Recovering methyl chloride

A case study looking at how Cryo-Condap® technology can help achieve the most stringent emission targets.

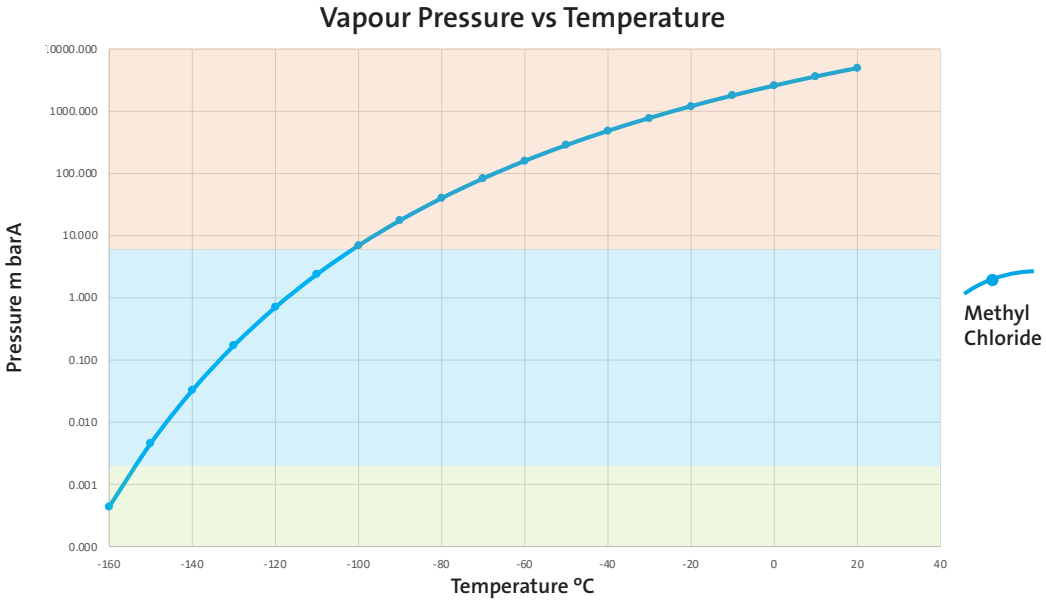
AIR PRODUCTS

The Cryo-Condap® solution

Cryogenic driven abatement systems typically leverage the low temperature physical properties of liquid nitrogen (LIN) to cool down process gases emissions generated from production activities to meet – or even succeed - emission targets. In many cases this is sufficient and provides a reliable regenerative approach to sustainable environmental protection and reducing a CO_2 footprint.

However, there are some volatile organic compounds (VOCs) that are more challenging and not that easy to recover due to their high vapour pressures even at their freezing points – for example, dichloromethane, acetone, along with various refrigerant types. The toughest one of all to treat is methyl chloride (MeCl) due to it having unique and challenging physical properties, it has an extremely high vapour pressure even at its freezing point where the concentration is significantly greater than the limits set by environmental regulations.

To address the issue, there are two potential ways of treating this most volatile of organic compounds: either subfreezing the process gas, with switching cryogenic heat exchangers or treating it as we discuss in this case study.



