



**Air Products'**  
**Cryo-Condap®** technology at a  
**Global Health Care Company . . .**

**tell me more**



Air Products' Cryo-Condap<sup>®</sup> technology ensures the recovery of virtually 100% of solvents at Global Health Care Company, meeting the toughest environmental legislation on Volatile Organic Compound (VOC) emissions.



Air Products' Cryo-Condap® system uses liquid nitrogen to condense and freeze Volatile Organic Compound (VOC) vapours. The condensate and frozen particles are then removed from the process providing a clean process gas stream that now conforms to environmental legislation and can be discharged into the atmosphere. The technology not only enables customers to meet the toughest and most stringent environmental regulations by reducing VOC emissions to below acceptable legislative levels, but can also recover nearly 100% of most solvents, enabling reuse in the process. More so, during the solvent recovery process, the liquid nitrogen is vaporised into gaseous nitrogen which can be reused for other applications such as purging, blanketing, pressurising and product movement, thus reducing operating costs.

Air Products and Herco Kühltechnik have been working in collaboration for more than 35 years. Air Products and Herco jointly developed the original Cryo-Condap® offering back in 1979 for the application of solvent recovery in video tape production. Since that date Air Products has been working exclusively with Herco to manufacture Cryo-Condap® systems and have developed extensive experiences in solvent recovery applications across a broad range of industries globally. Today there are over 130 installations in operation worldwide.

## Client

The client is a British multinational pharmaceutical, biologics, vaccines and consumer health care company. As of March 2014, it was the world's sixth-largest pharmaceutical company after Johnson & Johnson, Novartis, Hoffmann-La Roche, Pfizer, and Sanofi, measured by 2013 revenue.

Like many manufacturers in the chemical and pharmaceutical industries, solvents or VOCs are used as part of some of the production processes. Organic solvents are a class of chemicals commonly used in a large number of industrial processes. They are necessary for the production of pharmaceuticals by providing the medium in which reactions take place and they also separate desired products from unwanted ones, therefore maximising drug purity. Amid tightening environmental legislation, this Global Health Care Company has invested in a new emissions control system, Air Products' Cryo-Condap®, to recover VOCs from process gas streams to near 100% efficiency. The compact system is capable of recovering even the most complex VOCs at low gas flow rates, and can also be easily adapted on site to recover different VOCs at varying freezing temperatures and concentrations.

## VOCs: the emissions challenge

New laws and increasingly stringent regulation on environmental protection are driving down emissions of VOCs. In 1997, the UN Economic Council for the Environment agreed to cut global VOC emissions by 30% by 2002. The EU Solvent Emissions Directive (1999/13/EC) came into force in 1999 aiming to reduce the emissions of VOCs within certain processes and industrial installations. The overall objective of the directive is to reduce VOC emissions from member states by 57% of the 1990 emissions figures. The aim is to reduce the damaging effect of VOCs to human health and the environment. Many of these substances are carcinogenic and a key cause of photochemical smog.

The UK's Environmental Protection Act set stringent discharge limits for VOCs such as monomers and organic solvents. Allowable emissions vary according to the source and nature of each VOC, but a typical value for trichloroethylene (TCE), a common solvent, is 20 mg/m<sup>3</sup>. Manufacturers handling VOCs have had to think seriously about how to meet these new and increasingly restrictive limits. Traditional technologies for controlling emissions include adsorption on activated carbon and various methods of incineration.

The cleanest way to remove VOCs from exhaust gas streams is by condensation with liquid nitrogen. Using proprietary technology, Air Products' Cryo-Condap<sup>®</sup> process removes VOCs to meet emission levels of 20 mg/m<sup>3</sup>, as well as overcoming many of the limitations of traditional emission-control methods. Cryo-Condap<sup>®</sup> can be fully customised to remove most VOCs and is adaptable to suit most process types.



Dr. Idoko Ochuma,  
Air Products Senior Applications Specialist,  
explains:

“With the enforcement of the EU Solvent Emissions Directive (1999/13/EC), Cryogenic Condensation to recover solvents has suddenly become a big thing.”

## The Global Health Care Company meeting the challenges of environmental legislation

This Global Health Care Company, researching and developing pharmaceuticals, vaccines and consumer health care products, has a significant global presence with commercial operations in over 150 countries, a network of 84 manufacturing sites in 36 countries and large R&D centres in the UK, Spain, Belgium and China. The company is a world leader in the manufacture of topical antibiotics. Methyl acetate and methanol (VOCs) are emitted from one of its processes. To comply with Environment Agency regulations, it is necessary to limit the release of methyl acetate and methanol to the atmosphere.

Cryo-Condap® technology for VOC recovery. A 255 m<sup>3</sup>/h Cryo-Condap® installation with redundant low temperature condensers.



