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Cost Effective Mitigation of BTEX, GHG's and Other Organic Compounds

BTEX VRU System

By **Gaspro Compression Corp.**

Summary

Natural gas production requires the removal of small amounts of water that may be present when the gas is produced from a well. This is done by a commonly used process called dehydration (dehy). However, dehy units face challenges to avoid the release of greenhouse gases (GHG) and volatile organic compounds (VOC) such as benzene, toluene, ethylbenzene and xylenes (BTEX) into the atmosphere. These measures make the process cost intensive and complex in nature.

Gaspro is a growing and innovative company tackling the challenges of environmentally harmful emissions within the oil and gas industry. Gaspro has developed a BTEX Vapor Recovery Unit (VRU) to address these challenges with a 100% closed loop system. Petroleum Technology Alliance Canada (PTAC) and the National Research Council of Canada Industrial Research Assistance Program (NRC IRAP) supported this technological development, which, if implemented broadly, will result in a vast amount of BTEX emission reduction in the oil and gas industry.

Challenges

The Alberta Energy Regulator (AER) Directive 039 strictly regulates benzene emissions in Alberta because of its carcinogenic properties having long term negative impacts on the environment. Benzene and light hydrocarbon emissions are difficult to capture at low pressure and wet gaseous condition. Conventional VRUs heavily rely on natural cooling methods, which are less effective during warm weather.

Natural gas production involves the process of Glycol Dehydration to remove water vapor from wet natural gas. As shown in Figure 1, the gas enters the contactor and encounters a countercurrent flow of lean glycol, which absorbs water components from the wet natural gas. The glycol (which is now rich glycol after absorbing water) flows through the bottom of the contactor into the flash tank. The flash tank lowers the pressure of the glycol and passes it to the regenerator. The regenerator provides heat to the rich glycol, evaporating water into steam, GHGs and VOCs – including BTEX. The glycol (which is now lean) is then ready to be pumped back into contactor while the steam with GHGs and VOCs with BTEX need to be captured.

