CHANGING
GEA HEAT EXCHANGERS



GEA Mini Desublimator – Pluto

Desublimation "by GEA": smart, sustainable, customized



Benefiting from the HX factor: Focussed competence and excellence in heat exchanging

Efficiency and sustainability are standards. GEA Heat Exchangers (HX stands for heat exchange) offers you more. Because we have the HX factor. Everyone at GEA has it. Every team. Every employee. It can be found in all our products and services. It makes the difference. And gives you the edge in heat exchanging. Thanks to engineering know-how based on market experience and expertise. With skills and understanding leading to the right solution even in the most complex projects. With reliability in every situation. With enjoyment of the challenge. With commitment, foresight and precision. This is all a part of our HX Factor. Experience it. Benefit from it.

A reliable partner

The GEA Group views itself as a value-added partner throughout the complete lifecycle of a product or project. Maximization of customer satisfaction is achieved by closely observing and optimising all relative steps – planning, installation, start-up, operating costs, maintenance and upgrades. The GEA Heat Exchangers segment has one of the most comprehensive portfolios, if not the most comprehensive, of heat exchangers in the world. Within this segment desublimators are developed and manufactured in the Shell & Tube Competence Center.

With the development and manufacture of the first desublimator in 1954 for use in the PA process (PA separation) the GEA success story began as an equipment supplier for the manufacturing process of phthalic anhydride (abbreviated to PA). In the following years, based on its expertise on the complete PA process, GEA continued to develop and launch apparatus onto the market for this specific process. This also included mini desublimators – successfully introduced onto the market in 1982 – for use in the distillation section of a PA plant.

With small and ultrasmall substance streams separation using desublimation is a convincing economic solution. The GEA desublimator range for this application category includes the Pluto model, designed for a gas flow of between five and 500 kg per hour. In contrast to larger models no fin tubes are used here, but lamellas to permit a particularly compact design and a heat exchanger surface area of up to 100 square metres.

This means that the Pluto is highly versatile and offers significant benefits:

- "Clean" process: no use of chemicals, no water consumption
- Excellent separation rate of over 99.5 percent
- High product purity
- Low space requirements due to compact design
- No moving parts: low wear, high operational reliability, virtually maintenance-free

Pluto is also a customized product. As both design and manufacturing are by GEA, customer requirements of whatever kind can be integrated into the product. Pluto is deliverable in all weldable materials.

The desublimation specialists:

- Comprehensive engineering and manufacturing expertise
- Know-how transfers within GEA Heat Exchangers ensures state-of-the-art solutions
- Special process expertise guarantees optimum desublimator design
- Global after sales service



Imitating nature

The formation of hoarfrost is an example of desublimation. Water contained in the air is directly deposited on cold surfaces directly in its solid (crystalline) phase. This natural „experimental design“ was reproduced by GEA engineers in a desublimator for substance separation – and immortalized in metal as it were.

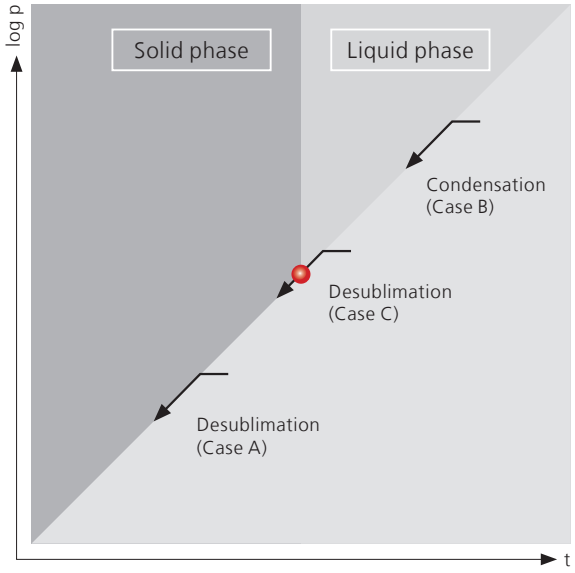


Illustration of desublimation in a log p/t phase diagram

Desublimation is the direct phase change of a substance from its gaseous to its solid (crystalline) phase. This physical phenomenon is known from nature: In winter air-bound moisture is deposited as hoarfrost.

