Glycol Dehydrators

Program Description

This strategy to reduce ambient ozone levels within the non-attainment Area (NAA) involves modifying Colorado Air Quality Control Commission Regulation No. 7 (Reg. 7) regarding natural gas glycol dehydrator systems located within the NAA and state-wide by revising one or more of the following:

- Modify dehydrator applicability threshold
- Increase 90 percent control requirement to 98 percent
- Require optimization of lean glycol pump circulation rates
- Require installation of flash tank separators and the control of emissions on new dehydration systems
- Require using portable desiccant dehydrators

Produced natural gas usually contains water, which can condense or freeze in gathering, transmission, and distribution piping. This can cause plugging, pressure surges, and corrosion. Therefore, it is desirable to remove water from the natural gas before it is sent to collection or sales lines. Glycol dehydration systems are commonly used to do this. They are used at exploration and production (E&P) sites, processing facilities, and compressor stations. Glycol entering the dehydrator contactor tower is considered "lean". As the glycol absorbs water and residual levels of hydrocarbons (methane, volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) from the natural gas it becomes "rich". Rich glycol is circulated to a glycol reboiler, where it is regenerated as water and hydrocarbons are boiled off. It is then pumped back to the contactor as lean glycol. Water and hydrocarbon vapors are discharged from the reboiler via still vents either to atmosphere or to a control device, such as an enclosed smokeless combustion device or a condenser.

Modify Dehydrator Applicability Threshold and Increase Control Requirement

Reg. 7 XII.C (NAA) and XVII.D (state-wide) requires that VOCs from natural gas glycol dehydrator still vents or vents from any gas-condensate-glycol separator shall be controlled by at least 90 percent through the use of a condenser or air pollution control equipment if the dehydrator(s) have uncontrolled actual emissions of 15 or more tons per year (tpy) VOCs. The Colorado Air Pollution Control Division (APCD) is considering modifying this regulation by reducing the threshold from 15 tpy to 2 tpy within the NAA. For the rest of the state, the threshold may be lowered from 15 tpy to 5 tpy. Also, APCD is considering increasing the control requirement from at least 90 percent to at least 98 percent. Many control technologies already in place achieve control efficiencies of at least 98 percent, such as vapor recovery units, enclosed smokeless combustion devices (e.g., thermal vapor incinerators, boilers, or process heaters), and smokeless flares.

Optimization of Pump Circulation Rates

A pump is used to circulate glycol through the dehydrator system between the reboiler and contactor. Often, the glycol circulation rate is set higher than necessary. At E&P sites, it is often set for an initial high production rate and then becomes over-sized as the well matures. Industry studies have found that circulation rates are often two or three times higher than necessary.[1] Rates may also initially be set higher than necessary to meet sales gas moisture content specifications. Dehydrator system hydrocarbon (methane, VOC, and HAP) emissions are directly proportional to the amount of glycol circulating through the system. Over-circulation results in increased hydrocarbon emissions without significant reduction in gas moisture content. The APCD is considering requiring that glycol pump circulation rates be optimized for dehydrator systems that are not subject to 90 percent control.

Installation of Flash Tank Separators and Controls

At most natural gas E&P sites and processing facilities, rich glycol is pumped directly to a reboiler. Reboiler vent hydrocarbon emissions can be reduced by installing a flash tank separator upstream of the reboiler. The tank separates gas (methane, VOCs, and HAPs) from liquid (water and glycol). Separation

occurs as a result of a sudden drop in pressure of the glycol solution, which allows the entrained gas to vaporize ("flash"). Water and residual levels of hydrocarbons stay in solution with the glycol. The glycol solution is then routed to the reboiler, where everything except the glycol is boiled off and either vented to atmosphere or further controlled.

In order to benefit from installing a flash tank separator, the gas that is removed from the glycol solution must be controlled by either recovery or combustion so that it is not released to atmosphere. It can be controlled using technologies including a vapor recovery unit (VRU), enclosed smokeless combustion device, or smokeless flare. These typically require an upstream condenser, which captures most non-condensable gas (primarily methane, but also VOCs and HAPs). This recovered gas may be recycled to the compressor suction and/or used as a fuel for the glycol reboiler and compressor engine. If this is done, valves should be in place to keep recovered gas from being routed to equipment that is not in use. Combustion technology typically consists of an enclosed flare/burner.

Portable Desiccant Dehydrator

Although the most common dehydrator systems use glycol to remove water from natural gas, other options are available. Desiccant dehydrators use moisture-absorbing salt tablets or specialized synthetic beads to remove water from natural gas. The system is closed; therefore, natural gas is only emitted when the dehydrator is opened, such as when adding salt tablets. The salt tablets gradually dissolve during the dehydration process. If beads are used instead of salt tablets, the system needs two chambers; one that is operating and one that has been regenerated. Chambers are regenerated by passing hot air counter current to the gas flow. Desiccant dehydrators are used at natural gas facilities and particularly at E&P sites, but generally only as backups for glycol dehydrators during maintenance or breakdown periods because desiccant dehydrators work best in specific conditions (e.g., when inlet gas is at a high temperature and low pressure). They may also be used during well completions as part of green completion methods.

