Polaris

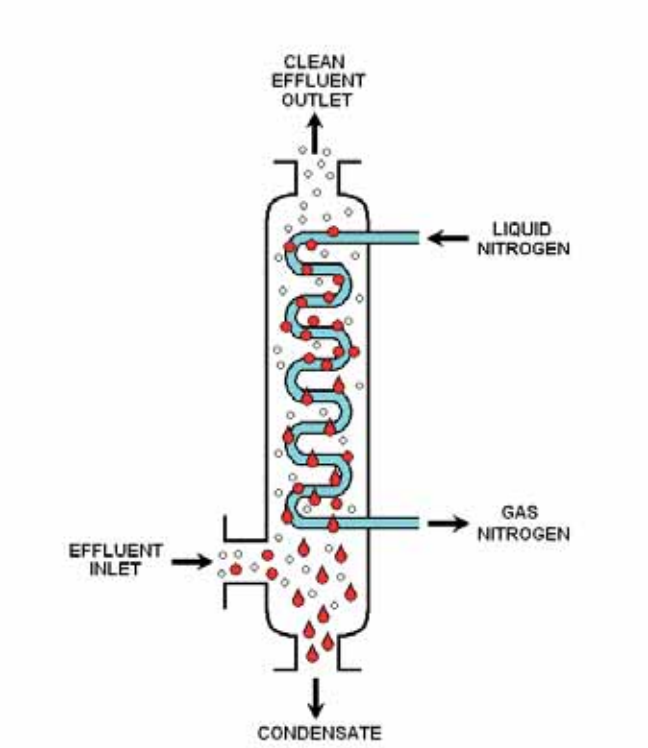
Smart VOC Recovery Systems

CRYOGENIC CONDENSATION

The cryogenic condensation technology developed by Polaris is a proven technique for the separation of volatile organic compounds from vent gases.

The principle of the technology is based on the decrease of vapour pressure at low temperature and consequent condensation of VOC's, by cooling the stream with liquid nitrogen or other cryogenic fluid. Due to the low operating temperature, some compounds can be separated in form of solid frost, depending on combination of melting point and vapor pressure equilibrium curves (vapor/liquid and vapor/solid equilibria). Polaris has developed a reliable design that allows a good separation of the condensed phases and a controlled fouling due to solid phase accumulation.

Each unit is specifically designed and customised for the required separation and VOC recovery, and the operating temperature is selected accordingly. The process and equipment configuration depends on several factors, considering the characteristics of the stream at the required operating temperature. The unit can include, were necessary and/or convenient, some pre-treatment steps, e.g. precooling, drying, washing, etc.



The units are fully automatic, thanks to a control system (PLC based) that monitors and adjusts the process parameters in order to get the required operating temperature and a stable and reliable working cycle. The operator interface is user friendly and includes useful features like automatic trouble-shooting guide, records of events and process data, etc.

Due to the process principle, the technology is better applicable to process streams and to relatively VOC rich streams, for flowrates up to 5.000 Nm3/h, with no limits for inlet VOC concentration. The final concentration achievable for common VOC's are in the order of few ppm, and in compliance with the more strict requirements expressed by the European norms.

The cryogenic condensation process is appearantly a "trivial" cooling application, but actually it involves some potential issues that have required some efforts to be overcome. In fact the standard approach for design of heat exchangers cannot be applied successfully. The maximum advantages have been got, from the great potential of cryogenic treatment, thanks to proprietary heat exchangers developed by Polaris, which are characterised by high fractionating capacity of vapours and gases.

BENEFITS OF CRYOGENIC CONDENSATION

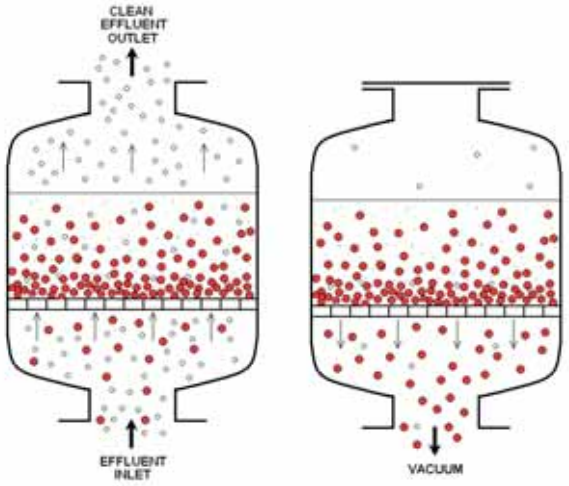
- The operating cost is low thanks to the reuse of nitrogen used for cooling;
- The investment cost is relatively low for application to process vent streams;
- In most cases the VOC's separated by the effluent can be recovered for reuse;
- It is a "static" equipment, no machinery/mechanical equipment other than the blower and valves – low maintenance cost – higher reliability of components;
- It is a safe process, no addition of air is required, no risk of flammability is introduced;
- It is a flexible process, suitable for practically all VOC's;
- The VOC's are separated without addition of other chemicals or dilution with water, and consequently the further processing of the recovered VOC's is easier, and in case the condensate cannot be recovered the disposal costs are reduced;
- No secondary pollutants are produced in the process;
- The unit is compact and requires a relatively small footprint, the prefabrication allows lower installation and commissioning costs.