The log p/T diagram shows that desublimation is separate from condensation. Whereas steam from an inert gas-steam mix condenses above the triple point (Case B), the steam below the triple point can only desublimate from the gas phase (Case A). In Case C as well, the result is crystallization, but indirectly via previous condensation. The gaseous substance first liquefies, but then freezes immediately on the cold surface – in nature this phenomenon occurs with freezing rain.



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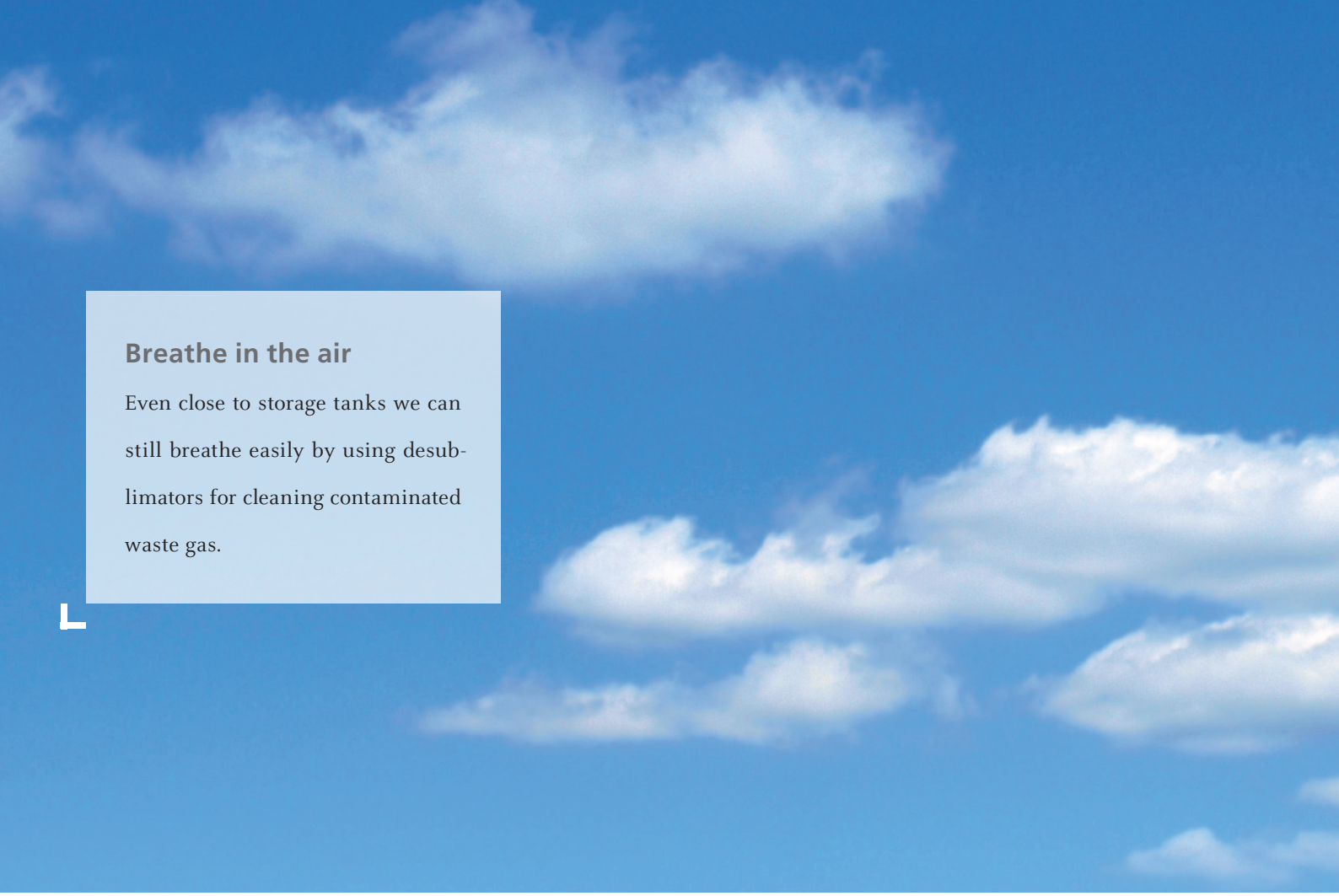
In the Pluto unit the gas mixture comes into contact with cooled lamellas. Here that part of the gas mixture to be separated desublimates either around or below its triple point and adheres to the cold surface in crystalline form. The Pluto unit is split into several sectors to prevent too much of the substance being deposited close to the gas inlet. A range of lamella designs are available for optimum utilization of the heat exchanger surface – and the sectors are adapted individually to each process requirement to achieve optimum results, i.e. separation efficiency of over 99.5 percent.

