Maximize Natural Gas Vapor Recovery

New regulations challenge oil and gas producers to optimize operations, and oil-free reciprocating gas compressors can help.

By Glenn Webb

Oil and natural gas producers have always had an economic rationale to capture or recover as much product as possible in the oilfield. Any vapors that were vented to the atmosphere or flared off during the production process were no longer saleable, or not worth the time and labor needed to reclaim them. Now, an even more compelling reason for producers to optimize their operation's vapor-recovery capabilities exists.

In August 2011, the U.S. Environmental Protection Agency (EPA) introduced New Source Performance Standard 40 CFR, Part 60, Subpart OOOO, or the "Quad O" regulation. In October 2012, Quad O became law and began affecting oil and gas storage facilities, natural gas processing plants and gas wells across the country.

Quad O establishes emission standards and compliance schedules for the control of volatile organic compounds (VOC) and sulfur dioxide (SO_2) emissions from storage tanks in tank batteries that are used to temporarily hold liquids produced during oil and natural gas production.

More specifically, Quad O includes a requirement that VOC emissions be limited to less than 6 tons per year (tpy)—a daily equivalent of 33 pounds—from storage tanks that contain crude oil, condensate, produced water and other unrefined petroleum liquids.

Per the edicts of the Quad O regulation, storage tanks were divided into two distinct groups:

- **Group 1**—Any storage vessel constructed, reconstructed or modified after Aug. 23, 2011, but before April 12, 2013
- **Group 2**—Any storage vessel constructed, reconstructed or modified after April 12, 2013, or within 60 days after startup, whichever is later

On April 15, 2014, all Group 2 storage tanks must be fully compliant with Quad O, while all Group 1 tanks have until April 15, 2015, to attain Quad O compliance.

This has led to a rush by oil and natural gas producers to upgrade their vapor-recovery abilities so that their tank batteries will emit less than the allowable 6 tpy of VOCs and SO_2.

This article will demonstrate how a specific type of compressor technology—oil-free reciprocating gas compression—can be used to maximize the performance of vapor-recovery units at storage facilities, all with the ultimate goal of satisfying the emission limits of the EPA's Quad O regulation.

THE CHALLENGE

Crude oil storage tanks often have issues with gas vapors escaping, even though most tanks have various types of door hatches, gaskets and low-pressure pop-off vent valves that have been designed to control and limit the amount of escaped product vapors.

Without any strong environmental regulations restricting this venting, many tanks were, and are, in poor shape, with faulty hatches and safety valves that leak badly. In some cases, operators do not even close the hatches, or the tanks have faulty gaskets that allow vapors to leak uncontrollably. In many instances, releases would occur simply because of the buildup of vapor pressure in the tanks, which would cause the tank's relief valves to open and release the excess vapor pressure.

The Quad O mandate requires that 95 percent of vapor releases now be contained, flared or reclaimed. Several types

Oil-free reciprocating gas compressors help oil and gas producers and handlers meet the Quad O requirements.

of compressors have been popular for the reclaiming process. Rotary vane, rotary screw and reciprocating piston compressors are all used. Depending on the overall operating conditions (required flow rate and discharge pressure) a particular compressor technology would be selected.

However, oil-free reciprocating gas compressors are ideal for applications in which discharge pressures are around 50 psig (3.4 barg), and in some extreme cases can be more than 500 psig (34.4 barg). Typical discharge pressures from crude oil storage tanks are usually less than 200 psig (13.8 barg).

The challenge for the compression equipment is that traditional lubricated piston compressors and some rotary designs do not have leak-tight sealing or the ability to handle small amounts of condensed liquids (condensate) that can form in the compressor. This condensate collects in the crankcases on some reciprocating compressors and contaminates lubricating oils, causing extremely frequent oil changes and, in many cases, significant power-frame damage to the bearings and shafts. In many cases, frequent complete compressor replacement is considered "acceptable" when the damage is considerable.

Oil-free reciprocating gas compressor technology with a distance-piece design is a unique feature that allows the condensate to be collected and controlled at the compressor's distance piece, keeping it out of the critical power-frame area in which damage can occur. The added benefit of the oil-free design is that it has two sets of rod seals that seal the gas at the distance piece, reducing the amount of gas vapors that can escape to the environment through the crankcase. This is typical in most styles of reciprocating machines.