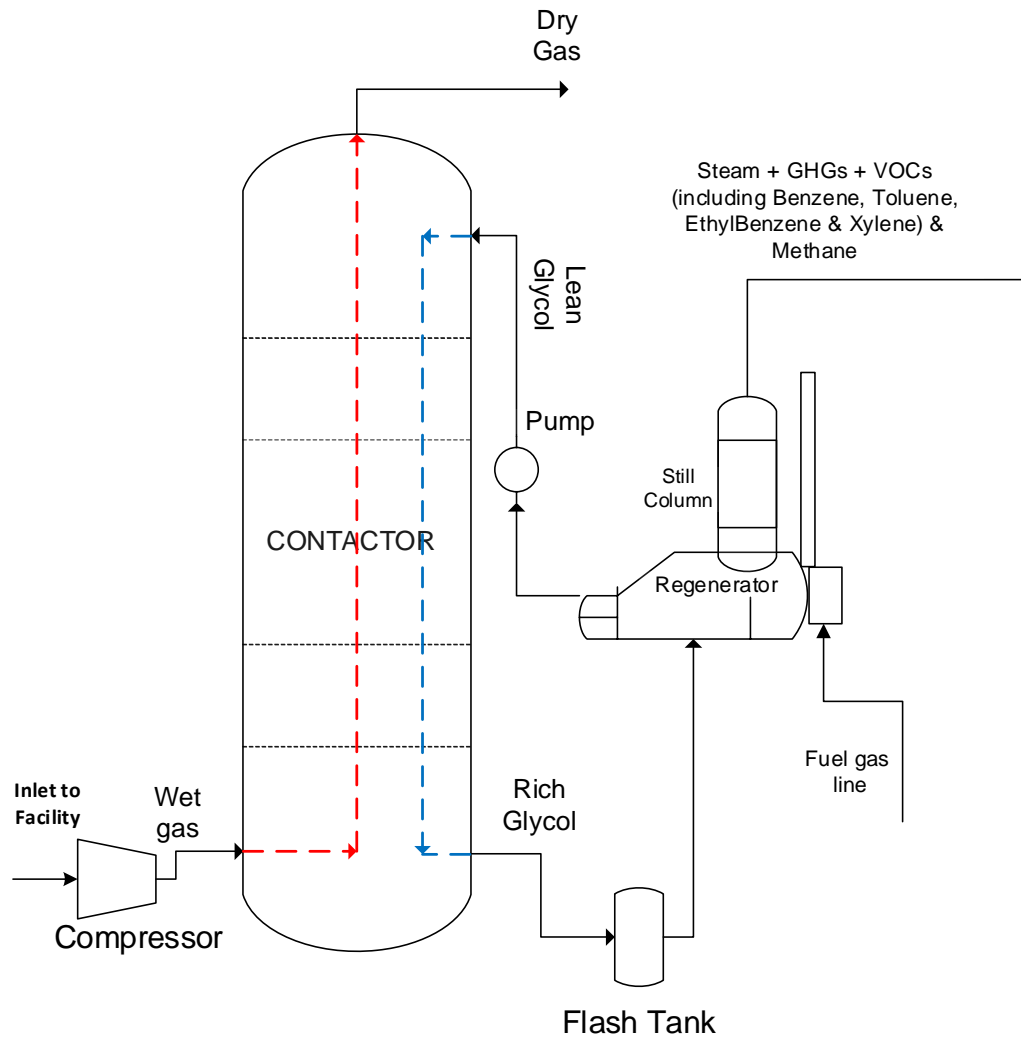


Figure 1. Conventional Glycol Dehydrator

There are plenty of technical challenges with other solutions to BTEX containment (e.g. venting and flaring), including:

- Impact of temperature on productivity to condense liquids in low flow gas condition
- Lack of efficiency when working with low gas volumes at low suction pressure
- Limitations to single stage and low discharge pressure
- Operational difficulty due to complex design
- The risk of venting, flaring and fugitive emissions damage the environment
- Wastage of methane gas along with the steam, GHGs and VOCs

Solution

Since 2003, Gaspro has been developing dependable, low maintenance and user-friendly compressor packages that surpass industry standards. Gaspro packages are engineered for extended life



and cost-efficient operation. They are continuously improving and innovating their products to keep up with the changing industry demands. Figure 2 shows how the Gaspro BTEX VRU will be connected to the Glycol Dehy system. The Gaspro BTEX VRU technology cycles the steam, GHGs, VOCs, and methane through the Gaspro Condenser which liquefies the condensable compounds in the gas stream. It is then sent into a separator where the liquids drop out and are pumped into the facility liquid storage tank. The uncondensed vapor collected in the separator goes into a compressor, which delivers the gas back into the inlet line of the facility at inlet pressure. The Gaspro BTEX VRU is a 100% close loop solution that requires no further testing to meet the AER directive 039. It will help the oil and gas industry to comply cost efficiently by reducing BTEX emissions to 45% by 2025.

Some of the highlighted features of the Gaspro BTEX VRU include:

- One-time upgrade can provide a close loop system that means 100% containment of emissions without any further requirement of emission reduction measures
- Temperature changes do not affect efficiency
- Can handle wide ranges of volumes
- Reliable at low suction pressure because of sensitive pressure sensors and a variable frequency drive
- The Gaspro BTEX VRU uses rotary or reciprocating compressor, allowing for a wide range of gas flow capacity and higher discharge pressure capability
- The Gaspro BTEX VRU has a simple and a user friendly design, which makes the compressor easy to operate
- Designed for lower overall maintenance costs
- 2.62 tonnes/year of methane are recovered from the still overheads through recycling