The crystallized product is melted off as soon as the desublimator is fully loaded. A continuous process is possible by using a minimum of two Pluto desublimators. With minor design adjustments it is also possible to feed separate gas streams into a single Pluto at the same time for substance isolation, using only one common cooling/heating system.

Despite the wide range of design possibilities and internal fittings the Pluto is available in standard sizes. Thanks to its compact design the unit does not take up much space. Pluto can be supplied in all weldable materials and can be used across a wide temperature range of between -20 and 350 °C, the pressure range is between vacuum and 10 bar

Substances that can be separated by desublimation in Pluto:

- PA
- Nitro-anthraquinone
- Water
- P2S5
- PMDA Naphthalene
- TDA
- Polymers
- Butyl phenol
- Naphthol
- Resorcinol
- Oligomers
- Iodine
- ...



Breathe in the air

Even close to storage tanks we can still breathe easily by using desublimators for cleaning contaminated waste gas.

Emission protection

A typical application for the Pluto unit is the cleaning of polluted waste gas streams. Fuel tanks or storage tanks in the chemical industry containing combustible or potentially explosive substances are regularly charged with inert gases. These inert gases include nitrogen or noble gases, for example.

Over the course of time the inert gases become contaminated with the stored substance. A desublimator as breathing cooler is used to prevent any escape to the environment of substances capable of desublimation. The waste air is reliably cleaned in the Pluto unit by separating the substance enriched in the inert gas.

In this application it is generally sufficient to install only one Pluto unit directly on top of the vessel or tanker, as the enrichment rate usually permits batch operation.

High unit reliability:

- No direct weld seams between gas and cooling/heating side
- Gastight housing (welded, not flanged)
- Lamellas not continuous to prevent thermal stress
- Robustness
- Small number of connections, minimising danger of leaky flange connections
- Testing to numerous international standards



Recovery of valuable (raw) materials

In the chemical and pharmaceutical industries it is not unusual that valuable raw materials have to be charged to the production process, but which are not intended to be present in the end product after the desired reaction. An example of this is iodine, which occurs less often than the other halogens and is therefore more expensive, and which is also classified as a hazardous substance. Iodine contained in gaseous substance streams desublimates even at room temperature. Using the Pluto unit 99.5 percent of this valuable chemical element can be recovered.

Substance separation using desublimation, when this process is suitable, is superior to other substance separation processes such as washing with solvents not only for cost reasons, but also from an environmental protection viewpoint. There are no solvents to be disposed of. Product purity and separation rates are higher in the desublimation process.

High process reliability:

- No by-passing of uncooled gas
- Defined loading times
- Long loading times possible
- Safe melting at predetermined time
- Low pressure loss
- Heatable nozzles prevent blockage by desublimated material
- Simple operation



Maintaining values

Whether our customers recover unneeded raw materials from the end product or increase the operational reliability of their facilities – the use of desublimators maintains values and safeguards investments.

Protection of downstream components

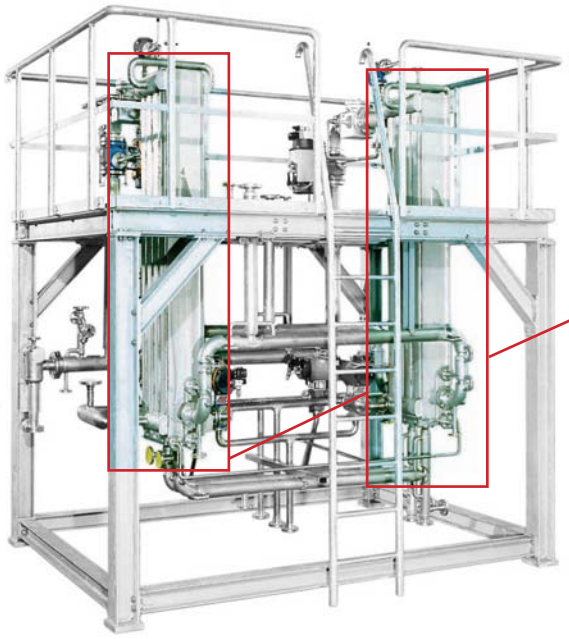
A classic problem in process engineering is that the vacuum generator draws in a substance mix that is already contaminated and this can lead to blockages. GEA has developed a skid-mounted vacuum station e.g. for the PA process. Here two Pluto units are used to clean the saturated leakage air from the distillation section. This prevents any blockage in the downstream vacuum generator.

