Engineered Concepts, LLC

Quantum Leap Technologies

EPA Verified 99.74% Emissions Free Natural Gas Dehydration Technology

That Improves Workplace Safety and Pays For Itself

Quantum Leap Natural Gas Dehydration Technology (QLT)

The patented[1] Quantum Leap Natural Gas Dehydration Technology

eliminates virtually all hydrocarbon emissions and pays for itself by recovering them as valuable fuel products. This new technology also creates a safer working environment, reduces fuel requirements, trims maintenance and operating expenses and super-cleans the glycol, reducing losses and glycol replacement costs. The U.S. Environmental Protection Agency[2] verified that the technology **eliminates more than 99.74% of all HAPs** (Hazardous Air Pollutants) comprised primarily of Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) plus n-Hexane. The EPA study further concluded the process effectively eliminated all Volatile Organic Compounds (VOCs) and methane emissions associated with the glycol dehydration process.

Key Environmental, Safety and Economic Benefits

A 1996 EPA report estimates that there are 252,000 gas wells in the United States serviced by 38,000 active dehydrators. The EPA also estimates that these dehydrators collectively emit about **18.6 billion cubic feet (393,000 tons) of methane, 60,000 tons of HAPs, and 142,000 tons of VOCs per year.** The **QLT** process would convert these emissions to usable fuel, equivalent in energy to about 240 million gallons of gasoline. Additional supplemental fuel now used by flares and thermal oxidizers would also be eliminated. It is evident that the total value of the **QLT** process probably exceeds the energy equivalent of **300 million gallons of gasoline per year – enough to fuel about 690,000 automobiles for a year** (assuming CAFE standard 27.5 mpg and 12,000 miles per year), or equivalent to the amount of electricity consumed by more than 1,000,000 homes per year.

As a greenhouse gas, methane is 21 times more potent than carbon dioxide. In the U.S. methane comprises about 0.5% of the total greenhouse gas emissions, but contributes about 10% of the total global warming effect attributed to greenhouse gases. Removing 393,000 tons of methane from the atmosphere is equivalent to removing about **23 million tons of carbon dioxide – or the amount of the carbon dioxide emissions from 5.6 million automobiles per year.**

EPA verified elimination of more than 99.74% of HAPs.

The **QLT** process is a much safer gas dehydration process because it eliminates virtually all toxic and explosive vapor emissions. These vapors are either condensed to stable liquids or compressed and used as fuel in the **QLT** process. Compression of the non-condensable vapors is a key environmental and safety feature – allowing control of the fuel-air ratio ensuring complete high efficiency combustion, but more importantly, guaranteeing **that the risk of fire or explosion due to combustion of "free floated" hydrocarbon vapors into the combustion chamber or stack is eliminated.**

How Quantum Leap Natural Gas Dehydration Technology Works

The **QLT** process requires electricity. Where electricity is unavailable - such as remote wellhead sites - an engine-generator set is provided. This engine-generator set is designed for **40,000 hours (5 years) continuous service** and uses natural gas as fuel. The use of electricity eliminates the need for the Kimray®[3] glycol pump, one of the primary sources of hydrocarbon emissions from the dehydration process. The engine-generator set coupled with an electric process glycol pump and high efficiency filtration provides greater flexibility and reliability, resulting in reduced operator attention and maintenance costs. As an added bonus, electricity is available for remote control and monitoring of the dehydrator, affording an opportunity for further reducing operator inspection and maintenance.

Greenhouse gas reductions equivalent to emissions from 5.6 million cars per year.

