GRS Europe

GAS RECOVERY SYSTEMS EUROPE

Cost effective and Environmentally sound

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Introduction

The disposal of 'waste' vapours in the atmosphere is a concern of the chemical industry. Technical solutions for vapour emission control which are economical acceptable are not always available.

When dealing with liquefied gasses in a tank, a considerable part of the total product quantity exist as vapour. Moreover, after discharging the liquid phase from the tank, the tank volume will entirely consist of remaining cargo vapours. In many cases, facilities for handling these vapour phases are not available, with a consequence that often for one or another reason they are to be realised to a vent stack or a flare system. This spillage of valuable product is coming extreme in case where storage tanks or cargo containment systems are to be gas freed for reasons of cargo change over or internal inspection.

The handling of liquefied gasses and other volatile cargoes often requires a release of product directly in the atmosphere or a release of product to a flare system. The quantities of VOC's and / or toxic products released in the atmosphere are during change over from one cargo to another one for which a gas freeing of the cargo containment system is required.

The table below gives an overview of vapour quantities released in the atmosphere for different products for gas freeing cargo tanks with a capacity of 10.000 m3 and an overpressure of 0,5 bar.

Compound	Vapour Temp.	Vapour density (Kg/m3)	Quantity (Kg)
Ethylene	0	1.88	18 800
Propane	0	2.95	29 500
Propylene	0	2.81	28 100
n-Butane	0	3.89	38 900
Iso-Butane	0	3.89	38 900
Butylene-1	0	3.75	37 500
Iso-butylene	0	3.75	37 500
Butadiene-1,3	0	3.62	36 200
Vinyl Chloride	0	4.15	41 500
Ammonia Anhydrous	0	1.14	11 400

GRS

GRS AS has developed a compact transportable multi-purpose recovery system for Volatile Organic Com-pounds (VOC's). Based on cryogenic condensation with liquid nitrogen, VOC's are recovered in a highly economical and environmentally friendly way, rather than disposed of through the use of flare or incineration. The application of an integrated heat transfer fluid makes this system truly unique, and its flexibility allows recovery of a wide variety of VOC's.

GRS Europe is a partnership between GRS AS (Norwegian Gas Carriers/Skaugen) and Chemgas Shipping B.V. and will introduce the system within the European gas market. All operations are backed up with scientific report from SINTEF Energy Research of Norway.

Economical & Environmental Benefits

The vapour recovery technology patented by GRS AS offers a clean and energy efficient method for refining, chemical and pharmaceutical industries to cut losses incurred during loading, unloading, storage and handling of organic compounds.

The release of vapours from a cargo containment system often requires inert gas during the procedure. Gas freeing and purging of gas containment systems are a typical example. The nitrogen vapours generated during the vapour recovery process of the GRS unit can be used for inerting or blanketing.

Besides an efficient in-specification recovery of the cargo vapours, the release of toxic compounds in the atmosphere is reduced to an absolute minimum.

The use of the GRS technology eliminates the need for a shore flare, increases the efficiency of gas free operations and change of grade operations. In addition to the economical benefits, the GRS system is totally environmentally safe. No secondary pollution such as acid gases, CO2 emission, waste water, nitrogen oxides, dioxins, etc. is created.

Compact, Flexible and Transportable

In addition to the high capacity and efficiency of the GRS unit, the system is also compact. All components are mounted in a standard 10-feet ISO container frame. That makes the GRS unit easy for transportation and consequently extremely flexible.

GRS is a multiple purpose unit and can be used as a:

- Vapour recovery unit during gas freeing and purging operations of cargo containment systems
- Vapour recovery unit during gassing up and cooling down operations
- Reliquefaction / Cooling unit for liquefied gases
- General recovery unit in the chemical industry

The technology

GRS utilises liquid nitrogen as coolant. The nitrogen never mixes with the cargo vapour stream and leaves the unit as a pure gas. The vaporised nitrogen can be used for purging or blanketing of the cargo containment system or for in-plant operations. The cargo vapours to be recovered from the cargo containment system are simply replaced by nitrogen vapours generated during the liquefaction process in the GRS unit.

A direct heat exchange between the liquid nitrogen and the cargo vapours would result in operational problems in the GRS unit, due to solidification of most of the hydrocarbons at the extremely low temperatures. To avoid this problem, a heat transfer fluid is used as the intermediate between both the liquid nitrogen and cargo vapours. The temperature of the heat transfer fluid is adjusted as a function of the nature of the compound to be liquefied.

Liquid nitrogen is introduced to a nitrogen vaporiser where it is vaporised against the heat transfer fluid with the result of cooling down the latter.