An operator from Wyoming made a presentation in March 2007 at the New Mexico Oil Conservation Division Greenhouse Gas meeting indicating that desiccant dehydration technology initially looked favorable, but his company has experienced operational concerns and is removing all desiccant dehydrators from service.[2]

Air Quality/Health and Welfare Benefits

While health benefits are not quantified here, it is understood that reducing direct emissions of VOC, NOx, and CO will reduce air toxics and other criteria pollutants. This will reduce the incidence of human health impacts caused by pulmonary, cardiovascular, respiratory, and nervous system disease. Because ozone damages crops, forests, and other natural plant life, all would benefit if emissions are reduced. NOx reductions, which would occur if the feed stream to the reboiler is reduced, benefit wildlife by reducing contributions to nitrogen deposition. This strategy would also reduce emissions of methane and other greenhouse gases, which contribute to climate change.

Modify Dehydrator Applicability Threshold and Increase Control Requirement

Reducing Reg. 7 applicability threshold would reduce emissions of methane, VOCs, and HAPs. Depending on the control device(s) already in use, facilities may reduce VOC and HAP emissions by up to 90 or 98 percent. Another consideration in determining emission reductions is that facilities already comply with other related regulations. An example is 40 CFR Part 63, Subpart HH, which applies to all triethylene glycol (TEG) dehydrators and has control device, testing, monitoring, leak detection and repair (LDAR), glycol pump optimization, record keeping, and reporting requirements. This option would also apply to ethylene glycol (EG) and diethylene glycol (DEG) dehydrators.

Require Optimization of Pump Circulation Rates

The amount of natural gas absorbed by glycol is proportional to the glycol pump circulation rate. Therefore, if the pump rate would be reduced, the amount of natural gas absorbed and emitted during the regeneration process would also be reduced. When recirculation rates ranging from 45 to 2,250 gallons

per hour (gal/hr) are reduced by 30 to 750 gal/hr, methane emissions are reduced by 400 to 40,000 thousand cubic feet (Mcf).[3]

Installation of Flash Tank Separators and Controls
Flash tank separators capture approximately 90 percent of methane and 10 to 40 percent of VOCs absorbed in glycol, which keeps those emissions from being released from the reboiler to the atmosphere during the glycol regeneration process.[1] However, the air quality benefit would be negated if the separator vent is not routed to a VRU or combustion device. VRUs and combustion devices reduce VOC and HAP emissions by at least 98 percent.[4]

Portable Desiccant Dehydrator
Natural gas is emitted from a desiccant dehydrator only when the dehydrator is being filled with desiccant. Emissions from a dessicant dehydrator are less than emissions from glycol dehydrator systems.[5]

Program Costs

Modify Dehydrator Applicability Threshold and Increase Control Requirement
If the regulation applicability threshold were reduced, companies would need to purchase, install, and maintain control devices. Depending on the control device(s) already in use, facilities may or may not incur costs if the control requirement increased from 90 percent to 98 percent. Many vapor recovery units and combustion devices already have control efficiencies of at least 98 percent.

Require Optimization of Pump Circulation Rates
The cost to reduce pump circulation rates would be negligible. Because less methane would be absorbed into glycol in the contactor, more would be available to sell. Industry has had annual savings of between $390 and $39,400 per system by reducing pump circulation rates (based on a sales price of $3 per Mcf).[1] In addition, reducing pump circulations rates reduces replacement costs and reboiler fuel consumption.

Installation of Flash Tank Separators and Controls
For all but the smallest systems, it is economical to install a flash tank separator at a glycol dehydration system. For systems with an energy-exchange pump and recirculation rates of 30 to 450 gal/hr, the payback ranges from 29 down to 5 months, respectively. For systems with an electric pump and recirculation rates of 150 to 450 gal/hr, the payback ranges from 17 down to 8 months, respectively. These estimates are based on a gas value of $3 per Mcf.[1]

The following VRU cost information is based on methane emission reductions of 3,300 Mcf per year applied to a 10 MMcf per day glycol dehydration unit with a gas-assist circulation pump and flash tank separator connected to an existing production tank VRU[4]:

- Methane savings = 3,300 Mcf per year
- Capital costs (including installation) = $1,000 to $10,000
- Operating and maintenance costs (annual) = greater than $1,000
- Payback (years) = up to 1 year

The cost to install a typical condenser and smokeless combustion chamber large enough to service a dehydrator is approximately $35,000. Because natural gas is destroyed during combustion, there is some loss in revenue due to combustion of natural gas. Fuel costs approximately $1,800 per year for each combustor pilot light (based on a sales price of $3 per Mcf).[4]

Portable Desiccant Dehydrator
It is not cost effective to replace an existing dehydration system with a desiccant system; however, it may be cost effective for new installations. Capital cost of a 10-inch portable desiccant dehydrator is estimated to be greater than $4,000. Operating costs, which include labor, transportation, set-up, and decommissioning, are approximately $5,000 per year. One source indicates that they are economical when used on gas wells that produce more than 15.6 Mcf/day.[2]

Implementation/Administration

This strategy has the potential to significantly increase the number of regulated sources, and has reporting, permitting, and/or compliance assurance impacts to the APCD.

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[1] US EPA, *Lessons Learned: Optimize Glycol Circulation and Install Flash Tank Separators in Glycol Dehydrators*
[2] Four Corners Air Quality Task Force, *Four Corners Air Quality Task Force Report of Mitigation Options*, Mitigation Option: Portable Desiccant Dehydrators, November 1, 2007
[3] ENVIRON, *WRAP Area Source Emissions Inventory Projections and Control Strategy Evaluation Phase II Final Report*, September 2007
[4] CH2MHill, *Review of Oil and Gas Operation Emissions and Control Options Final Report*, June 29, 2007
[5] US EPA, *Methods for Reducing Methane Emissions from Natural Gas Systems*, www.coalinfo.net.cn/coalbed/meeting/2203/papers/naturalgas/NG019.pdf