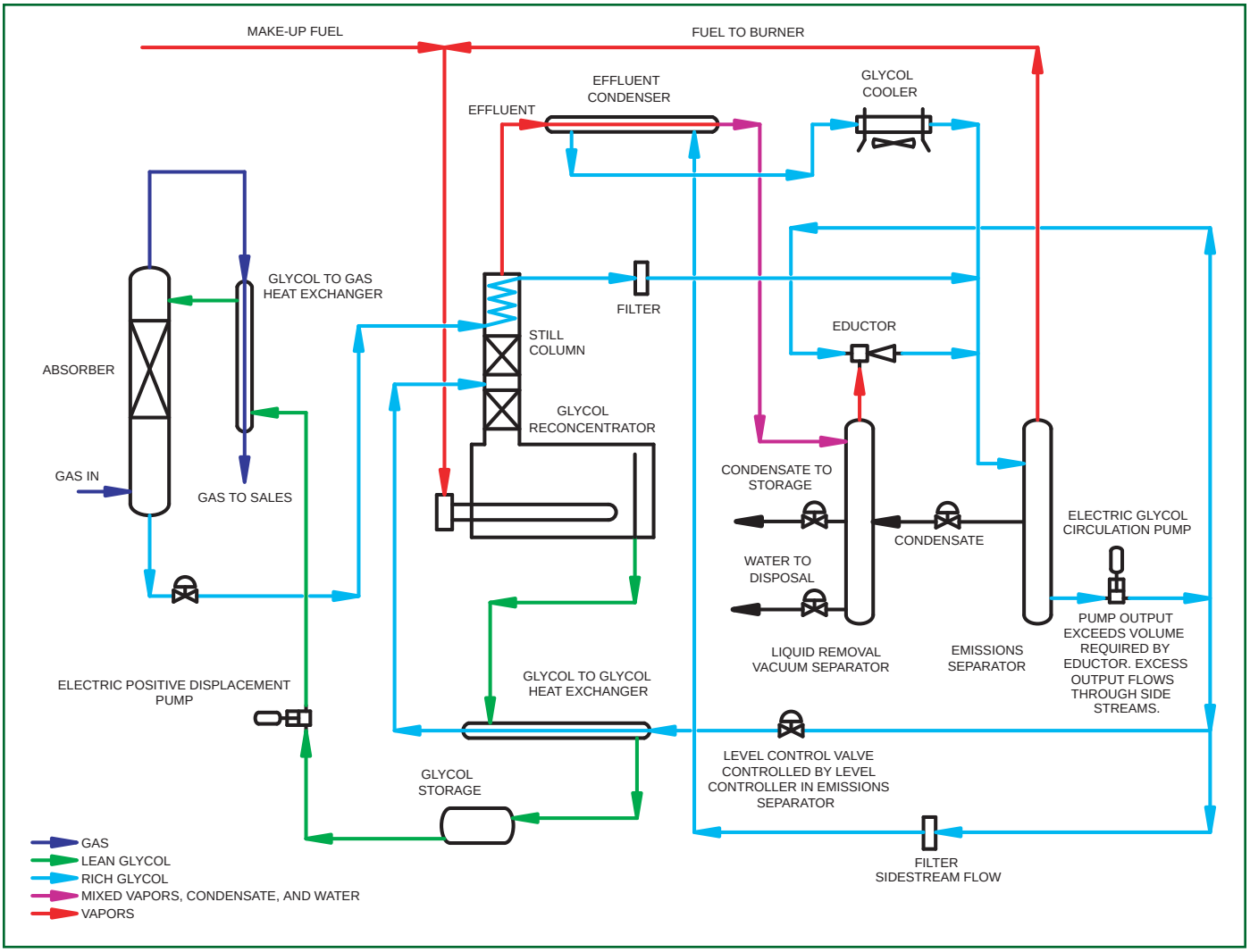
For severe applications, the **QLT** process achieves high lean glycol concentrations without the venting of hydrocarbons that result from gas stripping. Gas stripping is a prime source of methane emissions and is commonly used throughout the natural gas processing industry to attain high lean glycol concentrations. Methane is a potent greenhouse gas – 21 times more than carbon dioxide. Use of the **QLT** process eliminates gas stripping as a major contributor to greenhouse gas pollution, while significantly reducing operating gas expenses.

High lean glycol concentrations in the **QLT** process permit dehydration at lower circulation rates and enable dehydrator operation over a wider range of conditions. High glycol concentrations, coupled with an electric driven pump, eliminate the low-end pressure barrier created by Kimray pumps in traditional dehydration processes. This means that pressures as low as 50 psig or elevated gas temperatures are no longer impossible operating conditions with the **QLT** technology.

