



White Paper.

# Solutions to Contain VOC Emissions and Comply with Evolving EPA Regulations.



## Introduction

Terminal operators, oil and gas transportation companies, oil and gas storage companies, and oil and gas transfer operations are all seeking the most efficient and cost-effective method to control the emission of volatile organic compounds (VOCs) that are sometimes released into the atmosphere from a tank as a result of loading and unloading operations. Because VOCs can represent a health and environmental hazard and because their emission is strictly regulated, it is imperative to prevent the unwanted release of VOCs.

In August 2013, the Environmental Protection Agency (EPA) issued an update to its 2012 New Source Performance Standards for those producers who have tanks that are each emitting more than 6 tons of VOCs per year. This update has led many operations to re-evaluate their methods for controlling VOC emissions, while some may need to quickly implement a solution to comply with this new regulation, 40 CFR Part 60, by April 2014.

There are a number of approaches to prevent or minimize the release of VOCs into the atmosphere, some of which are defined in this white paper. Choosing the right solution is dependent on a number of factors, starting with the regulatory requirements. For an oil or gas operation that is currently emitting 6 or more tons of VOCs per tank each year and needs to comply with the EPA's regulation, 40 CFR Part 60, a reduction of 95% of uncontrolled emissions is required. This white paper explores cryogenic condensation (cryocondensation), which may be an ideal solution for operations that need to comply with the newest regulations.

## The Challenge of Meeting New and Evolving Regulations

As air quality regulations get stricter, facilities find themselves playing “catch-up” to meet new and evolving regulations.

For example, when crude oil, condensate, produced water or unrefined petroleum liquids known as “intermediate hydrocarbon liquids” are used or stored in any oil or gas tank, the facility is obligated to treat those emissions to comply with the Environmental Protection Agency (EPA) and air quality regulations such as 40 CFR Part 60.

We also see that as oil and gas operations seek to comply with the continually evolving air quality regulations, such as the President’s Climate Action Plans and the EPA regulations, they will need to use processing equipment and systems that help them act quickly, fit within their current and future design operations, and meet their cost requirements.

In addition, as the petrochemical industry expands as a result of shale gas availability, new plant construction will need VOC emission credits to off-set non-controllable point sources in non-attainment areas.

## There are Many Potential Methods to Control VOC Emissions...

A facility may need a low capital solution to control emissions in order to comply with new or updated regulations, particularly if it does not currently have the capacity to capture these emissions elsewhere on site. A facility may also have new Air Pollution Control (APC) systems requirements or old APC systems that are unable to adequately meet stricter regulations. In these situations, a facility needs to evaluate the many solutions that are available to contain or manage emissions.

While there is no one solution to control VOC emissions that will suit every facility, there are a range of solutions from which to choose. A facility needs to make that decision based on its operational requirements and the APC system it already has in place or lack thereof. For instance, a facility that has added stationary tanks and transfill areas may have the capacity to manage emissions with their current APC unit. On the other hand, a facility with remotely located storage tanks may need to find an alternative solution to regulate emissions.



### ...And Benefits to Capturing Those Emissions

The value of emission credits is rapidly increasing to the point that these credits can pay for the installation and operation of emission reduction systems. Emission credits can be generated through installation of control systems. In VOC non-attainment areas, the value of emission credits is also increasing rapidly, and the generation of those credits through the installation of control equipment on existing point sources can represent a sellable asset.

### Choosing the Right Solution

To choose the optimal method for treating and/or containing VOC emissions and/or Hazardous Air Pollutants (HAPs), a facility needs to consider its space constraints, capital cost constraints, emission flow profile due to batch processes, the desire to recover emissions to improve yield and the cost of control.

The most common ways to treat VOC emissions are:

**Adsorption** - the binding of molecules to a solid bed composed of activated carbon, alumina, zeolites, organic polymeric materials, or some combination of these with high surface area per gram of material.

**Biological Destruction** - the use of biofilters or irrigated packed bed containing microbes that consume organic compounds.

**Cryocondensation Abatement** - the use of cryogenic condensation technology to significantly reduce VOC emissions. Cooling energy is supplied by liquid nitrogen through cold gas technology, which efficiently condenses VOCs from the vent stream.

**Liquid Absorption** - the off-gas stream typically enters the bottom of the absorption column and flows through the media that physically absorbs the VOC. Clean air is vented and liquid is heated and pumped to the top of absorption column, where VOCs are removed under vacuum. Remnant VOCs in the liquid are removed by injection of steam or other heat source into the base of the desorption column. Liquid absorbent is recycled and the VOC/water mix is separated.

