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Advanced Dehydrator Design Recovers Gas, Reduces Emissions

Introduction and Background

It is estimated that about 252,000 natural gas production wells are currently operating in the United States. Gas produced from these wells often contains excess water, which must be removed to prevent corrosion and hydrate formation in pipelines. The most widely used natural gas dehydration process is the glycol dehydration process, in which Triethylene glycol (TEG) absorbs water by directly contacting natural gas. As TEG absorbs water, it also absorbs CH_4, other volatile organic compounds (VOCs), and hazardous air pollutants (HAPs) present in the natural gas. These pollutants are often vented to the atmosphere, making glycol dehydrators a significant source of CH_4 and HAP emissions.

A 1996 study conducted by the Environmental Protection Agency (EPA) estimated that more than 38,000 glycol dehydration units are operating in the U.S., collectively emitting about 18.6 billion cubic feet of CH_4 per year into the atmosphere [1]. Within the gas production sector, glycol dehydration of natural gas is the third largest source of total CH_4 emissions accounting for 17 percent of total GHGs [2]. HAP and VOC emissions from glycol dehydrators represent 85 and 81 percent of annual emissions from natural gas production, respectively [3, 4]. On June 17, 1999, the EPA promulgated final maximum achievable control technology (MACT) standards, which require owners or operators of glycol dehydration units to reduce HAP emissions by 95 percent [5].

In response to the Oil and Natural Gas Production MACT rule, affected facilities must install control devices to recover and/or destroy pollutants in the dehydration vent stream. Engineered Concepts, LLC (ECL), located in Farmington, NM, has developed a new gas dehydration system designed meet this goal. In the process of reducing HAP emissions, the technology also reduces CH_4 emissions, a potent GHG. The technology, referred to as the Quantum Leap Dehydrator (QLD), is an integrated system which collects hydrocarbon vapors present in the dehydrator vent, condenses the hydrocarbons to form a condensate product for sale and water for disposal, and uses excess hydrocarbon vapors as fuel for the system.

Technology Tested

The QLD is a re-design of the conventional glycol regeneration process. It uses principles of liquid condensation, phase separation, and hydrocarbon combustion in an integrated system that reportedly produces a saleable product, wastewater that does not require significant cleaning, and very little air pollution. As shown in Figure 1, the following key modifications (as compared to conventional dehydrators) have been integrated into the QLD: replacement of gas-assisted pump with electric pump (reduces CH_4 losses and emissions), recovery and use of still vent emissions (eliminates direct release of CH_4 and pollutants), and reboiler re-design (reduces natural gas fuel input and emissions).