1 The Quantum Leap Natural Gas Dehydration Technology is covered by U.S. Patents 5,766,313, 6,238,461, 6,364,933, 6,551,379 and other patents pending.

2 ETV Joint Verification Statement, SRI/USEPA-GHG-QAP-20, ETV Greenhouse Gas Technology Center, September 2003

3 Kimray is a trademark of Kimray Inc.



The still column overhead vapors (steam, methane, ethane, VOCs and HAPs), and instrument gas vented from the process control system are collected under a vacuum. Condensed hydrocarbons from the still column vapors form a stable product and are routed to oil storage after separation from the condensed water. All uncondensed hydrocarbons are routed to the fuel system and consumed by the burner of the glycol reboiler. The condensing temperature is thermostatically controlled to assure efficient condensation under any weather condition.

Conserves energy equivalent to the electricity consumed by more than 1,000,000 homes per year.

Previous still column overhead vapor elimination technologies include flares and thermal oxidizers (incinerators). Flares and thermal oxidizers are uneconomical and increase products of combustion attributable to the dehydration process. All hydrocarbons, both non-condensable vapors and condensable liquids, destroyed in this manner are unnecessarily wasted, providing no return to the operator. In addition, flares and thermal oxidizers require substantial quantities of supplemental fuel gas to operate. Since the still column vapors are "free-floated" to the flare or combustion chamber of the thermal oxidizer at essentially atmospheric pressure, proper mixing of these vapors with oxygen becomes an issue and incomplete destruction of these polluting and explosive vapors may result. Non-condensable hydrocarbons fuel

the **QLT** reboiler. The hydrocarbons are compressed and fed to the reboiler combustion chamber without bypassing any of the fuel safety devices, shut-downs, flame arrestor or operator interface devices. In the reboiler combustion chamber an improved burner system burns the hydrocarbons at an efficient fuel-air ratio. EPA tests verified the **QLT**'s improved burner system surpassed all EPA threshold limits for NOx, CO and unburned hydrocarbons. In fact, unburned HAPs and methane levels were below the detection level of the test instruments.

Eliminating both the Kimray pump and gas stripping ensures the amount of uncondensed hydrocarbons collected by the **QLT** process is less than the fuel required to heat the dehydration process. A small amount of make-up fuel is required. If a flare or thermal oxidizer is used to destroy the still column vapors, the entire quantity of required reboiler fuel must still be supplied to the dehydrator and supplemental fuel must also be supplied to the flare or thermal oxidizer.

A dehydrator equipped with the **QLT** process consumes only the fuel required for the process. The fuel consumed by **QLT** is a fraction of the fuel required for a flare or thermal oxidizer equipped dehydrator, and as a result, the combustion emissions are a fraction of those systems using a flare or thermal oxidizer.

Other equipment designs route the non-condensed hydrocarbon vapors directly to the reboiler combustion chamber or stack by "free floating" the vapors at atmospheric pressure into the combustion zone and relying on the stack draft to pull and properly mix the vapors with oxygen. **This technique increases the risk of fire or explosion and vents unburned hydrocarbon vapors directly to the atmosphere.** The **QLT** process eliminates this risk and provides the safest, most economical use of fuel while eliminating virtually all emissions.

QLT may be purchased new or retrofitted to existing systems without variance in efficiency or functionality. Retro-fitting to an existing dehydrator requires minimal field construction, typically without flame cutting or welding. **QLT** may be incorporated into a new dehydrator design at less cost than retrofitting to an existing dehydrator. **QLT** applies to small remote wellhead applications, large plant dehydrators, or offshore service - anywhere elimination of hydrocarbon emissions, increased dehydrator performance, and improved safety are desired.

QLT is flexible. **QLT** modules operate over a wide range of conditions without special design for specific applications. The process is not limited by pressure or temperature like other dehydrator equipment and designs. Utilization of an electric process pump allows efficient dehydration below the low pressure barrier imposed by current Kimray pump designs; while high concentrations of lean glycol make low pressure and high temperature applications possible without resorting to gas stripping.