In the cargo condenser, the VOC's are liquefied by heat exchange with the chilled heat transfer fluid. From the condenser, the liquefied VOC – incondensable mixture flows to the vapour / liquid separator. Incondensable, such as nitrogen vapours, are released from the top of the separator to the atmosphere. The condensate is pumped from the liquid collector of the separator to storage or to plant facilities. Complete condensation occurs in the condenser and an extremely efficient recovery of the product is achieved.

A fully integrated control system makes this system easy to adjust for flow and concentration fluctuations.

Few moving parts makes the compact and transportable GRS unit very reliable, provides low energy consumption and guarantees a low maintenance cost.

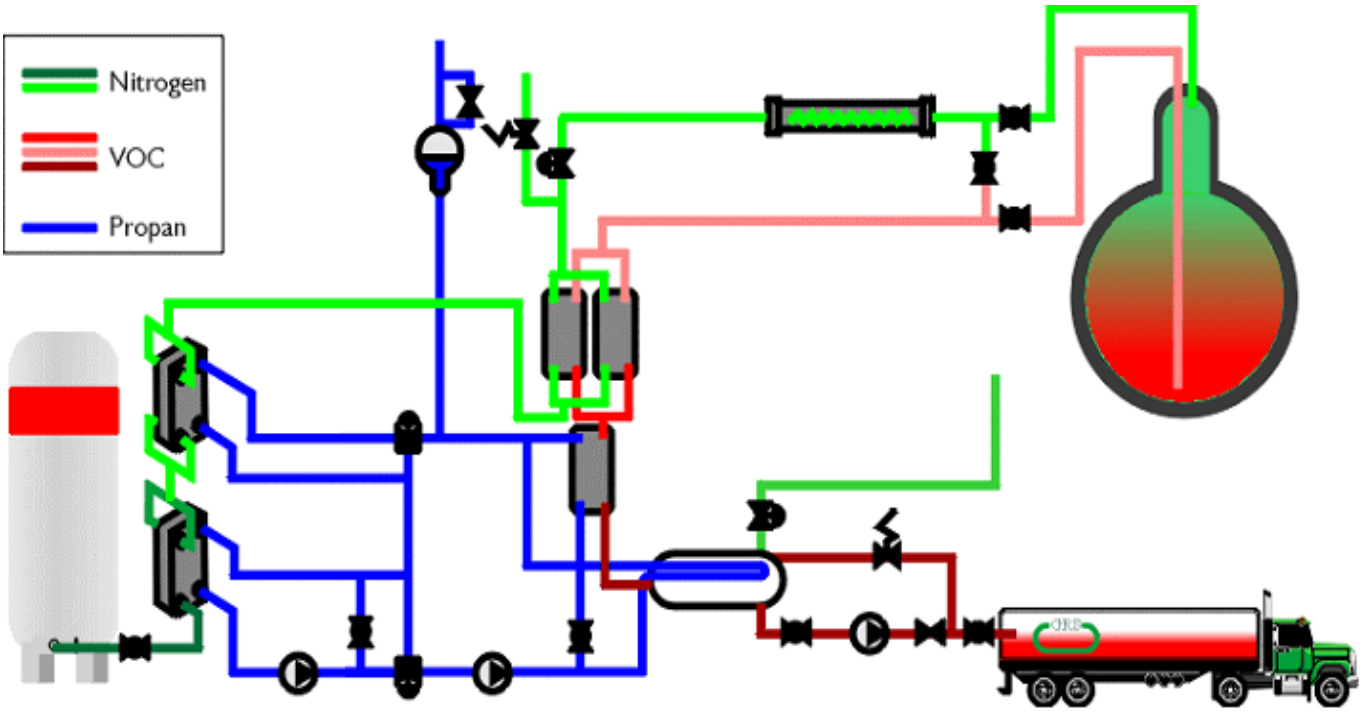


Fig 1. GRS System

GRS Application and benefit

Gas freeing / purging

Gas freeing of cargo containment systems is required for reasons of maintenance or technical inspection. By introducing nitrogen in a cargo containment system, the content on remaining vapours of a previous cargo is reduced so that contamination is avoided. For the change over from some products to other ones it's recommended to first bring the cargo tanks under air for a visual cleanliness inspection and to reduce the remaining previous cargo content to zero. All such an operations requires the use of nitrogen vapours and implement a release of previous cargo vapours to the atmosphere or to a flare system.

The GRS unit is perfectly designed to exclude the emission of organic and/or poisonous vapours in the atmosphere. While the vaporizing liquid nitrogen liquefying previous cargo vapours, the nitrogen vapours originating from the heat exchange in the unit are introduced in the cargo tank to be purged. A closed circuit is obtained, the emission of VOC's or toxic vapours tot the atmosphere is excluded. Many tones of valuable cargo vapours are recovered and can be further used. The emission of carbon dioxide in the atmosphere is totally excluded.

