Rich Amine Letdown

Application Discussion
AD123
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Amines are used to remove Acid Gases (H_2S, CO_2) from raw natural gas streams to make a gas composition acceptable for Sales Gas requirements or for use in other parts of the plant. The gas stream is fed into the bottom of the absorption tower while liquid is fed into the top of the tower to "contact" the gas as it flows from the bottom to the top of the tower and out. The contacting liquid can be an amine (DEA, MEA) or Potassium Carbonate. Trays are present in the absorption tower to provide maximum surface area for liquid to gas contact.

There are two severe service valves associated with this process. The level valve (Rich Amine Letdown Valve) controls the level in the tower as to not flood the overhead section or allow the level to drop too low which causes inefficient absorption as the gas stream flows from the bottom to top of the tower. The liquid pump bypass valve, outside the scope of the schematic seen in Figure 1, is used as a minimum flow bypass valve to protect the pump. This valve may not exist due to a variable speed pump driver.

This is a continuous operation liquid process using absorption for the acid-gas removal with subsequent heat addition used to strip the acid-gas components from the absorbent solution. Figure 1 shows the basic process:

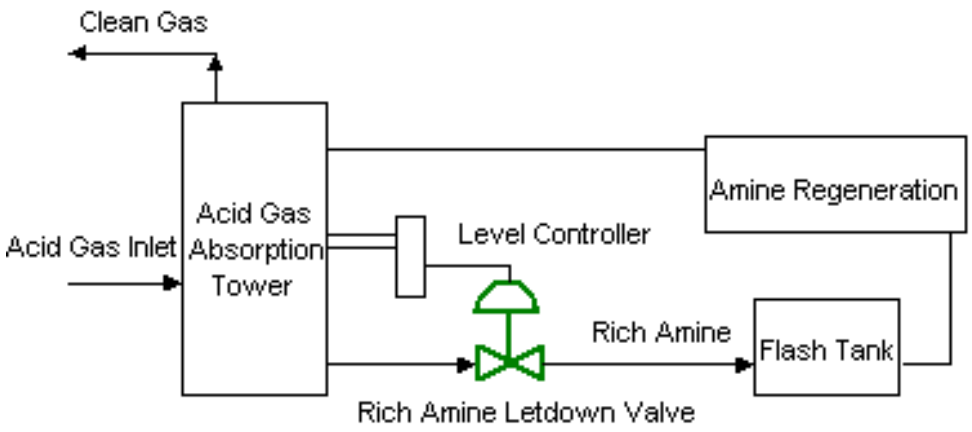

Figure 1: Rich Amine Letdown Process

After any free liquids are removed from the gas at an inlet scrubber, the gas passes to the absorber section. Here it rises counter-currently in intimate contact with the descending amine solution. Purified gas flows from the top of the absorber.

Lean amine enters the tower at the top where it flows across trays and downward, against the flow of the gas. At the bottom of the absorption tower, the acid-gas-rich amine leaves through a the rich amine letdown valve that is actuated by a liquid-level controller. The rich amine then goes to a flash tank, operating at a reduced pressure, where large portions of the physically absorbed gases are offgassed.

From there, the rich amine goes through various processes to be regenerated and start the cycle over again.

This application is demanding because the process rich amine has entrained gas in solution. As the fluid passes through the letdown valve it takes a pressure drop due to the pressure differential between the tower and the flash tank. As this pressure drop takes place in the valve, large amounts of outgassing (entrained gas coming out of solution) occurs.

As a result of this outgassing, the valve will see two-phase flow. One phase is the liquid amine, the other is the CO2 and/or H2S that has come out of solution. This two-phase flow may produce excessive vibration and may be very erosive due to high velocity impingement of the liquid phase on the valve trim.

Outgassing is very similar in effect to flashing and requires special consideration in the proper choice of valve, trim style and materials. Generally speaking, the overall approach is dependent on the severity of the pressure drop experienced. The following are recommendations based on years of successful experience with this difficult application:

Although some sizing methods predict cavitation, small orifice Anti-Cavitation trim should not be used on this service for two reasons. First, the vapor present cushions any cavitation bubble implosion, therefore cavitation damage should not be experienced. Second, the accelerated gas breakout that in turn accelerates the liquid would rapidly erode the trim structure of multiple passage trim because of incompressible fluid impingement. Typical valve wear looks like flashing or high velocity erosion.

For pressure drops of 300psi or less - Use of standard trim styles with hardened trim materials in globe bodies is recommended. Flow down installation for balanced valves is acceptable.

For pressure drops of 300-600psi - Use of slotted (Whisper I) or drilled hole (Whisper III) trim styles installed in the flow up direction is recommended. The slotted or drilled hole cages “break up” the flow, minimizing the potential energy available to be dissipated during the outgassing process. Many relatively small sources of energy do not possess the damage capabilities of fewer large sources. By flowing the process fluid up, these small sources of energy are kept away from other critical trim parts. Standard hardened cage, plug and seat parts are recommended.

For pressure drops over 600psi - Use of slotted Whisper I cage made of solid Alloy 6 is recommended or Whisper III cage made of 17-4PH SST. A hardened valve plug and seat ring is also recommended.

In special cases, high-pressure drops, large volume ratios of gas, or particulate may be present. In these cases, alternate valve styles should be considered. DST can be used in select cases when high pressure drops and particulate are present. Other options include the 461 sweep flow angle body and the V500 eccentric plug valves in reverse flow. Both valves have been proven successful at handling this service.

Stems should be ¾” minimum on 2” and over valves to maximize stem/packing area to reduce wear due to the vibration inherent in the process. Nitronic 50 stem material is adequate but Inconel can be used on high vibration application retrofits if needed. If the stem plug connection needs strengthening, it can be welded.

Enviro-Seal packing is recommended to reduce vibration and extend packing life. Packing

leaks can often be the first sign of trim wear. Many valves are torn down because of packing/stem seal degradation. The Enviro-Seal packing has proven to extend service life in hydrocarbon and steam applications.