Improves workplace safety while reducing operating expenses for:

- ***Fuel***
- ***Maintenance***
- ***Operator attention***

Key Features and Benefits Comparison

Quantum Leap Dehydration Technology

- Verified by the EPA, more than 99.74% of HAPs are eliminated.
- Virtually all methane and VOCs are condensed or used as fuel.
- Near zero hydrocarbon emissions create opportunities for pollution credit trading.
- Eliminates foul odors caused by hydrocarbons vented into the atmosphere.
- All hydrocarbon vapors (non-condensable hydrocarbons and free hydrocarbons flashed in the emissions separator) are consumed in the normal course of heating the glycol reboiler.
- EPA verification may reduce or eliminate costs and delays associated with environmental permitting process.

- Carbon dioxide and other combustion products are minimized by efficiently using still column vapors to fuel the process and incorporating an improved burner system.

- Operator safety is enhanced. Non-condensable hydrocarbons and gas vented by pneumatic instruments are compressed and fed to the reboiler combustion chamber. No bypassing of dehydrator safety systems. The risk of fire or explosion due to uncontrolled hydrocarbons “free floating” into the combustion chamber or stack is eliminated.

- Reboiler fuel expenses are reduced by 70% or more by capturing and using hydrocarbons traditionally vented or destroyed in flares and thermal oxidizers. Less supplemental fuel is required to operate the process.
- Eliminates fuel requirements for flares or thermal oxidizers.

- A thermostatically controlled still column effluent condenser provides efficient operation regardless of ambient temperatures.
- The condenser is supplied with abundant cooling medium from glycol circulation system.

- Condensed hydrocarbons are typically high vapor pressure products. Condensed hydrocarbons are collected and maintained under vacuum until transferred to the storage tank. These hydrocarbons are stable and will not flash or weather under atmospheric conditions.

- Eliminates the Kimray pump allowing a wider operating pressure range and reducing pump maintenance and the gas wasted by the pump.

- Eliminates the hydrocarbons emissions caused by gas stripping.

- Field proven – Units have operated reliably in the field during a three-year test program.
- When incorporated into new dehydrator designs, the size, weight and complexity is comparable to conventional dehydration systems.
- Responds to fluctuations in gas volume just like conventional dehydration systems.
- Easy to retrofit. Existing dehydrators may be upgraded to meet more aggressive environmental constraints and higher dew point depressions with minimal field construction.
- A versatile process suitable for any climate and equally applicable to wellhead, plant and offshore dehydrators.
- Reduces maintenance and service expenses by eliminating Kimray pumps and preventing glycol degradation.

Traditional Dehydration Methods

- Many dehydrators have uncontrolled emissions.
- Condensers may condense the bulk of the HAPs and VOCs but do not address non-condensable hydrocarbon emissions (primarily methane and ethane).
- Flares and thermal oxidizers may be employed to attain reductions of 98% or more.

- Combustion products resulting from the dehydration process are increased by using flares or thermal oxidizers.
- Incomplete combustion due to inadequate mixing of still column vapors with oxygen is an issue with flares and thermal oxidizers.

- Some designs allow the non-condensable hydrocarbons to “free float” at atmospheric pressure into the reboiler combustion chamber or stack. These systems rely on the stack draft to pull the vapors into the combustion zone and to mix the vapors with oxygen. Inadequate mixing of the “free floating” vapors creates incomplete combustion and increases explosion risks.

- A significant quantity of supplemental fuel is required for flares and thermal oxidizers.
- Non-condensable hydrocarbons are not used to fuel the reboiler. Additional fuel is required.

- Many designs rely on atmospheric cooling of the still column effluent condenser. This method is subject to overcooling and freezing of condensed water during winter operations and insufficient cooling capacity during summer operations.

- Condensed hydrocarbons are typically high vapor pressure products. When still column effluent condensers are used, condensed liquids are captured at atmospheric conditions and may flash or weather in the storage tank, increasing overall product losses.

