Sour Water Stripper Process

Application Note

Background Information

Sour Water is the wastewater that is produced from atmospheric and vacuum crude columns at refineries. Hydrogen sulfide and ammonia are typical components in sour water that need to be removed before the water can be reused elsewhere in the plant. Removal of these components is done by sending the sour water from the process to a stripping tower where heat, in the form of steam, is applied. The ammonia and hydrogen sulfide contained in the water is released by the heat and exits the top of the tower.

Introduction

The ideal pH value for stripping H_2S is below 5, since above 5, sulfide is primarily found in the form of ions (HS^- or S^{-2}). Alternatively, efficient ammonia stripping requires a pH above 10 to prevent the formation of ammonium (NH^{4+}) ion that cannot be stripped. Although the most favorable strategy for sour water stripping is a three step process where two separate stripper towers are used, one for removing hydrogen sulfide and the other for removing ammonia, economics usually dictates a compromise. Having only one stripper tower and using a pH around 8 allows adequate removal of both gases.

There are three distinct processing steps in the sour water stripping process: degasification, hydrogen (acid-gas) stripping and ammonia stripping. Figure 1 shows only one stripper column.

During the degasification stage the sour water feed from the plant is cooled and fed to a degasser where dissolved hydrogen, methane and other light hydrocarbons are removed. These removed gases are known as sour Gas and are pumped off to the Sulfur Recovery Unit (SRU). This degassed sour water is pumped into a storage tank that serves to dampen the flow rate and facilitates removal of entrained oil and solids.

The next step in the process is known as hydrogen sulfide stripping. The degassed sour water is fed to the acid gas or hydrogen sulfide stripper, which is a steam-reboiled distillation column. The hydrogen sulfide, which is stripped overhead, is of high purity – an excellent feed for sulfur recovery units or sulfuric acid plants.

Next, the hydrogen sulfide stripper stream, containing all the ammonia in the feed water and some hydrogen sulfide, is fed directly to the ammonia stripper, which is a refluxed distillation column. In this column, essentially all ammonia and hydrogen sulfide are removed from the water. After exchanging heat with the hydrogen sulfide stripper feed, the stripped water is cooled and sent off for either reuse or treating.

Challenges

Measuring pH in sour water poses several challenges. The abrasiveness of the wastewater affects the pH electrodes over time; the reference electrode junction may plug and require cleaning; and the reference element itself will be poisoned over time due to the presence of hydrogen sulfide. Process temperatures, which affect sensor life, can be quite high in order to facilitate removal of the unwanted components. Ammonia and cyanide can poison the reference electrode by reacting with the silver element.

Product Recommendations

There are two recommended pH sensor combinations we recommend for sour water monitoring. If you are looking for a retractable installation assembly, the PH87 holder with the PH97/DP sensor is the best chose. The sensor's solid state reference provides longer lifetime by lengthening the amount of time it takes for the reference to become poisoned.

For either a flow thru or a direct insertion assembly we recommend breaking the pH measuring system up into it three parts: the measuring electrode, reference electrode, and the temperature electrode. The Yokogawa FF20 is the flow thru holder and the FS20 is the direction insertion holder, each are available in different materials of construction. For the temperature electrode we recommend the SM60-T1, a Pt1000 thermometer. The measuring electrode we recommend is the SM21-AL6, a heavy duty glass electrode that is strengthened for chemical resistance and higher temperatures. The Bellowmatic SR20-AC32 reference electrode is recommended for the reference electrode because of its flowing junction and ability to automatically compensates for process pressure variations.

When either pH assembly is matched with any Yokogawa pH analyzer, the user is provided with diagnostics that warn for sensor breakage or coating. Yokogawa analyzers reduce the guesswork as to when maintenance is required in the pH measuring loop. Compatible pH analyzers are either the Model PH202 for Class I Div I areas, or the model FLXA402 for Class I Div II areas. For Complete details on each piece of equipment please refer to the appropriate product specification pages.

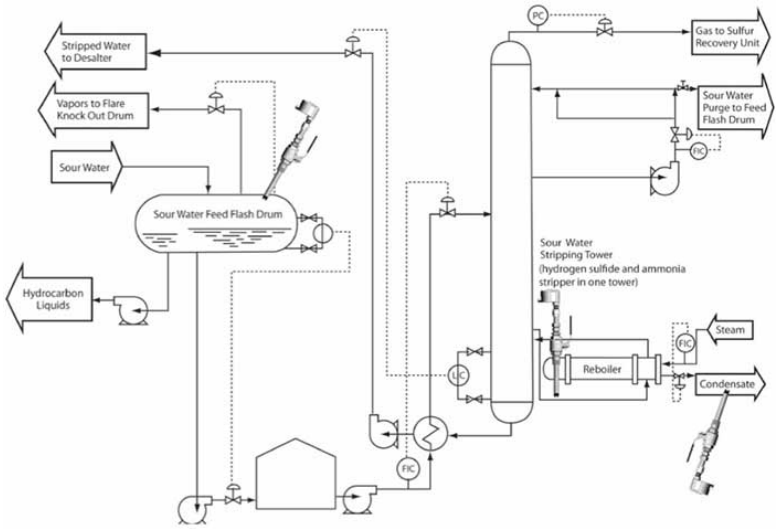

Figure 1 Sour Water Stripper Process Flow Diagram

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