



Compression heat pumps

In touch with heat pumps for industry and commerce

In industry and commerce, the requirements for heating and process heat are highly specific. Heat pumps can very often satisfy these needs. Thanks to their efficiency and short amortization period, they represent an environmentally compatible and economically attractive alternative to conventional heating systems.

In touch with your processes and your requirements

Efficient heat pump solutions



The name GEA Refrigeration Technologies of course indicates company affinity to the production of cooling systems. Our engineers, however, are also accomplished specialists with heat pumps. To be sure, heat pumps and refrigeration systems exploit the same physical principle: and they all consist of the same core components such as compressors and heat exchangers.



A heat pump raises heat from its surroundings – air, ground water, or waste process heat – from a lower temperature level to a higher. A crucial factor in the planning and selection of a heat pump system is the type of intended application. If requirements change from heating to cooling in accordance with the seasons – as is typically the case in office buildings and greenhouses – a reversible heat pump can supplement the conventional heating system in winter, or can even replace it. During the summer, the hydraulic system of a heat pump is reversed to supply cooling instead of heat energy. As shown in our references on pages 3 and 6, ground water or the earth itself can in such cases function to store heat or cold.



Many industrial processes simultaneously demand great heating and cooling duty. This especially applies to the food and beverage industries: for example, dairy operations and the manufacturers of frozen foods. In such applications, the waste heat of a refrigeration system can often be used as heat source for heat pumps – which raise the residual heat to a usable level.

Whatever application may interest your company for a heat pump, it will – when its overall life cycle is considered – amortize quickly by a reduction in energy consumption. And this reduces emissions that affect climate. In addition, emphasis is placed on using natural refrigerants such as ammonia wherever possible.

The field of application for heat pumps is diverse. Two fundamental applications can be distinguished:

- *Simultaneous demand for heat and cold (ready meals, slaughterhouses, dairy plants, etc.)*
- *Seasonal requirements for heat and cold (large buildings, district heating, horticulture in greenhouses, etc.)*

The sustainable, reliable solutions offered by heat pumps are rapidly improving in efficiency and payback periods. For the "greenest" office in the Netherlands, an ammonia-based heat pump with V compressor provides heat energy in the winter with exceptionally great efficiency.



Instead of separately generating cold for refrigeration and heat for pasteurization, a British dairy-product processor at its plant in Manchester counts on GEA heating-cooling cogeneration with heat pumps.

In touch with Robert Wiseman Dairies

Milk in a contrast of temperature cycles



The combined central heating and refrigeration system reduces annual CO₂ emissions by more than 1,100 tons – and reduces operating costs.



Based on six GEA machines, this system provides refrigeration at -2 °C/28.4 °F and heat at 80 °C/176 °F.

The refrigeration plant at Robert Wiseman Dairies in England had become obsolete. The company was confronted by the choice of replacing the refrigerant R22 by a more environmentally friendly solution, or of investing in a completely new plant based on ammonia as refrigerant. Although planning revealed that an ammonia plant would operate more efficiently, the customer initially did not accept this solution owing to the long amortization period. Yet, in the end, GEA Refrigeration Technologies made an investment so attractive by an add-on, in the form of a heat pump, that Wiseman could not resist. The new system allows using the heat emitted by the refrigeration plant to be used for pasteurization of the milk – and the entire plant will now amortize itself in less than two years.

When milk in insulated tank trucks reaches Wiseman Dairies, it is at a temperature of approx. 4 to 5 °C/32.2 to 41 °F. Once it enters the plant, it is pumped directly into cooling tanks and stored there at 2 °C/35.6 °F until it is further processed. The next step is pasteurization of the milk – i.e., heating briefly to 74 °C/165.2 °F – then cooling within a few seconds back to 2 °C/35.6 °F. At this point the plant operator had earlier practiced a simple but highly effective form of heat recovery: already heated milk that left the pasteurizing unit would warm the new cold milk that flowed into the pasteurizer. This method of heat recovery of course does not result in 100 % efficiency of recuperation – with the result that the fresh milk after heat recovery was about 65 °C/149 °F. A hot-water heating cycle provided the remaining necessary heat, which was earlier supplemented by a gas boiler. The already pasteurized milk leaves the heat-recovery point at around 11 °C/51.8 °F and is cooled in a downstream heat exchanger to the required temperature of 2 °C/35.6 °F.