- The Kimray pump is used extensively in the oil and gas industry. This pump is a major source of methane emissions in the dehydration process.

- Gas stripping is used throughout the oil and gas industry as the standard method to obtain high dew point depressions. Gas stripping is a prime source of methane emissions.

Frequently Asked Questions

How quickly can I recover the capital expense of the Quantum Leap Natural Gas Dehydration (QLT) Technology?

The price of natural gas, operating conditions, environmental issues and pollution credit trading opportunities are key to determining how quickly the capital investment will be recovered. For a particular application contact Engineered Concepts.

QLT eliminates the gas vented by the Kimray pump and reduces the gas presently being consumed in the form of fuel or stripping gas by 70% or more depending on the operating conditions. **QLT** reduces operating expenses by reducing maintenance and operator attention.

The cost of fines imposed or other equipment required to meet environmental constraints must be considered as well as lost income due to delays in permitting. Additional investment and operating costs for flares, thermal oxidizers or other equipment mandated by environmental concerns are eliminated.

QLT is much safer than conventional gas dehydration, reducing potential accidents and operator liability.

How much operational flexibility will I have if I use QLT?

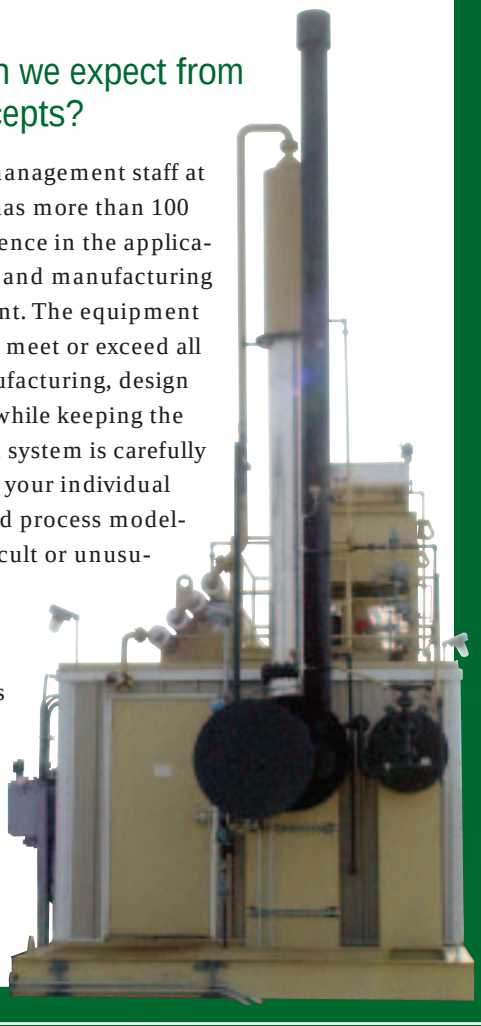
QLT operates over a wider pressure envelope than conventional glycol dehydrators. Operating pressures as low as 50 psig are obtainable. The process also responds to fluctuations in gas volume just as any conventional dehydrator. **QLT** is designed with the operator in mind, with control systems and degree of complexity similar to conventional dehydration equipment. **QLT** is applicable to any glycol dehydration requirement, in any location, anywhere in the world.

What is the difference in QLT and a traditional glycol system?

QLT captures all BTEX and other hydrocarbons that traditional glycol dehydrators emit from the still column. The captured hydrocarbons are consumed as fuel or are routed to the oil storage tank as stable liquids. **QLT** eliminates virtually all hydrocarbon air emissions, enhances work place safety, has greater flexibility and wider operating range, and lowers overall operating expenses by reducing maintenance, operator attention and fuel costs.

What support can we expect from Engineered Concepts?

The engineering and management staff at Engineered Concepts has more than 100 years combined experience in the application, design, operation and manufacturing of oil and gas equipment. The equipment is carefully designed to meet or exceed all applicable safety, manufacturing, design and fabrication codes while keeping the operator in mind. Each system is carefully analyzed to insure that your individual needs are met. Detailed process modeling is available for difficult or unusual design conditions. Installation of equipment and training of operations personnel is also provided.



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