THE SOLUTION

Recognizing the untapped potential for an improved vapor-recovery technology in the oilfield, a Michigan pump manufacturer provides compressor products that cover a broad range of markets, including oilfield vapor-recovery applications.

Several of the pump manufacturer's series of oil-free reciprocating gas compressors were designed to handle hazardous, toxic or flammable gases. Their oil-free design provides unique features that were once considered unnecessary and unimportant in the natural gas market. These features have strong environmental appeal while offering the best vapor-recovery mechanics and sealing technology. The benefits of these features include:

- Oil-free designs do not add additional contamination to the gas being handled or recovered.
- Maximum control of gas leakage from the compressor is achieved because of the

A vapor-recovery unit featuring an oil-free reciprocating gas compressor is a reliable way to control the amount of vapors that are lost to the atmosphere at a crude oil tank battery.

compressor's full distance-piece compartment and piston-rod seals. The two sets of rod seals create a compartment between the process gas and the lubricated crankcase, which provides leakage control and minimizes any leakage to the crankcase or the atmosphere.

- The ductile-iron construction of all pressure parts results in greater resistance to harmful thermal and mechanical shock.
- High-efficiency valves made of polyether ether ketone are self-lubricating and provide high-quality sealing characteristics and durability.
- A heavy-duty, precision-ground crankshaft features roller bearings and integral counterweights to ensure smooth, quiet operation.

These design advances make these compressors environmentally friendly and a safe method to move and recover gas vapors. In highly regulated tank vapor-recovery applications, these important features help deliver peace of mind to the oilfield operator and producer.

The distance-piece design feature of the oil-free reciprocating gas compressors is critical because condensate can form inside the compressor because of the wide mix of hydrocarbons that can often be found in the gas stream.

Formation of condensate inside the compressor is never good. When the gas is compressed, heavier hydrocarbons and small amounts of water vapor can form. Compressors that do not have a distance piece allow the condensate to leak directly into the crankcase. It can damage the quality of the lubricating oil and lead to significant bearing damage or a complete failure of the power frame.

The oil-free reciprocating gas compressors help control condensate that may form. Their design helps control small amounts of condensate by collecting it in the distance-piece compartment.

Easy operator access to this compartment allows the end user to empty it regularly. The distance piece can also be vented to a safe disposal area when available. While single-compartment, distance-piece designs will generally satisfy most design requirements, the pump manufacturer also provides triple-packed (two-compartment distance-piece) models for applications in which leakage control is extremely critical. These designs have been used in industrial and chemical plant applications for many years.

Single-stage models, which are recommended for use on low-to-moderate compression-ratio applications, are available in seven sizes with piston displacements up to 125 cubic feet per minute (212 cubic meters per hour) at working pressures up to 1,000 psia (69 bara). The three, two-stage models, which are available for higher compression-ratio requirements, provide piston displacement up to 53.7 cubic feet per minute (91.2 cubic meters per hour) at a working pressure up to 615 psia (42.4 bara).

CONCLUSION

In January, the North Dakota Petroleum Council's Flaring Task Force reported to the North Dakota Industrial Commission that it believed that the state's oil and gas industry can increase natural gas capture to 85 percent of the total volume produced within two years, to 90 percent by 2020 and up to 95 percent within the next decade. Reaching these levels, however, will require full buy-in from a number of entities, most notably the oil and gas companies operating in the state.

Process-system designers and environmental-compliance managers at those oil and gas companies—and at others around the country—will improve their chances of 95 percent capture of natural gas by continuing to incorporate improved vapor-control technology that minimizes the amount of vapors and VOCs that are released to the atmosphere at tank battery locations.

Oil-free reciprocating gas compressor designs provide a safe and effective method to control potentially dangerous vapor emissions. In addition to their environmentally-friendly benefits, they provide economic advantages to operators because of their ability to efficiently recover gas from different types of storage tanks. This leads to a higher amount of saleable end-product while simultaneously protecting the atmosphere. When used in many tank battery applications, the vapor recover unit equipment will have a lucrative payback period. **P&S**

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