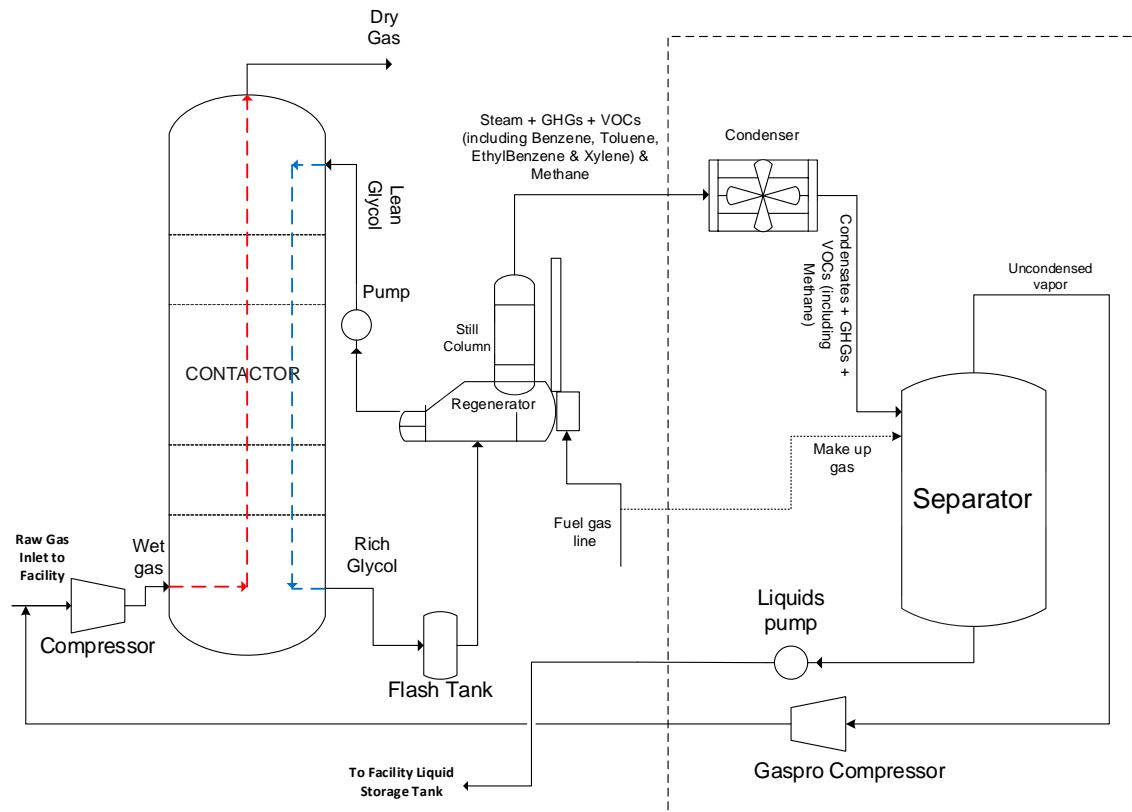


Figure 2. Gaspro BTEX VRU System

The NRC IRAP and PTAC worked together to help Gaspro develop new innovative equipment to address industry needs by responding to more stringent GHG emission regulations. The NRC IRAP assisted Gaspro with the hiring of their first engineer so that they were able to design and fabricate the first VRU prototype. Once the prototype was ready for testing, The NRC IRAP referred Gaspro to PTAC to help increase its industrial network and product recognition. Following introductions, PTAC arranged a presentation for Gaspro to showcase their company profile and compressor packages to the Technology for Emissions Reductions and Eco-Efficiency (TEREE) Committee and other industry stakeholders. PTAC also introduced Gaspro to Cap-Op Energy, who assisted PTAC in the preparation of an Upstream Oil and Gas Eco-Efficiency Handbook. The Handbook is posted on the PTAC website and the Gaspro BTEX VRU technology is included in the Dehy Units and Gas Treatment section. This Handbook details field-deployable technologies and serves as an informative checklist to create better standards and consistent practices that industry can refer to when installing new builds or completing upgrades and expansions on well sites. The Handbook has been extremely well received by

“PTAC has done an excellent job in opening doors to different opportunities for Gaspro. They are wonderful to work with and are doing an excellent job in preparing proper channels to bring to light the various challenges faced by the industry and the innovative solutions to those challenges.”

(Tom Nichols - President GasPro Compression Corp.)



industry end-users who are currently looking for additional funding to further develop it. PTAC continues to offer opportunities that allow SMEs like Gaspro to highlight their services and technologies to the oil and gas industry to increase awareness of available solutions.

PTAC also collaborated with Gaspro to secure funding from NRCan’s CIPEC program (Canadian Industry Program for Energy Conservation) to hire a third-party subject matter expert to inspect and validate the Gaspro BTEX VRU and produce a final report stating the project findings. A steering committee comprised of major oil and gas companies oversaw the project and the outcome was a positive final report prepared by subject matter expert - Process Ecology. More specifically, the final report validated that the VRU technology can eliminate all emissions from a glycol recycling unit. Gaspro is now marketing the VRU to producers in Canada and exploring potential markets in California, Australia, China, India and Mexico.

Results

The Gaspro BTEX VRU is an efficient and highly effective solution for reducing methane, GHG, and BTEX emissions in the glycol dehy process. The first unit was put in operation in March 2016 and has been working up to expectations. As per field operators’ feedback, the Gaspro technology is easy to understand and is more reliable and robust compared to alternative technologies. Operators gave positive feedback, claiming that the BTEX VRU required almost no operator intervention. Currently, there are five BTEX VRU packages out in the field. The design of the system is simpler than previously used VRUs, which greatly lowers the cost and maintenance problems associated with the package.



Figure 3. On Site Connection to Gaspro BTEX VRU



Outlook

The Gaspro BTEX VRU removes and contains BTEX, GHGs, VOCs including methane emissions from the regenerator still column and other vent sources in a dehy facility (compressor packings, pneumatic devices, tank vent etc.). Emission volumes vary with different dehydrators, but emissions calculations by Process Ecology using GlyCalc (an emissions data model) indicated that approximately 247 tonnes/year CO₂e were captured at one process facility using one Gaspro BTEX VRU. Emissions from glycol dehy facilities across Western Canada represent 5% of GHG emissions in the oil and gas industry. This new technology has the potential to make a significant impact in reducing emissions in Alberta and will have a lasting effect on air pollution and management.