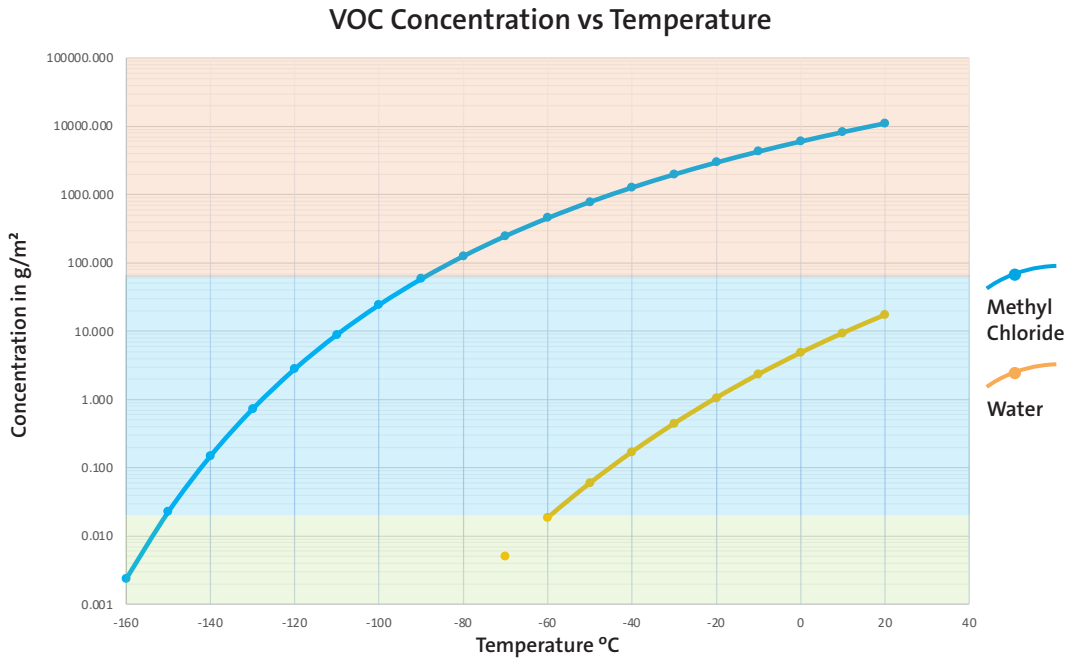
Vapour pressure of methyl chloride – source Air Products & Chemicals, Inc. CAPP (Computer-Aided Physicochemical Property)

Subfreezing is not always the most desirable approach as it can involve overcoming several hurdles and disadvantages, including the radical freezing of heat exchangers and within droplet separators, the unexpected formation of aerosols, process instability, higher liquid nitrogen consumption all resulting a higher CO_2 footprint.

The first cryogenic solvent recovery Cryo-Condap® system was developed jointly by Air Products and Herco Kühltechnik in the early 80s. Since then, Air Products has worked exclusively with Herco to manufacture Cryo-Condap® systems and together they have gained extensive experience in solvent recovery applications covering a wide variety of global industries. Herco Kühltechnik is also a leader in refrigeration technology solutions. One of those applications is in the recovery of Methyl Chloride.

Low temperature cooling of a process gas is achieved by using a combination of cryogenically cooled heat exchangers to leverage the available enthalpy of the vaporised nitrogen to its fullest potential. By using a combination, cold energy recovery recuperator exchangers and proprietary cryogenically cooled low temperature exchangers with intermediate fluids, process gas cooling and associated solvent recovery can be accurately controlled according to the type of solvent and its composition within the process gas. However, when the process gas contains methyl chloride additional measures need to be considered and a final 'polishing' step is necessary to consistently meet the required environmental emission limits.

As the boiling point for methyl chloride is -24 °C and a freeze point is -97°C, at ambient pressure, it is important to control the rate of cooling to achieve the correct conditions for final process gas treatment step, which is achieved by using cryogenic adsorption technology. By operating at extremely low temperatures, we can increase adsorption capacity and performance of the molecular sieve beds.

