

# Cryogenic recovery of volatile organic compounds

## Introducing an efficient and versatile method of liquid gas recovery

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### The method

The cryogenic recovery of volatile compounds was developed to efficiently and simultaneously purge liquid gas storage tanks with nitrogen, and recover the remaining gas heel on specification, without emission to the atmosphere.

The process is based upon a supply of liquid nitrogen, where the liquid nitrogen is heat-exchanged with the outgoing gas vapors in such a way that the gas is efficiently recovered at cryogenic temperatures, on specification, ready for further processing. Therefore, the vaporized nitrogen is used as a purging gas.

### The process development

The process was developed in close co-operation with Sintef Research Institute in Norway, and with the funding of I.M. Skaugen Norway, Statoil Norway and by governmental programs. The development led to various patents within the cryogenic field of technology.

### The gas recovery unit

The gas recovery unit is a compact unit built into a standard 10-foot container frame. It consists of a series of configured copper brazed heat exchangers containing heat transfer fluid, and pneumatic and electronic control systems.

The GRS unit is remotely controlled from a control station during operations, where the GRS unit is positioned in hazardous zone 1 area, hooked up by hoses to the tank being gas freed, and to the tank into which the recovered product is being pumped.

The same technology can be used during the recovery of petrochemical gases such as:

- Ethylene
- Propylene
- Butadiene
- Halons
- Chlorofluorocarbons
- Freons
- Ethane
- Propane
- Butane
- VCM
- Isoprenemonomer
- Isobutane



Recovery operation of VCM at Vopak Middlesborough, England.



Measuring emission of VCM on GRS unit Vopak Middlesborough, England.

## VOC emissions during operation.

The heat exchange circuit of GRS enables the recovery of each product close to its freezing point. Typically, in a VCM operation the recovery temperature is at  $-153.8^{\circ}\text{C}$ , at which temperature the product has no vapor pressure and thus the emission is reduced to a couple of ppm only.

A typical VCM recovery operation was conducted at Vopak Terminal in Immingham, in which a  $6,647\text{m}^3$  sphere was decontaminated. The results were as follows:

1. VCM liquid recovered from system: 13.020 kg
2. VCM recovered during purging operation: 89.130 kg
3. VCM emissions to atmosphere total: 5 kg
4. Total liquid nitrogen consumption: 120.172 kg
5. Recovery efficiency: 99.98 %

### ABOUT THE AUTHOR

**Bård Norberg** is a Master Mariner with 20 years of seagoing experience on gas and chemical carriers, specializing in gas operations. Over the past two decades, he has worked closely with the Sintef Research Institute of Norway, developing cryogenic processes such as vapor recovery technology and small-scale LNG boil-off re-liquefaction systems, which are now being installed on ships. He also works on processes and design responsibility for a series of small LNG carriers.

### Facilities at which the technology is already in use

Aga Norway	recovery of propane
Zebrügge	recovery of propylene
Simon Storage UK	recovery of P12
Simon Storage UK	recovery of P114
Vopak Finland	recovery of IPM
AVC Australia	recovery of VCM
Maersk Sussex	recovery of VCM
Vintron Germany	recovery of VCM
Vopak UK	recovery of VCM
GlaxoSmithKline	recovery of P11
GlaxoSmithKline	recovery of P12
Norsk Hydro	recovery of VCM
Chemgas 16	recovery of VCM
AVC Australia	recovery of VCM
Immingham Stor.UK	recovery of P12
EVC Barry	recovery of VCM
GlaxoSmithKline	recovery of P11
Norsk Hydro	recovery of VCM
Inneos	recovery of VCM

As we can see, using this method of cryogenic recovery for volatile compounds is almost 100 percent efficient, with little emission to the atmosphere. In short, the system can be said to be one of the most effective available today.

### ENQUIRIES

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