**Membrane Separation** - the use of semi-permeable polymer membranes during chemical processing, which allows only organic vapors to pass through.

**Thermal and catalytic oxidation (incineration)** - the off-gas stream is heated to 1000-2000°F (500-1100°C) for a very short period of time (a fraction of a second to a few seconds) and can be combined with an adsorbent concentration step. Note: In non-attainment areas that require higher than 99.99% VOC removal with low NOX Linde also offers its patented Flameless Thermal Oxidizer (FTO) technology.

### A Better Way to Control Emissions at Point of Use: Cryocondensation

Cryocondensation technology offers a comprehensive approach to minimizing or restricting the release of VOCs. When implemented at a facility that chooses to recover and re-route emitted VOCs or reuse the vaporized nitrogen, cryocondensation can be a low-cost solution that increases production safety. These systems are safe, cost effective, reliable and environmentally sound, with a proven installed base across terminals, oil and gas and chemicals installations worldwide.

### Using Cryocondensation to Meet EPA Regulation, 40 CFR Part 60

EPA's regulation, 40 CFR Part 60, states that a reduction of 95% of uncontrolled emissions is required for an oil or gas operation that is currently emitting 6 or more tons of VOCs per tank each year. This translates into varying ppm thresholds, depending upon variables such as tank size, VOC loading, composition, frequency of filling operations, etc. Because this is a generally low concentration limit, cryocondensation is particularly suited to meet this level if the VOCs are to be recovered or re-routed back into the tank or elsewhere in process. In order to separate VOCs from an emissions stream, very low temperatures are needed – mechanical refrigeration can come close, but this requires very complex and expensive cascade systems. Cryogens such as liquid nitrogen can provide that cooling without the added complexity.

Further, many of the tanks targeted by this EPA regulation have intermittent emissions so that the utilization for a solution would be far less than 100%, a factor which must be considered when assessing the per-use cost of the capital investment. In the case of a cryocondensation solution, the primary cost of liquid nitrogen is directly proportional to the usage, with a low required capital investment. Finally, the nitrogen can be further used for applications such as inerting, which could improve the safety of the tank installation.



### Using Cryocondensation to Demonstrate Compliance

A cryocondensation solution can help an oil or gas operation do more than control emissions; its control system may also help an operation demonstrate to regulatory authorities that it is complying with new and updated regulations. This does not replace analytical equipment required by the EPA to meet emission standards.

The way cryocondensation can allow a facility to track and analyze emissions is simple – and important. In the past, a facility may have used a thermal oxidizer to burn the hazardous material. Today, operations are required to prove that they are combusting these emissions efficiently. With a thermal oxidizer, a facility may have to use different types of gas analyzers, such as stack gas analyzers to prove that the combustion is efficient and not running too rich. At best, this can be an expensive solution. At worst, the solution may not work, causing the facility to shut down.

A cryocondensation system, on the other hand, can monitor the outlet temperature of the abated emissions. Controlling to a pre-determined temperature may demonstrate that abated emissions are low enough to meet guidelines. This is a much simpler way to track emissions than combustion analyzers, stack gas analyzers, or any other method used to prove that a thermal oxidizer is running effectively.





### Needed: Experience and Technology

It is important to work with a solutions provider that has proven technology and with engineers who are trained to ensure that every installation is a success. The right partner should have expertise in designing and installing cryocondensation equipment for a variety of pure and multi-component oil and gas streams such as gasoline, diesel, and even light naphtha. If cryocondensation is not the right solution for your facility, the right partner will help you evaluate other alternative abatement technologies for controlling VOC emissions.

# Getting ahead through innovation.

With its innovative solutions, Linde is playing a pioneering role in the global market. As a technology leader, it is our task to constantly raise the bar. Driven by our tradition of entrepreneurship, we are working steadily on developing new high-quality products and innovative processes.

Linde offers more. We create added value, clearly discernible competitive advantages and greater profitability. Each solution is tailored specifically to meet our customers' requirements – offering standardized as well as customized solutions. This applies to all industries and all companies regardless of their size.

If you want to keep pace with tomorrow's competition, you need a leader in industry technology by your side for which top quality, process optimization, and enhanced productivity are part of daily business. Linde will not only be there for you ... but with you.

After all, working together to solve problems forms the core of commercial success.

**Linde – Ideas become solutions.**

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