This technology works by using liquid nitrogen to cool a vent gas stream, therefore lowering the vapor pressure of the volatile organic compounds (VOC) in the stream while condensing them. Due to the low operating temperature, some compounds can be separated into solid frosts, depending on the combination of the melting point and vapor pressure equilibrium curves. Polaris has developed a reliable design that allows for good separation of the condensed phases and a controlled fouling due to solid phase accumulation.

Each unit is specifically designed and customized 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 some pre-treatment steps (e.g. pre-cooling, drying, washing, etc. depending on what is necessary or convenient).

The units are fully automatic thanks to a PLC based control system that monitors and adjusts the process parameters in order to attain the required operating temperature and a stable and reliable working cycle. The operator interface is user-friendly and includes useful features like an automatic troubleshooting guide, and records of events and process data.
This technology is best applied with process streams and relatively VOC rich streams, for flow rates up to 5,000 Nm3/h, with no limits for inlet VOC concentration. The final concentration achievable for common VOCs is in the order of a few ppm, and in compliance with EU and US requirements.

The cryogenic condensation process carries some potential issues that have required innovative efforts on the part of Polaris to overcome. The standard design approach for heat exchangers cannot be applied successfully in this application. As a result, maximum efficiency of the cryogenic treatment is possible because of the proprietary heat exchanger technology developed by Polaris. These heat exchangers are characterized by the high fractionating capacities of vapors and gases.

**TYPICAL APPLICATIONS**

- Pharmaceutical industry
- Chemical industry
- Tank farms
- Ship loading terminals
- Solvent recovery industry
- Other applications with a flow rate up to 5,000 Nm3/h

**BENEFITS**

- Any VOC concentration is acceptable.
- The process is flexible, and suitable for practically all VOCs.
- The VOCs are separated without adding other chemicals or diluting with water, making it easier to further process the recovered VOCs.
- In most cases, the VOCs separated by the waste can be recovered for reuse.
- No secondary pollutants are produced in the process.
- The process is safe. No air is added, and there is no risk of flammability.
- The investment cost is relatively low for applications that process vent streams.
- The operating cost remains low by maximizing the nitrogen usage in and after the cooling process.
- Maintenance costs are low with higher reliability of components.
- The equipment is static; there are no additional machines or mechanical equipment other than the blower and valves.
- The unit is compact with a small footprint. Installation and commissioning costs remain low due to prefabrication.