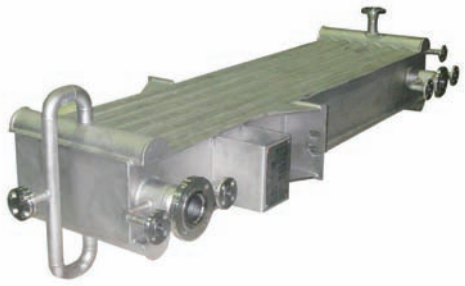
A special feature of the PA process is that each Pluto unit has two chambers to enable the separate cleaning of two gas streams and prevent any intermixing of the desublimated materials – in addition to the PA appreciable amounts of by-products are generated. The clean gas streams are re-combined at the exit section.

Pluto application fields:

- Product recovery in chemical and pharmaceutical processes
- Environmental protection
- Protection of downstream vacuum generators
- Pilot plants/Test facilities
- Freeze-drying
- Breathing coolers







Main components of a skid-mounted vacuum station:

- Plutos
- Jet pumps
- Valves
- Fittings Pipework
- Steel structure

Pluto mini desublimator installed in a skid-mounted vacuum station



Prior to delivery, the Pluto is subject to pressure testing with water according to the standards.



Pressure test passed - this Pluto is ready for shipping.

Manufacturing and quality

GEA has been developing and manufacturing desublimators since 1954. And the Pluto unit has been a popular model in our product range since 1982. Our engineers base their expertise not only on thermodynamics and heat engineering, but also integrate numerous customer-specific process-engineering applications. And our customers can make use of and benefit from this unique know-how.

With their intimate knowledge of manufacturing and processes the GEA experts analyse production environments and the corresponding processes. They then develop recommendations and assist in their implementation. Our approach is holistic, but the solution is specific and individual.

The decisive factor is the preliminary work by experts on both sides. GEA can adapt and design the desublimator to exactly match the customer's process, as both engineering and manufacture are integrated at GEA. With our many years of experience in manufacturing and welding engineering we can offer all weldable materials when designing the unit. Our range of services is rounded off by support during plant start-up and optimisation in day-to-day-operation.



Stringent welding standards guarantee highest product quality

In good hands during the entire service life

At GEA, plant operators benefit from both manufacturing know-how and application knowledge. This is why these apparatus are optimally designed, installed and serviced.



Full service from the start

GEA is your reliable partner and direct contact around the clock. Even at the preliminary plant design stage our consulting experts assist in tailoring manufacturing aspects with our in-house maintenance experts. However, if used for their intended purpose our desublimators are practically maintenance-free, besides routine visual inspections.

But when maintenance is required GEA as the leading specialist for heat exchangers has established a global service network that is available to our customers around the clock. Our customers also benefit from numerous in-house GEA synergy effects and the expertise of our highly-trained technicians – and also enjoy the benefit of our manufacturing know-how. We offer consultation services for customers looking to expand or upgrade an existing facility and guarantee precise and meticulous installation.

Our prime objective is the permanent availability of your equipment. Reliable operation is impossible without high-quality spare parts with an absolutely perfect fit. Our OEM spare parts guarantee optimum fitting, efficient functioning and a long service life – and are covered by the manufacturer's warranty. GEA OEM spare parts are subject to demanding quality assurance testing and are certified. Industrial insurance companies generally require plant operators to use OEM spare parts.

You can expect fast service – to safeguard your investment.

International certification:

- TÜV NORD
- TÜV Rhineland
- TÜV Austria
- Det Norske Veritas
- Class NK
- Lloyd's Register of Shipping
- Bureau Veritas
- American Bureau of Shipping
- Germanischer Lloyd
- Urzad Dozoru Technicznego
- Inspection and Quarantine of the PRCh
- Gost – RT
- U-Stamp acc. ASME Code

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