OUTLINING STEPS TO GLYCOL HANDLING IN MIDSTREAM NATURAL GAS: WHITE PAPER

Glycol, typically triethylene glycol (TEG), is a common input for natural gas dehydration. In the glycol dehydration process, clean TEG is essential to the safe performance of gas dehydrators and regularly needs to be replaced or reconditioned to maintain its cleaning efficiency.

As the production of natural gas continues to increase throughout the United States, operators across all sectors of the industry face decisions about how to meet growing demand and consumption. The midstream sector acts as a link between natural gas production at the wellhead and the refining and delivery of natural gas products to consumers. To ensure natural gas moves safely from upstream to downstream, midstream operators must process the gas to remove potentially hazardous components, such as water, chlorides and sludge, from the gas stream. Midstream operators rely on dehydration to help accomplish this vital task.

Dehydration is a necessary step in the processing, transportation and storage of natural gas. Raw natural gas contains water and other contaminants that must be removed before the natural gas can be safely delivered to its downstream destination. According to NaturalGas.org, "Whatever the source of the natural gas, once it is separated from crude oil (if present) it commonly exists in mixtures with other hydrocarbons; principally ethane, propane, butane, and pentanes. In addition, raw natural gas contains water vapor, hydrogen sulfide (H2S), carbon dioxide, helium, nitrogen, and other compounds."[1] The removal of these materials protects the integrity of pipelines and processing equipment by reducing the likelihood of hydrate formation and corrosion. Accumulated hydrates, solid or semi-solid compounds with a resemblance to ice crystals, can impede the passage of natural gas through valves and gathering systems, slowing production and blocking pipelines.[2]

Beyond compromising the integrity of pipelines and processing equipment, the presence of water and corrosive materials can also pose an environmental and public health risk. To minimize these risks and ensure the quality of the natural gas end product, strict requirements dictate the level of dehydration and contaminant removal that must occur. The U.S. Energy Information Administration (EIA) states that, "Because a natural gas leak could cause an explosion, strict government regulations and industry standards are in place to ensure the safe transportation, storage, distribution, and use of natural gas."[3] The National Energy Technology Laboratory clarifies the division of regulatory power in the natural gas industry by explaining,

> "The development and production of oil and gas in the U.S., including shale gas, are regulated under federal, state, and local laws that address every aspect of the exploration, production and transportation processes ... The U.S. Environmental Protection Agency (EPA) administers most of the federal laws, although development on federally owned land is managed primarily by the Bureau of Land Management (BLM), which is part of the Department of the Interior, and the U.S. Forest Service, which is part of the Department of Agriculture. In addition, each state in which oil and gas is produced has one or more regulatory agencies that permit wells (including their design, location, spacing, operation, and abandonment) and regulate activities with potential environmental impacts (including water withdrawals and disposal, waste management and disposal, air emissions, underground injection, wildlife impacts, surface disturbance, and worker health and safety)."[4]

To illustrate the scope of regulatory supervision over the natural gas industry at the state level, in Texas, the Railroad Commission of Texas (RRC) has primary regulatory jurisdiction over the oil and gas industry, and the Texas Commission on Environmental Quality (TCEQ) acts as the environmental agency in the state. RRC and TCEQ work closely together to oversee regulations, permitting and responses to spills, air emissions, waste materials, wastewater and storm water, on-site sewage facilities and domestic sewage associated with oil and gas activities.[5] As demonstrated, safety and compliance are of the utmost importance in the natural gas processing sector.

With all aspects of the natural gas chain regulated across levels of government as well as privatized business, natural gas processors face obligatory waste management decisions regarding the use of glycol. Glycol dehydration, typically conducted with triethylene glycol (TEG), is a reliable and widely used method of dehydration in the natural gas industry. As John Carroll asserts in the third edition of Natural Gas Hydrates: A Guide for Engineers, TEG is the most commonly used solvent for the dehydration of natural gas because it meets commercial application criteria and possesses other advantageous qualities, including less dew point depression and lower vapor pressure.[6] When used to dehydrate natural gas, glycol works as a liquid desiccant to absorb water and liquid hydrocarbons from the gas stream. As a result, spent glycol can be saturated with contaminants including benzene, ethylbenzene, toluene and xylenes (BTEX) and volatile organic compounds (VOCs) in addition to its water content. Carroll proposes that due to the solubility of aromatic hydrocarbons like BTEX, TEG could absorb up to 25 percent of these compounds present in the gas stream, under typical temperature, pressure and circulation rate conditions.[7] While its significant absorption abilities provide benefits in the natural gas dehydration process, glycol also presents the pressing operational concern of waste management. While glycol is considered an exempt oil and gas waste in the scope of the federal Resource Conservation and Recovery Act (RCRA), it is still subject to state and local waste management regulations due to the presence of potentially hazardous pollutants in spent glycol, rendering proper disposal or regeneration mandatory.[8]

