U.S. Environmental Protection Agency

SOUTHERN RESEARCH INSTITUTE

ETV Joint Verification Statement

TECHNOLOGY TYPE:	**Emissions Control of Criteria Pollutants, Hazardous Pollutants, and Greenhouse Gases**
APPLICATION:	**Natural Gas Dehydration**
TECHNOLOGY NAME:	**Quantum Leap Dehydrator**
COMPANY:	**Engineered Concepts, LLC**
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The U.S. Environmental Protection Agency (EPA) has created the Environmental Technology Verification (ETV) program to facilitate the deployment of innovative or improved environmental technologies through performance verification and information dissemination. The ETV program goal is to further environmental protection by accelerating the acceptance and use of improved and cost-effective technologies. ETV seeks to achieve this by providing high-quality, peer-reviewed performance data to those involved in the purchase, design, distribution, financing, permitting, and use of environmental technologies.

ETV works in partnership with recognized standards and testing organizations, stakeholder groups composed of buyers, vendor organizations, and permitters, and with the full participation of individual technology developers. The program evaluates technology performance by developing test plans that are responsive to stakeholders' needs, conducting field or laboratory tests, collecting and analyzing data, and preparing peer-reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance protocols. This ensures that the resulting data are of known quality and that the results are defensible.

Southern Research Institute operates the Greenhouse Gas Technology Center (GHG Center), one of six ETV Centers, in cooperation with EPA's National Risk Management Research Laboratory. The GHG Center has recently evaluated the performance of the Quantum Leap Dehydrator (QLD), manufactured by

Engineered Concepts, LLC, of Farmington, NM. This Verification Statement provides a QLD verification test summary.

TECHNOLOGY DESCRIPTION

Background

Natural gas often contains excess water vapor at the wellhead which must be removed to avoid pipeline corrosion and solid hydrate formation. Glycol dehydration is the most widely used natural gas dehumidification process. Triethylene glycol (TEG) typically absorbs water from natural gas in a contactor vessel. The TEG absorbs water from the natural gas, but also absorbs methane (CH_4), volatile organic compounds (VOCs), and hazardous air pollutants (HAPs). Gas-assisted or electric pumps circulate the TEG through a distillation column for regeneration and back to the contactor vessel. Distillation removes the absorbed water and HAPs from the TEG to the still column vent as vapor. Conventional dehydrator still columns often emit this vapor directly to the atmosphere. Natural gas dehydration is the third largest CH_4 emission source in the natural gas production industry. Glycol dehydrators also cause over 80 percent of the industry's annual HAP and VOC emissions.

QLD Technology

Information supplied by Engineered Concepts, LLC provided the basis for this discussion. GHG Center personnel verified the function and operation of major system components during the test campaign.

The QLD is an integrated system which collects the water and hydrocarbons present in the glycol reboiler vent stream and separates condensable and non-condensable fluids. The two primary condensable products are: (1) wastewater, which can be disposed of with treatment and (2) hydrocarbon condensate, which is a saleable product. The reboiler burner combusts the uncondensable vapors as the system's primarily fuel. The QLD uses condensation and combustion to reduce both HAP and CH_4 emissions.

The QLD uses a series of heat exchangers, condensers, separators, and electric pumps to recover and use distillation column vapors. First, a liquid removal vacuum separator condenses and collects still column vent water and HAPs vapors under vacuum. The separator partitions the vapor stream into three products: (1) wastewater, (2) condensate, and (3) uncondensed hydrocarbon vapors. The separator discharges the wastewater and condensates into product holding tanks through pneumatically-operated level controllers. Negative gage pressure, created by glycol flow through an eductor (which provides additional scrubbing), transfers hydrocarbon vapors to the emissions separator.

The emissions separator further separates liquid products from uncondensable hydrocarbon vapors and glycol. It transfers liquid products back to the vacuum separator while the reboiler burner combusts the hydrocarbon vapors. The burner operates continuously and throttles the heat output in response to still column heat demand. Burner performance is the primary indicator of whether the QLD can combust the widely varying amounts and quality of fuel gas recovered by the system. The burner system can also accept makeup natural gas if the still column demands additional heat.

