Compliance Issues Facing Midstream Production

It's in the news every day; the natural gas production industry is experiencing record growth. The gas reserves in the United States are thought to hold enough natural gas for hundreds of years and the gas and oil industry has improved extraction techniques that make gas production more affordable and less impactful on the landscape. This is good news for the country and our environment.

The Midstream Process

Midstream gas processing plants are complicated production facilities. These plants process large quantities of natural gas and hydrocarbons. Safety comes first at every site and high quality standards drive every decision. Natural gas has to be processed to very demanding industry standards.

The process involves cleaning natural gas of harmful impurities and water. When natural gas is extracted from the ground it contains high amounts of CO2, water, and corrosive sulfur compounds. A common processing operation includes glycol dehydration and amine stripping. An amine stripper is a counter current stripping operation where natural gas is directed into the bottom of a tall tower and an amine liquid solution is poured into the top of the tower. As the gas contacts the liquid, the CO2, water, and H2S impurities are adsorbed from that gas and held in the liquid. The natural gas is now processed and ready to be directed to the downstream users. The amine system uses a re-boiler that boils off the CO2, water, other VOC's, and H2S so the amine solution can be re-used. The vent gas from the re-boiler is the subject to EPA guidelines; 40 CFR, Part 63, Subpart HH. Under this rule, greater than 95 percent of the pollutants must be destroyed before release to atmosphere.

The Problem

The typical off gas from an amine treatment system is rich in CO2, contains substantial amounts of water, and varying concentrations of hydrogen sulfide (H2S). These three components combine to form a corrosive gas that has a tendency to condense and form a corrosive liquid. The gas also contains a variety of hydrocarbons such as; methane, ethane, propane, butane, benzene and others, all in varying concentrations. To further complicate the abatement plan, the gas contains no oxygen. Oxygen is a necessary ingredient when "oxidizing" VOC's.

Given the complications the vent gas presents, many operators have opted to use flares as the abatement device. However, flares have several drawbacks that prevent efficient operation and under recently proposed EPA changes to the rules, flares will surely be discontinued in many future plant designs. (See, for example, 40 CFR, Part 63.11b for flare design criteria that will apply to flare installations in the future). As a replacement technology for flares, thermal VOC abatement can be broken down into two common technologies: Catalytic Oxidation and Thermal Oxidation.

1. Catalytic Oxidation uses a catalyst to initiate conversion of hydrocarbons to CO2 and water vapor at low temperatures. However, given the presence of sulfur compounds (sulfur is a catalyst poison), Catalytic Oxidation is not a good long term choice.
2. Thermal Oxidation is a process by which the vent gas is raised to 1,400 F, held in a reaction chamber where the hydrocarbons are oxidized to CO2 and water vapor. Thermal Oxidation provides very high destruction efficiency and is considered a safer method than flaring.

Gas processors are now focused on efficient operations of their plants. The old school mentality of the gas processor did not consider natural gas fuel efficiency because they had an unlimited supply of the fuel. Now the modern gas processing facility understands the gas they use in their operations is less gas they can sell downstream. Plus, EPA considers Greenhouse Gas (GHG) emissions as a regulated air pollutant. Methane, the primary component in natural gas, is a GHG with a Global Warming Potential 21 times that of carbon dioxide, according to the EPA.

Midstream processors have multiple issues to think about when designing their plants:

- Reliable VOC abatement systems
- Long lasting designs that consider the corrosive nature of the vent gas
- Safe designs that are capable of operating in hazardous areas
- Fuel efficient to help lower processing costs, provide more product for sale, and limit GHG emissions

The Solution

The first step to developing a suitable action plan is choosing the right partner. For a successful project, the processor should work with a company that has a long history in the petro-industries, offers a complete product line, has the knowledge to integrate a safe system, and a support staff with a proven track record of success.

Next, a thorough review of the expected vent gas must be conducted. As noted earlier, different natural gas regions have different varieties of gas, and thus different vent gases can be expected. Once the vent gas has been defined the final choice of abatement technology can be considered.

Thermal Oxidation can be segmented into three primary technologies for the natural gas processor:

- Regenerative Thermal Oxidation – uses ceramic media and switching valves
- Recuperative Thermal Oxidation – uses traditional shell and tube heat exchanger
- Non-recuperative Thermal Oxidation – commonly called an afterburner or combustor, this system does not employ heat recovery. These systems easily meet EPA requirements, but consume substantial amounts of fuel.

We consider all three systems appropriate technology, but the final choice is usually based on the expected amount of VOC's contained in the vent gas. If the vent gas contains low amounts of VOC (usually less than 10 percent of the LEL) then the Regenerative Thermal Oxidizer (RTO) is an appropriate device. However, if the vent gas contains higher LEL or upset conditions that may exceed 25 percent, then the Recuperative Thermal Oxidizer is a better choice. Certain circumstances may point to the use of the non-recuperative Thermal Oxidizer, but considering the high fuel use, these systems are employed less.

It's important to partner with a company that offers all technologies. The right equipment provider can work with the gas processor to identify all considerations in equipment design and finally offer the right solution, based on the gas processors unique needs; not the equipment providers product line.