To maintain an effective glycol dehydration process and to adhere to regulatory requirements, spent glycol must be either disposed of and replaced or reconditioned. Traditionally, site operators rely on hazardous waste disposal and/or storage services to ensure disposal practices comply with all applicable laws and regulations. Disposal through an approved waste management provider ensures the safe handling of spent glycol, and replacement with new glycol ensures the dehydration unit's efficiency. However, disposal and replacement have its drawbacks. Perhaps most significant on the natural gas processor side is cost. The U.S. Energy Information Administration's (EIA) Annual Energy Outlook 2018 projects that U.S. dry natural gas production will grow 59 percent from 2017 to 2050, from 73.6 billion cubic feet per day (Bcf/d) in 2017 to 118 Bcf/d in 2050.[9] With the average dehydration unit requiring 1,000 gallons of TEG and the price of TEG continuing to rise, processing by the glycol disposal/replacement method can rapidly yield substantial expenses. Moreover, the safe removal and replacement of spent glycol in a dehydration unit requires site downtime, which in turn is an added operator expense due to lost production time.

To combat some of the shortcomings of spent glycol disposal and replacement, glycol reclamation is a viable option. Similar to waste disposal services, numerous reclamation services exist that provide off-site recycling and reconditioning of spent glycol. The U.S. Environmental Protection Agency (EPA) asserts the environmental benefits of recycling hazardous wastes include "reducing the consumption of raw materials, reducing pollution, reducing energy use and reducing the volume of waste that must be treated and disposed of." The EPA continues by noting hazardous waste recycling's economic benefits: "recycling hazardous waste can increase production efficiency and reduce costs associated with purchasing raw materials and waste management."[10] However, although off-site glycol reclamation eliminates the expenses of new glycol and waste disposal, this reclamation method also presents site operators with recurring costs. To process the glycol off site, spent glycol must be either collected and hauled away by the off-site reclamation service or stored and taken to the recycling facility. Both alternatives require site shutdown to gather and transport the contaminated glycol to be reconditioned. In addition to transportation costs and production loss, off-site reclamation limits operators' control over the quality of their reclaimed glycol. Illegitimate or "sham" recycling is a possible risk operators face when selecting an off-site reclamation provider. According to the EPA, "sham recycling may include situations when a secondary material is ineffective or only marginally effective for the claimed use; used in excess of the amount necessary; or handled in a manner inconsistent with its use as a raw materials or commercial product substitute."[11] As the EPA explains in its Guide for Generators of Hazardous Secondary Materials, materials sent for recycling can be poorly managed or mismanaged, posing serious health and environmental hazards. Choosing a responsible recycling facility is paramount to complying with safety, health and environmental regulations as well as protecting your business operation.[12]

Another method of recycling spent glycol is on-site reclamation. In on-site glycol reclamation, a reclamation unit is attached to the dehydrator and processes polluted glycol while the dehydration unit continues to run. Such reclamation units include the PACER by Cimarron Tank and TEG Solutions' reconditioning unit. The method employed by these brand name systems uses vacuum distillation to allow natural gas processors to recycle glycol with minimal disposal or transportation fees and site downtime. A U.S. patent for an on-site glycol refining system explains the reclamation process by vacuum distillation. First, spent glycol is brought into the reclamation system by vacuum and/or gravity. Inside the system, spent TEG is heated to its evaporation point while being subjected to a vacuum, and resulting vapors are moved to a separate chamber where they are cooled, condensed and stored. Meanwhile, suspended solids settle into a basin in the bottom of the unit.[13] Through this ongoing process, on-site glycol reclamation also grants site operators direct control over the quality of reconditioning conducted. Depending on the composition of the site's natural gas stream, operators can elect how long to let the reclamation system run to meet their desired level of glycol purification.

Moreover, on-site reclamation systems such as The PACER by Cimarron Tank and TEG Solutions' reconditioning unit boast added preventative maintenance as their units utilize a closed system, cleaning the dehydrator unit at the same time the system treats spent glycol. While significantly reducing production loss, on-site glycol reclamation requires site downtime to remove the potentially hazardous byproduct that results from insoluble contaminants' settling in the unit's settling basin. A benefit to the site operator, however, is that this waste accumulates slowly over time. In fact, the PACER by Cimarron Tank and TEG Solutions state the use of their on-site reclamation systems reduces hazardous waste disposal by 97 percent, compared to the disposal and replacement method. [14,15] The on-site reclamation provides the benefits of reusing an expensive input while minimizing service costs, site downtime and waste production.

In summary, natural gas processing is a significant and recurring component of the midstream sector. Operators must remove water and impurities from natural gas to ensure the gas moves safely from upstream to downstream, no matter how the gas is transported, stored or ultimately refined. As many midstream players rely on glycol dehydration to conduct this process, clean glycol is a valuable input on any midstream natural gas operation. On-site glycol reclamation using a system such as the PACER by Cimarron Tank or TEG Solutions delivers the benefits of reconditioning spent while reducing production loss, minimizing site downtime and protecting site equipment.

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