An electric pump circulates approximately four gallons per minute (gpm) of TEG through the natural gas contactor vessel. A separate pump circulates about 72 gpm within the QLD condensation/separation system. Electric pumps, in contrast to the widely used gas-assisted pumps, further reduce CH_4 emissions and losses.

Primary QLD air emission sources include: (1) the reboiler burner exhaust, (2) HAPs dissolved in the recovered wastewater, and (3) pressure-relief vents (PRVs). The QLD fabricator and field installers certified the equipment as leak-free, so this verification did not quantify fugitive emissions.

VERIFICATION DESCRIPTION

The GHG Center executed the QLD performance verification test at the Kerr-McGee Gathering Station in Brighton, CO. The test campaign proceeded under requirements set forth in the Test and Quality Assurance Plan – Engineered Concepts, LLC Quantum Leap Dehydration (SRI/USEPA-GHG-QAP-20), June, 2002 (Test Plan). The system was designed to dehydrate approximately 28 million standard cubic feet per day (mmscfd) of natural gas.

Testing commenced in April 2003, approximately one month after completion of system start-up activities. Tests consisted of a seven-day operational performance monitoring period followed by one day of environmental performance testing. The system operated normally during testing, and the GHG Center evaluated the verification parameters listed below:

Operational Performance

Sales Gas Moisture Content: The field site requires that dry natural gas exiting the QLD process contain less than seven lb water/mmscf. An inline moisture analyzer continuously monitored and recorded sales gas moisture readings at one-minute intervals.

Sales Gas Production Rate: The QLD must allow uninterrupted natural gas dehydration and maintain a continuous natural gas flow. An inline integral orifice meter continuously monitored the natural gas flow rate. Data were logged in one-minute intervals.

Glycol Circulation Rate: Facilities affected by the 40 CFR Part 63 standard (Subpart HH) regulations must continuously monitor TEG circulation rates. An ultrasonic meter, installed on the regenerated lean glycol line, recorded one-minute average circulation rates.

Makeup Natural Gas Flow Rate: A separate meter continuously monitored reboiler burner makeup natural gas. The one-minute average readings characterized any additional fuel required by the QLD.

Environmental Performance

Reboiler Stack Emission Rates: Emissions tests determined concentration in parts per million volume, dry (ppmvd) and emission rates in pound per hour (lb/h) for the following air pollutants: nitrogen oxide (NO_X), carbon monoxide (CO), VOCs, HAPs (benzene, toluene, ethylbenzene, xylene, and hexane), and greenhouse gases (CO_2 and CH_4). Three test runs were conducted, each lasting approximately 90 minutes. All testing conformed to U.S. EPA Title 40 CFR 60 Appendix A Reference Method procedures.

HAP Destruction Efficiency: Dehydration facilities subject to MACT must reduce HAP emissions by 95 percent. The tests verified HAP destruction efficiency as a measure of emissions reduced by the QLD. HAP destruction efficiency is the HAPs entering the system (absorbed in rich and lean glycol streams) minus the HAPs emitted from the system (discharged and vented to atmosphere from stack, PRVs, and wastewater) divided by the HAPs entering the system. HAPs dissolved in the condensate product stream are not an emission source because the site uses this product as feedstock for other processes. The regulation defines this as "controlled" or "sequestered" emissions.

Wastewater and Condensate Production Rate: HAP destruction efficiency determination required volumetric measurement of wastewater and condensate production rates.

Independent GHG Center QA personnel conducted a technical systems audit during testing to ensure that field activities complied with the Test Plan. The Center's QA Manager implemented a data quality audit of at least ten percent of the data to ensure that data reduction and reporting accurately represented actual results. The field team leader conducted performance evaluation audits to ensure that the measurement system produced reliable data. In addition to these quality assurance audits, EPA QA personnel conducted a quality assurance review of the Verification Report and a quality systems audit of the GHG Center's Quality Management Plan.