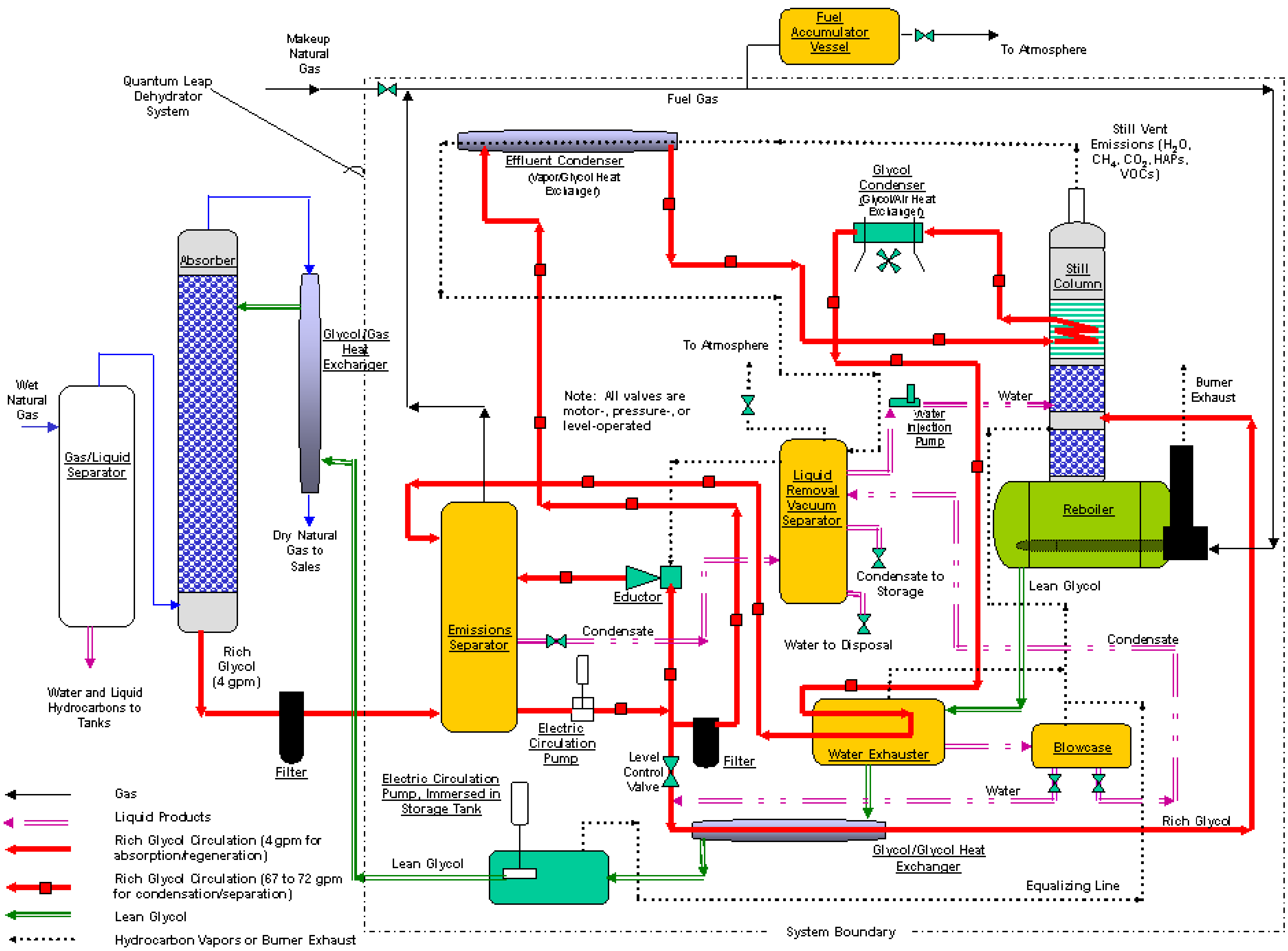

Figure 1. Schematic of QLD Natural Gas Dehydration Technology

The primary design modification in the QLD is a control system that recovers and uses still vent vapors. As shown in Figure 1, hydrocarbons and HAPs emitted via the still column are collected under vacuum and condensed. About 72 gpm of rich glycol functions as a circulating fluid throughout the condensation system, in addition to the 5 gpm glycol circulated throughout the absorption/regeneration process. The entire condensation system comprises a glycol condenser/cooler, an emissions separator, an effluent condenser, and a vacuum separator.

Performance Verification

The verification approach that was developed for the test included the following parameters: sales gas production rate, annual gas savings, reboiler stack emission rates, and HAP destruction efficiency.

Performance testing was conducted in two stages. Operational testing occurred over 7 days to obtain reportable flow rate data and to also ensure that the plant was operating normally. Environmental testing occurred on the following day in three test runs of 70-85 minutes each.

Verification Results

Performance testing showed that average sales gas flow rates were 26.8-29.3 MMscfd. The QLD saved the equivalent of more than 35 million standard cu ft/year of natural gas valued at approximately $173,000. Overall average emission rates for NO_x, CO, CO_2, and VOCs from the reboiler stack were 0.0817, 0.0005, 111, and 0.0003 lb/hr, respectively. HAP destruction efficiency was greater than 99.74% ± 0.01%. Complete verification results of this test are available for free on two websites: www.sri-rtp.com and www.epa.gov/etv.

References

[1] *Methane Emissions From the Natural Gas Industry: Volume 2, Technical Report*. EPA-600/R-96-080b, U.S. Environmental Protection Agency, National Risk Management Research Laboratory, Research Triangle Park, NC. June 1996.

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[3] *National Emissions Standards for Hazardous Air Pollutants for Source Categories: Oil and Natural Gas Production and Natural Gas Transmission and Storage – Background Information for Proposed Standards.* EPA-453/R-94-079a, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. April 1997.

[4] *Preliminary Assessment of Air Toxic Emissions in the Natural Gas Industry, Phase I, Topical Report*. GRI-94/0268, Gas Research Institute, Chicago, IL. 1994.

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About the Authors

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The Greenhouse Gas Technology Center is one of six verification organizations established by the U.S. Environmental Protection Agency's Office of Research and Development as part of its Environmental Technology Verification program. This program facilitates the deployment of new technology through voluntary performance verification and information dissemination. The Center conducts third-party verification testing of promising greenhouse gas mitigation and monitoring technologies. The Greenhouse Gas Center's verification process consists of developing verification protocols, conducting field tests, collecting and interpreting field and other data, obtaining independent peer-review input, and reporting findings.