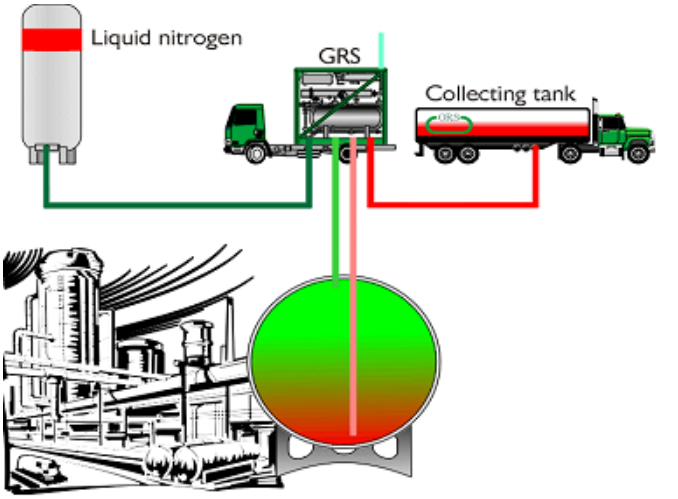


Fig 2. Purging of shore tank

Gassing up / cooling down

After tanks, ships have been inerted prior to receive a certain cargo of liquefied gas, removal of all incondensable is necessary to allow a smooth operation of the cargo handling systems such as reliquefaction units etc… That means that the nitrogen vapours are to be substituted by vapours of the next cargo. Moreover, for products with a low boiling point, the tank material needs to be cooled down in accordance with certain procedures. This operation includes the use of a vapour return system in which commonly vapours are released to a shore incineration system.

The GRS system is even utmost efficient for this type of operations. The consumption of release of valuable product to the flare system is avoided. Product is liquefied and incondensable are simply released to the atmosphere. Sub-cooled condensate is returned to the cargo system and is reused in the cooling process of the tank. The fact that the condensate is sub-cooled makes the whole operations faster and much more efficient.

GRS for ships

When applying GRS technology during the discharge operation of a certain liquefied gas and if afterwards a purging operation has to be performed, GRS makes it possible to recover the vapour atmosphere completely, product otherwise remaining in the cargo tanks after completion discharge.

Besides a total recovery of the vapour atmosphere representing valuable product, the vessel will leave the discharge port with the cargo tanks already under nitrogen atmosphere. Time for purging is saved and in some cases the used of the ship's inert gas plant is avoided. Moreover, the environment has been protected from the emission of VOC's or carbon dioxide.

In general berth occupation will be reduced, gas carriers will be employed at a more efficient and cost efficient way.

Highlights

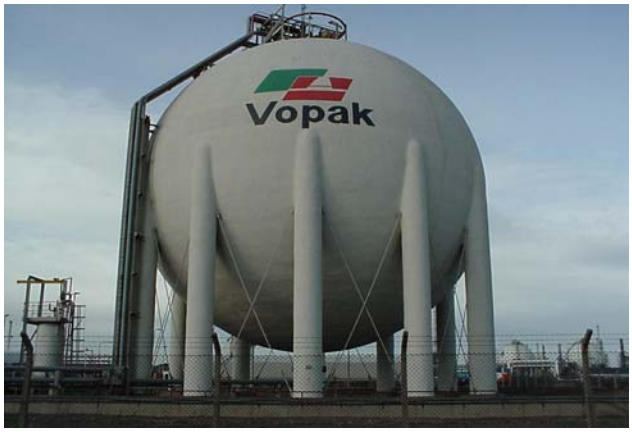
- **Highest removal efficiency of VOC's**
- **Small equipment size**
- **Good reliability**
- **Easy to adjust on flow and concentration fluctuation**
- **No secondary pollution**
- **Low capital investment**
- **Low annual operating cost**
- **Low energy consumption**
- **Recovered product is not contaminated**
- **Compact and transportable**

References

- Vopak Teesside
- Vinnolit Germany
- Maersk Australia
- Simon Storage
- GlaxoSmithKline
- Norsk Hydro
- AGA Norway
- AVC Australia
- Infracor Marl

Past operations

Location:	Vopak Teesside, UK
Tank sphere:	6.650 Cbm
Product:	VCM
Product recovered:	67 mton
Liquid nitrogen used:	90 mton
Duration:	5 days
Remaining product in tank:	< 50 ppm



Location:	Infracor Marl, Germany
Tanks:	6 x 347 cbm = 2.082 Cbm
Product:	VCM
Product recovered:	20 mton
Liquid nitrogen used:	20 mton
Duration:	24 hours
Remaining product in tank:	< 5 ppm

Location:	GlaxoSmithKline Ware, UK
Tanks:	8 x 137 cbm = 1.096 Cbm
Product:	Freeon
Product recovered:	17 mton
Liquid nitrogen used:	24 mton
Duration:	4 days
Remaining product in tank:	< 50 ppm