Before conversion of the Wiseman Dairies plant, the heat removed from the milk after delivery to the plant, and after pasteurization, was ejected as waste heat from the plant, together with excess heat from the production hall. No one knew how to productively use this heat. The problem was that this waste heat was available at a temperature of approx. 32 °C/89.6 °F: too low for pasteurization.



To ensure that milk is not only tasty, but also healthy, GEA systems with heat pumps provide the required process heat and refrigeration – at extremely energy-efficient levels, thanks to “heat recycling”.

This was the point at which our new refrigeration plant, plus heat pump, came into play. This heat pump can raise the waste-heat temperature from 32°C/89.6°F to over 80°C/176°F, a level at which the heat can be used for the hot-water circulation cycle of the pasteurization unit. A precisely controlled valve mixes cooler water into the cycle to achieve the optimal water temperature (76°C/168.8°F). Although this heating now takes place electrically, the result is quite a satisfying energy balance. After all, the principle of the heat pump makes the system six times more efficient: whereas the earlier boiler, fossil-fired with gas, required combustion of gas with 125 kWh to provide 100 kWh of heat, the heat pump needs only barely 20 kWh for the same purpose. To cool the milk, all the energy involved here is “recycled”: energy from the pumps, the chiller, the compressor, the heat pump itself – and even the heat emitted from the bodies of the plant employees.

The old gas boiler can now remain switched off. But that's not all: in addition to energy, the British plant at Wiseman Dairies also saves fresh water and waste water by employment of the heat pump. This is because the old gas burner generated steam to keep the hot-water circulation system at the correct temperature – which required a considerable amount of fresh water.

A new greenhouse in Holland? At first glance, nothing spectacular. The orchid breeder Maurice van der Hoorn, though, has installed the first greenhouse in the Netherlands that functions without natural gas. A heat pump supplies his Phalaenopsis orchids with heat and cooling – throughout the entire year.

In touch with Van der Hoorn Orchids

A green greenhouse



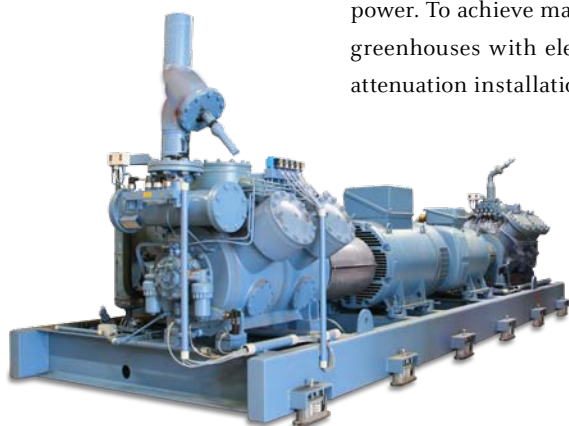
It is no secret that the Dutch love flowers. In 2006 the orchid breeder Maurice van der Hoorn, owner and operator of Van der Hoorn Orchids, gave this passion an environmentally friendly face. In his new greenhouse in Ter Aar, near Amsterdam, his Phalaenopsis orchids thrive wonderfully – and without the use of natural gas. During the summer, a greenhouse acts as a giant solar collector. The fundamental principle developed by Van der Hoorn was to collect the summer heat, instead of blowing it out by fans, and to use it in winter. This became possible thanks to an electric driven heat pump supplied by GEA Refrigeration Technologies.