PERFORMANCE VERIFICATION

Operational Performance

One-minute readings provided daily average flow rates and moisture content over the seven-day performance evaluation period. The 75th percentile interval of these readings defined normal operating conditions.

- The QLD natural gas dehydration process met the test site's 7.00 lb/mmscf moisture content requirement. Daily average values ranged between 0.89 and 1.28 lb/mmscf.

- The QLD enabled continuous sales gas flow, with daily average flow rates ranging between 26.8 and 29.3 mmscfd.

- Daily average glycol circulation rates through the absorption and regeneration process ranged between 3.00 and 3.77 gpm.

- The verification test demonstrated that the QLD required little to no makeup natural gas. The normal range of the makeup natural gas flow rate was 0.00 to 1.76 scfh, which is well below the 166 scfh design capacity. The volume and fuel quality of the uncondensed hydrocarbon vapors was generally sufficient to maintain optimum burner control.

Environmental Performance

- Average NO_X concentration for the three test runs was 65.1 ppmvd during normal operations. This equates to a mass emission rate of 0.0817 lb/h.

- Emissions of CO and VOCs were low during all three test runs, averaging 0.6 ppmvd (0.0005 lb/h) and 0.6 ppmvd (0.0003 lb/h), respectively.

- Stack emissions of all HAP constituents were below the sensitivity of the sampling system. The detection limit was 0.1 ppmvd, which meets the specifications of the Title 40 CFR 60 Appendix A reference methods. The hourly average stack HAP emission rate is verified to be less than 0.0016 lb/h.

- Methane concentrations were not detected during any of the test periods The detection limit was 0.1 ppmvd, which meets the specifications of the Title 40 CFR 60 Appendix A reference methods. CO_2 concentrations averaged about 9.3 percent of the stack gas volume, equating to a mass emission rate of 111 lb/h.

- PRVs did not operate at any time during the entire test campaign, nor are releases anticipated during normal operations. Therefore, no expected emissions were assigned to PRV operation.

REBOILER STACK EMISSIONS						
	NO_X		CO		VOC	
	ppmvd	lb/h	ppmvd	lb/h	ppmvd	lb/h
Run 1	67.8	0.0873	0.3	0.0003	0.4	0.0002
Run 2	66.0	0.0817	1.0	0.0007	0.8	0.0004
Run 3	61.6	0.0761	0.6	0.0004	0.5	0.0002
Avg.	**65.1**	**0.0817**	**0.6**	**0.0005**	**0.6**	**0.0003**
	HAP		CH_4		CO_2	
	ppmvd	lb/h	ppmvd	lb/h	ppmvd	lb/h
Run 1	<0.6	<0.0016	<0.1	<0.00004	9.5	117
Run 2	<0.6	<0.0016	<0.1	<0.00004	9.2	109
Run 3	<0.6	<0.0015	<0.1	<0.00004	9.1	108
Avg.	**<0.6**	**<0.0016**	**<0.1**	**<0.00004**	**9.3**	**111**

- HAPs entering the QLD were 9.09 lb/h. Maximum HAPs leaving the system in the reboiler exhaust and wastewater were 0.0016 and 0.0220 lb/h, respectively. The HAP destruction efficiency is greater than 99.74 ± 0.01 percent.

- Wastewater production rate was approximately 0.106 gallons per minute or 6.36 gallons per hour.

- Saleable condensate product recovery rate was approximately 0.048 gallons per minute or 2.88 gallons per hour.

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Notice: GHG Center verifications are based on an evaluation of technology performance under specific, predetermined criteria and the appropriate quality assurance procedures. The EPA and Southern Research Institute make no expressed or implied warranties as to the performance of the technology and do not certify that a technology will always operate at the levels verified. The end user is solely responsible for complying with any and all applicable Federal, State, and Local requirements. Mention of commercial product names does not imply endorsement or recommendation.

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