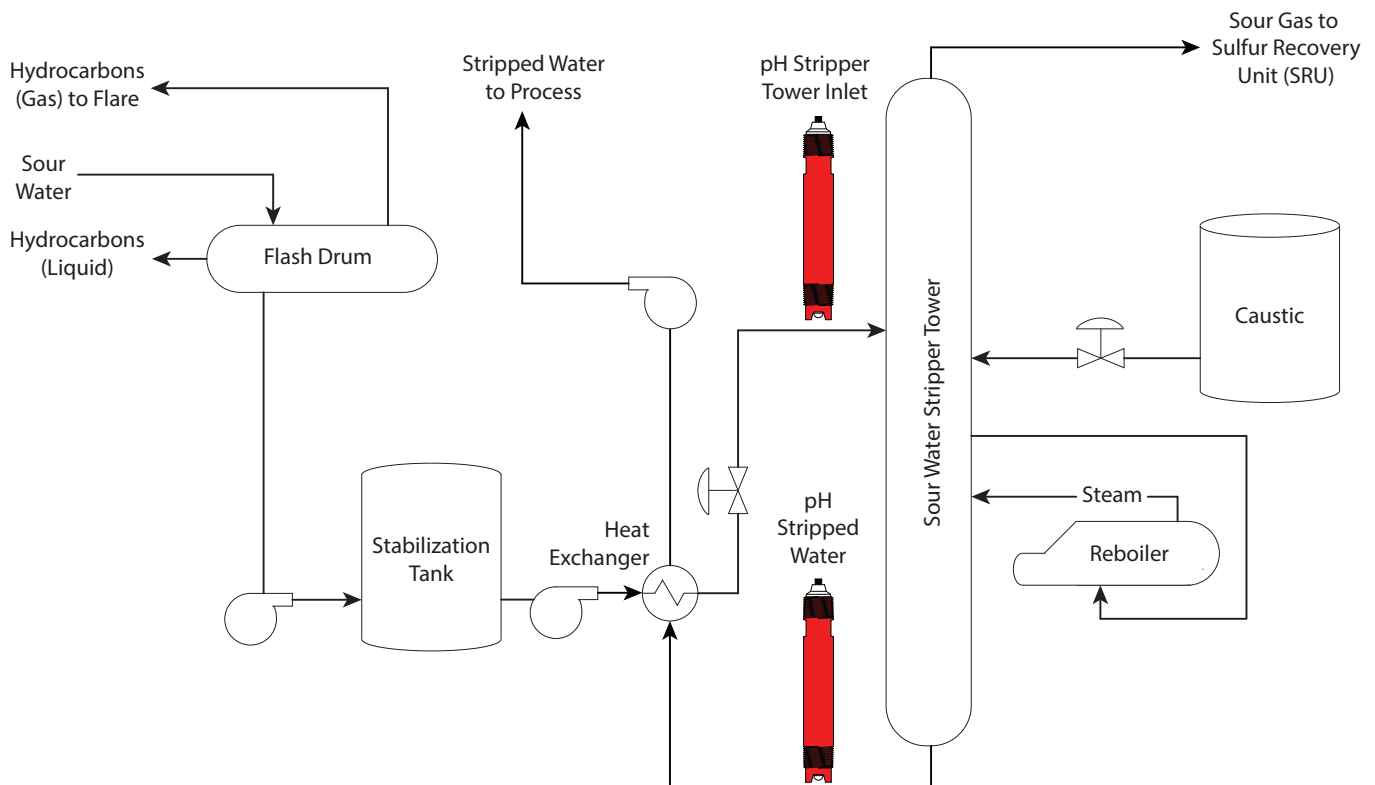


Figure 1

Application Note

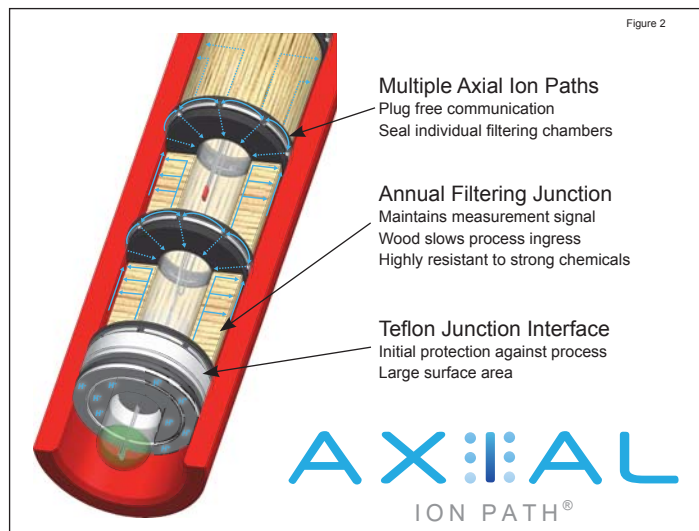
pH Control - Sour Water Stripper

pH Measurement Problems

Measuring pH in sour water is difficult for most sensor designs. The high temperatures required to convert impurities to the gas phase shorten sensor life. The presence of H_2S can poison and plug most conventional reference cells. Cyanide and ammonia can poison a reference by forming a complex with the silver ions in the electrolyte. Historically, traditional double junction references would die within a day or less when the sulfide, cyanide, or ammonia levels were very high.

The Solution

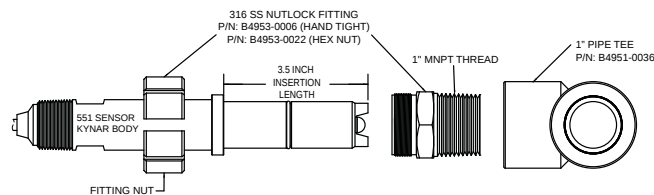
The Barben Analyzer Performance Series pH sensors with Axial Ion Path® technology have proven to be a breakthrough in stripper pH measurement. The maximum temperature rating of this sensor is 130°C (266°F), providing a substantial buffer to the temperatures maintained in the stripper. The Axial Ion Path® reference cell provides multiple filtration stages to prevent the ingress of the sulfides, cyanides, and ammonia, thereby avoiding reference poisoning.



Barben sensors should be specified with “R” or “CR” high temperature glass electrodes for these applications. Kynar (PVDF) should be specified as the sensor body material due to its chemical compatibility and integrity at elevated temperatures.

Sensors in these applications are often mounted on sample line installations. The Barben 551 Quick Change sensor with flow cell provides an easy way to install and remove the sensor.

551 Quick Change Sensors



Lifespan improvements over well-known competitive “gel-type” pH sensors have been in excess of 4 times. A well-known German pH manufacturer specified a pH sensor with a flowing reference utilizing a re-fillable potassium chloride reservoir for this application. This sensor required replacement every 5 to 10 days. The Barben 551 Quick Change sensor that replaced it ran for over 6 months, without the necessity or hassle of refilling a KCl reservoir.

Barben pH sensors will easily connect to most modern pH analyzers in use today. Wiring diagrams for commonly available instruments can be found on www.BarbenAnalytical.com or via request from technical support.

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