Technical data for the heat pumps used by Van der Hoorn Orchids:

- Heat pumps: 1 x GEA Grasso RC612E 1 x G810
- Capacity: 1,500 kW at +6/+50 °C / +42.8/+122 °F
- Refrigerant: R717 (NH₃)

The temperature required by such exotic beauties depends on their size and their stage of growth. As a result, the required temperature on one half of Van der Hoorn's large (15,000 m²) greenhouse annex is 20 °C/68 °F, and 28 °C/82.4 °F on the other half. Heating and cooling take part with support from ground water from a depth of 80 to 100 m. In the summer, the water from this level, at around 7 °C/44.6 °F, is pumped to the surface to cool the greenhouse. It returns deep to the earth at a temperature of approx. 18 °C/64.4 °F. The sunnier and hotter the weather, the greater the cooling requirements – and the more the cooling water is heated. During winter, the slightly heated water is pumped back to the surface to support heating.

The heating mode requires operation of the GEA ammonia heat pump. It has a rating of 1,500 kW at 6 °C/42.8 °F and 50 °C/122 °F. This heat pump operates mostly at night, outside peak-demand periods. It heats the boiler heating water to a maximum temperature of 50 °C/122 °F and stores it in a buffer storage unit with a capacity of 400 m³, until the greenhouse requires this heat. In the heating mode, the heat pump cools the ground water to store cold in aquifers – which then provide cooling during the summer months. As a result, the greenhouse can do without natural gas, but not without electric power. To achieve maximum climate protection, Van der Hoorn Orchids powers their greenhouses with electricity from renewable energy sources (wind energy and bio-attenuation installations).





Every blossom is a work of art. With a heat pump, Van der Hoorn Orchids can – in an environmentally friendly system – control down to a precision of one degree the temperature for orchids from the tropic rain forests of Southeast Asia and Taiwan.

The German company Wohlhaupter, makers of precision machining systems, requires heat as well as refrigeration for its production – and for the heating and air conditioning of its shop floors. In 2010 the company replaced its old oil heating system, which had been in service for over 20 years, by a geothermal heat pump.

In touch with Wohlhaupter

Heat pumps also deliver cooling for air conditioning

A total of 44 geothermal probes have been installed at the Wohlhaupter company site, which is located on the edge of the Swabian Alb mountains in southwest Germany. These sensors contain a water-glycol mixture as heat-transfer medium. This mixture is continuously pumped from the sensors to the heat exchangers of the heat pump system – which exploits the heat of the earth from a depth of approx. 95 m under the company site. This system covers about 85 % of the entire heating requirements for the large factory floor (7,500 m²). On the basis of the top quality, reliability, and efficiency of our GEA Bock compressors, we were selected by Wohlhaupter to implement this project. The entire system offers an additional plus in efficiency – not least owing to the use of large buffer storage units, which prevent frequent compressor cycling (switching on and off unnecessarily). The remaining heat requirements are provided by a conventional gas heating system. This allows high-temperature heating throughout the boiler, which prevents the proliferation of legionellae pathogens – and which also supplies additional energy for extremely cold winter periods. Another clever benefit of this system: in the summer, it operates in reversible mode and supplies the company with approx. 330 kW of cooling duty for air conditioning of its rooms.



Heat pump systems

Useful knowledge at a glance

GEA Refrigeration Technologies offers heat pump systems whose beneficial characteristics include high usable temperatures. GEA forcefully promotes the use of natural refrigerants such as ammonia, since this refrigerant – as only one example – possesses no ozone-depletion potential and does not contribute to the greenhouse effect. Its global warming potential (GWP) is zero. GEA heat pumps are available in various models, in accordance with individual customer requirements.

Why heat pump systems?

- In western European countries, 25 % of primary energy used is for cooling and heating applications.
- Oil and gas reserves are being depleted.

A heat pump uses electrical energy to raise (“pump”) heat from a lower temperature to a higher, usable temperature level – a function that gives such equipment its name. Its mode of functioning is primarily based on the same physical principle as a refrigeration system: a thermodynamic cycle process consisting of compression, condensation, depressurization, and evaporation of a suitable fluid: for example, ammonia. Components such as heat exchangers, compressors, and depressurization units are

virtually identical. Only the purpose has been reversed: the heat pump uses the low level extracted heat. The source of heat, for example, can be water; without a heat pump, the heat in water would not be at a temperature level high enough for practical uses. Other systems use extracted air as heat source. Even though its name indicates something else, a heat pump can also simultaneously serve as a refrigeration unit. GEA Refrigeration Technologies has equipped applications in which both functions – cooling and heating – are used at the same time. This possibility considerably extends the available field of industrial heat pumps.