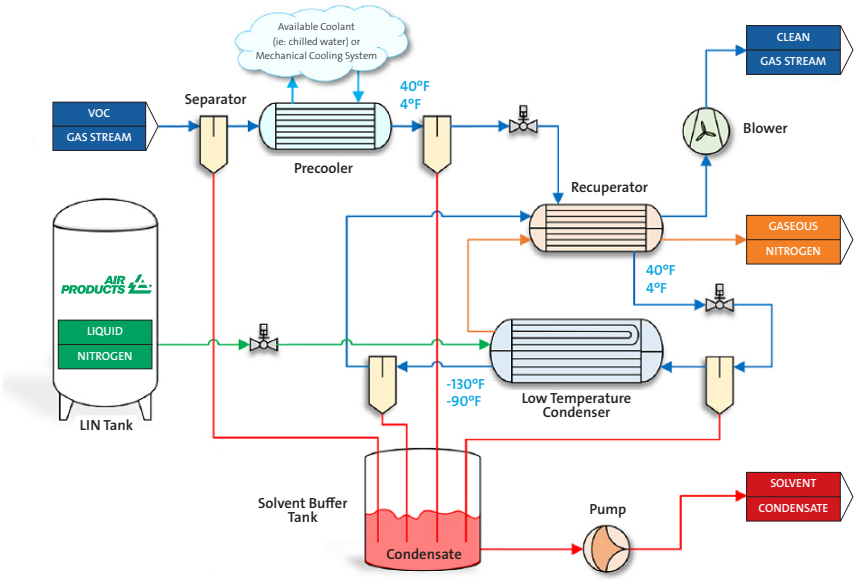


Concentration of methyl chloride – source Air Products & Chemicals, Inc. CAPP (Computer-Aided Physicochemical Property)

According to the VOC Concentration chart, the residual concentration shows the inlet condition of the molecular sieve. Since the molecular sieve normally has a very low adsorption capacity for methyl chloride at room temperature, the colder it is, the more beneficial the adsorption capacity of the molecular sieve will be. With this extreme VOC we used a three-bed molecular sieve station: two beds for adsorption and the third bed for desorption. When the system switches bed the desorbed fresh bed is always the second bed in line, so guaranteeing the emissions will not be exceeded, whereas the first bed adsorbs the majority of the methyl chloride content.

By using molecular sieve technology, Cryo-Condap® plants are able to adsorb the residual methyl chloride concentration and purify the process gas to a degree whereby the vent gas is well within required limits and can be emitted to the atmosphere. The major difference between the traditional subfreezing approach, with switching cryogenic heat exchangers, is that the Cryo-Condap® solution conditions the process gas condition to as cold as -94°C (3 degrees above the methyl chloride freeze point), for optimal stable reliable cryogenic adsorption.

Basic Cryo-Condap® process



The process gas condensate recovered from the Cryo-Condap® system is collected into a solvent reservoir that is further cooled by liquid nitrogen to avoid any boiling off the recovered methyl chloride. A special cryogenic pump then transfers the liquid methyl chloride to a storage tank for other downstream use.

Dealing with difficult and challenging volatile organic compounds (VOCs) is not a problem for a Cryo-Condap® system. Partnering with cooling technology specialists Herco Kühltechnik brings a combined knowledge and experience to every application challenge, ensuring that the right environmental and economic technology solution can be provided every time.

To learn more about Air Products' proprietary Cryo-Condap® VOC recovery technology visit our webpage at

www.airproducts.co.uk/cryocondap

MeCl

Facts about Methyl Chloride

Methyl chloride, which also known as **Chloromethane**, is an organic compound, with the chemical formula CH_3Cl. One of the haloalkanes, it is a colourless, odourless, flammable gas. Methyl chloride is a crucial reagent in industrial chemistry, although it is rarely present in consumer products.

Methyl chloride is employed as a methylating and chlorinating agent, e.g., the production of methyl cellulose. It is also used in a variety of other fields: as an extractant for greases, oils, and resins, as a propellant and blowing agent in polystyrene foam production, as a local aesthetic, as an intermediate in drug manufacturing, as a catalyst carrier in low-temperature polymerization, as a fluid for thermometric and thermostatic equipment, and as an herbicide.

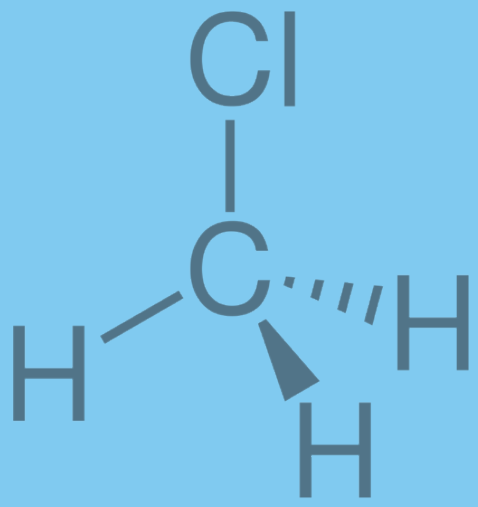
Formula: CH_3Cl

CAS nº: 74-87-3

Molar mass: 50.49 g·mol−1

Melting point ≈ -97°C

Boiling point≈ -24°C



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