Andrew Goss, PM Group Project Manager, consultant to Global Health Care Company comments:

“While the site was currently meeting its legal permit requirements, a request from the Environment Agency asked the site to reduce the emissions from this pharmaceutical process by Best Available Technology (BAT). The process is operated batch wise and the emission profile has a number of line blows which generates a short sharp emissions profile, along with a period of powder drying which generates a long, slowly decreasing profile. This emissions profile meant common abatement technology faced challenges in providing the low emissions required.”

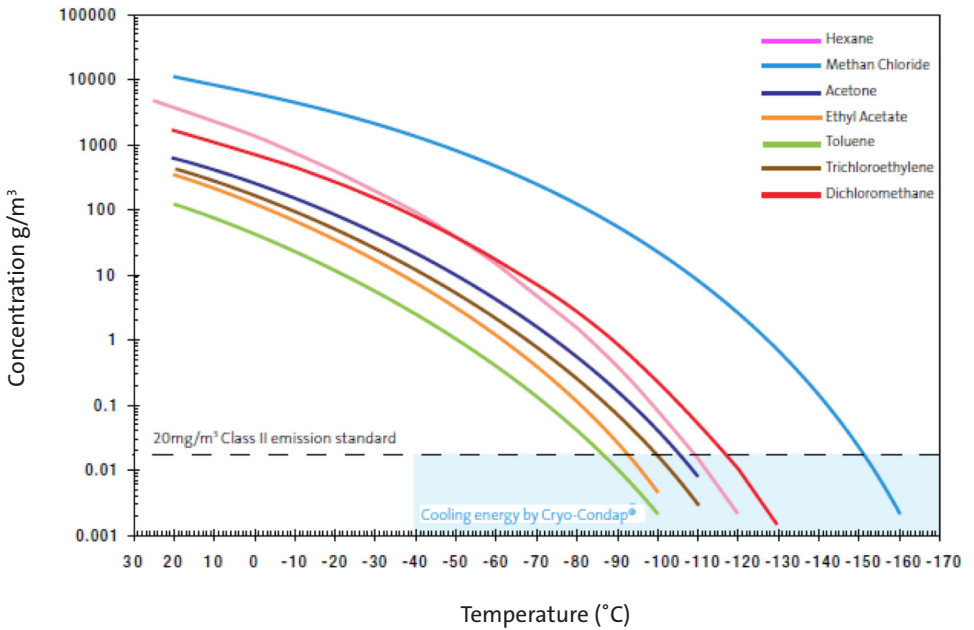
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### Why cryogenic condensation?

The Cryo-Condap® cryogenic VOC recovery and abatement system, designed and engineered by Herco and supplied by Air Products, combines the refrigeration power of liquid nitrogen with the inerting properties of nitrogen gas. The result is a modular, skid-mounted VOC control system that is simple to install, economical to run and highly effective.

With a boiling point of  $-196^{\circ}\text{C}$  liquid nitrogen is a perfect medium to recover most VOCs nearly completely. Solvent recovery performance is typically better than 99.9%, giving discharge concentrations sufficiently low to meet even the most stringent environmental standards.

Saturation concentration of some VOCs





## How does the Cryo-Condap® technology work?

Cryo-Condap® is Air Products' proprietary technology for recovering solvents and VOCs. The system uses liquid nitrogen in a heat exchanger to cool down the process gas. As the temperature drops, so does the capacity of the gas to carry the VOCs as vapour. The VOCs condense and freeze into particles and are removed. The process gas then conforms to environmental legislation and can be discharged into the atmosphere. Recovered VOCs can often be re-used directly, something that is more difficult with adsorption systems and impossible with incinerators or catalytic oxidisers. Another factor that helps keep running costs to a minimum is the ability to re-use the nitrogen. Sites handling VOCs commonly use nitrogen to purge and blanket pipework and tanks; nitrogen gas recovered from the Cryo-Condap® process is effectively free. In some cases, the recovered costs can exceed the costs of control.



**Air Products is an international supplier of industrial gases as well as technology and services, and has over 50 years of cryogenic experience and has installed more than 100 Cryo-Condap® systems worldwide.**

## Designing and installation

Methyl acetate and methanol are emitted from a process on site and needed to be recovered to meet ever stringent UK Environment Agency laws.

Dr. Idoko Ochuma,  
Air Products Senior Applications Specialist,  
says:

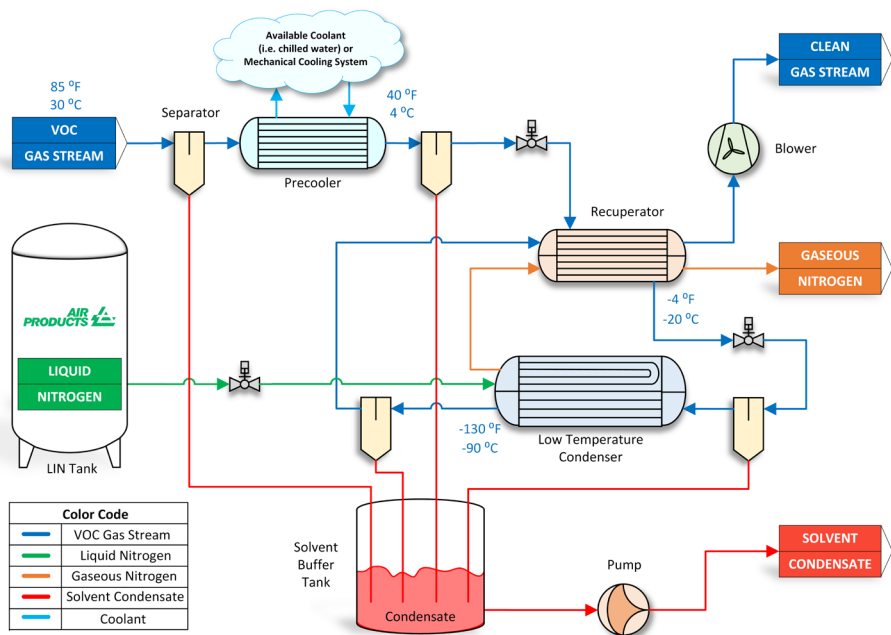
“The solution was: a Cryo-Condap<sup>®</sup> system to condense the methyl acetate and methanol requiring a proprietary heat exchanger, with the installation and control package surrounding the heat exchanger being key to providing accurate temperature control capabilities.”

The company completed a questionnaire and provided Air Products with a performance specification for the methyl acetate and methanol recovery process.

Andrew Goss,  
PM Group Project Manager, consultant to  
Global Health Care Company, says:

“Herco’s bespoke design was arrived at during our first meeting and much of the functionality that was required, was able to be incorporated. Over a period of several months, the design was refined and HAZOP and SIL reviews brought in extra design requirements. The incoming process gas could not rule out a water component, which can freeze onto the surface of the liquid nitrogen cooled condenser. Functionality had to be designed into it to ensure the equipment could be defrosted during periods of inactivity.”

## Basic Cryo-Condap® process



**Overall:** The Cryo-Condap® process uses liquid nitrogen in a proprietary low temperature condenser to treat VOC laden emission streams.

**Pre-cooling:** The VOC gas stream is first pre-cooled with available cooling fluids or a mechanical chiller to condense the bulk of the VOCs and moisture.

**Energy recovery:** Cold exhaust streams from the low temperature condenser are used to further pre-cool the incoming VOC gas stream.

**Cryogenic condensation:** The flow rate of liquid nitrogen is regulated to control the temperature inside the low temperature condenser which cools the VOC gas stream to the desired temperature to help ensure compliance.

**VOC recovery:** Condensed VOCs pass through droplet separators and are collected in a buffer tank to be pumped and reused.

**Nitrogen recovery:** Liquid nitrogen is fully vaporized in the process and exits the system as clean nitrogen gas to be reused for other applications.



## The result

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Andrew Goss,  
PM Group Project Manager, consultant to  
Global Health Care Company, says:

“The result is that emissions have been reduced and the Environment Agency commitment to reduce the levels of solvent emitted from this process has been met. Since the unit has been commissioned, solvent has been recovered that would otherwise have been emitted to the atmosphere.”

Air Products understands the impact that environmental regulations can have on businesses. That is why the Cryo-Condap® technology has been developed, not only to meet the toughest government legislation worldwide, but also to improve process efficiency.

## Air Products' Cryo-Condap® system vs. the traditional way

A major advantage of Air Products' Cryo-Condap® application is the inherent flexibility built into the system and the ability to be customised to meet specific needs of customers' process and to match the properties and requirements of their process.

Andrew Goss,  
PM Group Project Manager, consultant to  
Global Health Care Company, says:

“The Cryo-Condap® system's ability to cope with stop-start and fluctuating emissions profiles, as it is normally seen in a batch process, by having a 'cold-sink' of a refrigerant bath is a major advantage. It does not produce the over or under cooling as would be seen by a system using direct process gas to liquid nitrogen heat exchange. Another advantage is the ability to create the bespoke system tailored to the process' flows and solvent loads.”

Dr. Idoko Ochuma,  
Air Products Senior Applications Specialist, says:

“Another benefit of the Cryo-Condap® system is that the solvent can be recovered and recycled.”

## Conclusion

Andrew Goss,  
PM Group Project Manager, consultant to  
Global Health Care Company, concludes:

“Previously the process had removed solvent using glycol condensers. Whilst they take the majority of the solvent load generated, an emission was still generated. The use of the Cryo-Condap® system allowed an even greater amount of solvent to be removed from the process gas.”

Dr. Idoko Ochuma,  
Air Products Senior Applications Specialist,  
concludes:

“With increasingly restrictive legislation on solvent emissions to the atmosphere, there has been a greater need and urgency for industry to reduce emissions to meet or exceed targets and also continue to do so in the future.”

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