TYPICAL APPLICATIONS

- Flowrate up to 5.000 Nm3/h
- Any concentration is acceptable
- Pharmaceutical industry
- Chemical industry
- Tank farms
- Ship loading terminals
- Solvent recovery industry

ADSORPTION WITH DRY REGENERATION

The “dry regeneration” process was developed by Polaris in order to find an adequate solution for VOC recovery from higher flowrate streams, where cryogenic condensation is not economical.
As far as the adsorption is concerned, the process is based on traditional techniques, using activated carbons or other adsorbent.
The innovation is relevant to the desorption step, and consists of a sequential procedure of heating the bed of adsorber by means of inert gas (e.g. nitrogen) in a closed loop, and following with desorption under vacuum to get the quantitative removal of the adsorbed compounds. Only a minimum overflow from the regeneration loop, but saturated with the desorbed compounds, is cryogenically treated with LIN, while the produced GAN enters the regeneration circuit.
Thanks to the above procedure, all the cryogenic energy from LIN is recovered, as well as the GAN produced. The regeneration of adsorbent materials is extremely effective. The regeneration costs are low thanks to a rational and efficient use of the cooling and heating energy. Compared with steam regeneration, the use of hot nitrogen avoids the formation of big amounts of polluted water to be treated and the possible hydrolysis of some organic compounds



TYPICAL APPLICATIONS

- Flowrate between 500 to 100.000 Nm3/h (or more in special cases)
- VOC concentration in the order of 1 - 30 grams/Nm3
- Printing industry
- Painting/coating industry
- Pharmaceutical industry
- Chemical industry

BENEFITS OF DRY REGENERATION

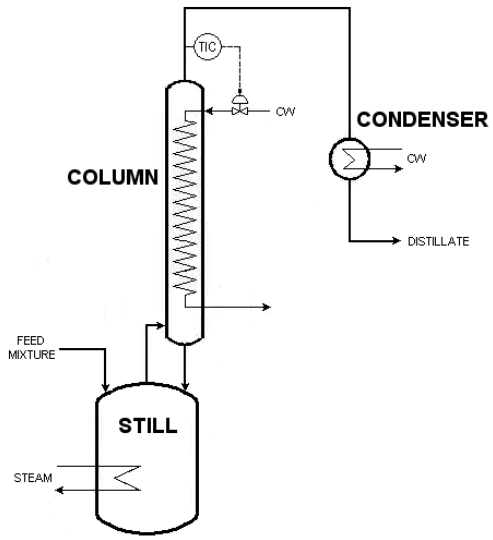
- maximum safety, even in presence of highly flammable compounds
- better compatibility with compounds that present hydrolysis problems
- reduction of waste water treatment costs (no volume increase due to steam dilution)
- easier recovery of the separated organic compounds (no dilution with steam)
- compared to other regeneration techniques with inert circuit, the operating costs are lower
- compliance with emission limits required by the more strict norms
- the process is suitable for most common substances, also to the more volatile ones, for which the other conventional regeneration techniques are not effective

INTERNAL REFLUX DISTILLATION

The internal reflux distillation technique is based on a particular type of column which combines mass transfer and heat transfer, necessary for the fractionation of mixed vapours generated by boiling of a multi-component liquid mixture, in an equipment basically made of a number of vertical finned coils, internally cooled by a cooling fluid.
The heat transfer thus carried out, thanks to a specific surface of about 500 m2/m3, is associated to an extremely efficient mass transfer, also advantaged by the uniform wetting of the surface at all points.
The technology results particularly efficient in batch distillation of compounds where it is required a good quality of distillate, as well as in solvent recovery from complex mixtures, where other available techniques result inadequate or bring to economically inconvenient recovery.
With the Polaris column, it is possible to design the recovery process according to various modes, adopting case by case the more convenient one for the mixture to be treated and depending on the quality specifications of products:

- distillation at pressure less, equal or more than atmospheric
- distillation under high vacuum
- azeotropic distillation
- extractive distillation
- de-hydration by distillation with phase separation

For each of the above mentioned processes, it is possible to fractionate with variable or constant internal reflux, depending on convenience to be evaluated case by case.



ADVANCED SEPARATION TECHNOLOGIES

Polaris is a leading supplier of turn-key systems for the separation and recovery of organic compounds, based on innovative proprietary technologies.

Polaris is a private company established in 1996. Since then the Company core business has been the design, the construction and the turn-key supply of plants for the chemical and pharmaceutical industry in Italy and abroad, and effluent treatment plants for process industries.

Most units are fully prefabricated, for better construction control and cost reduction, in Polaris own 4000 m^2 workshop.

The Quality System complies with the norm ISO 9001:2000.

It is the company policy to pursue innovation in the processes and technologies. This approach gave, as a return, the development of several new technologies and patents.

To date Polaris has implemented successfully more than 150 tailor made plants, operating in many European and extra-European countries.

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