Highly diverse areas of application

Heat pump systems enable appreciable savings in primary energy use for great numbers and types of applications – which results in reduction of operating costs. The first two essential steps here are to recognize a suitable source of heat and to evaluate it for feasible use. The heat energy provided by a heat pump can be used to produce hot water for many and various application possibilities: room heating and sanitary water are only two. Industrial processes, especially in the production of foods and beverages, often require cold and heat at the same time. Add-on heat pumps, which have a particularly great coefficient of performance (COPh), are especially effective for these applications. They recycle heat emitted from the refrigeration process by raising it to a usable level. This type of application can also be integrated into existing facilities.

Great efficiency

GEA Refrigeration Technologies assures its users high degrees of efficiency. Its heat pumps achieve high COPh levels, in accordance with the temperature of the heat source. These results are achieved by individual components that are flawlessly intercoordinated. The use of natural refrigerants makes heat pumps in many cases even more efficient and environmentally compatible. Heat pumps lead to a reduction in primary energy use and avoid direct CO₂ emissions, by virtue of the fact that they supplement or replace existing components for supply of heat. These replaced conventional components are often less efficient than heat pumps installed at the same sites by GEA Refrigeration Technologies. The favorable environmental balance sheet can be improved even more when the electrical power for drive of the heat pumps comes from renewable energy sources.

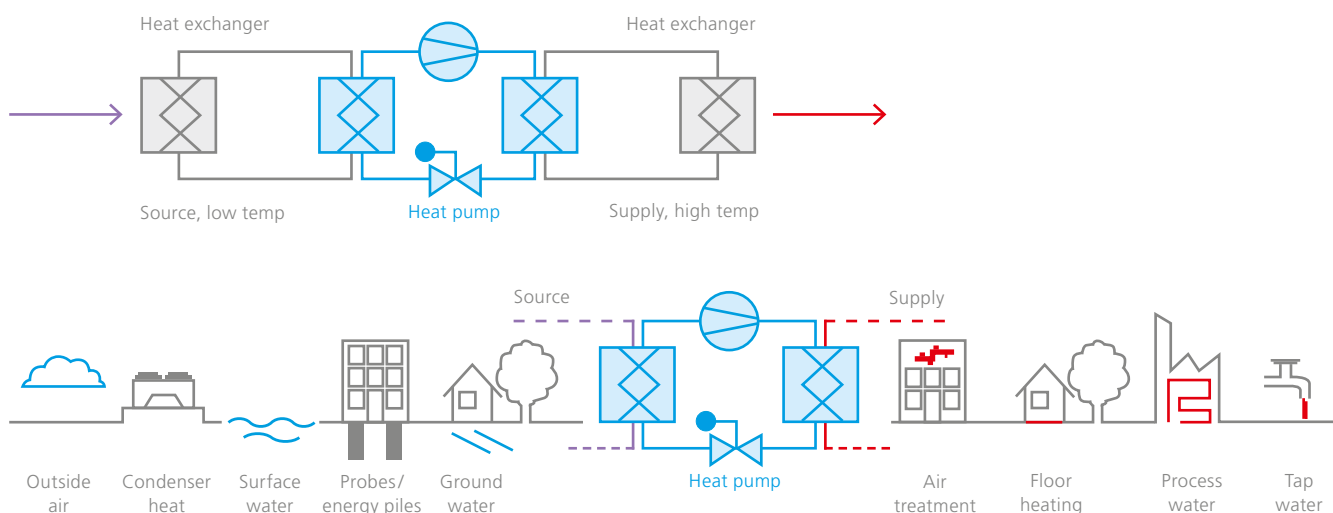
- An instrument to achieve reduction quotas for CO₂ and other greenhouse gases (as per Kyoto Protocol)
- An aid in achieving European Union objectives: e.g., to increase the share of renewable energy sources in total energy consumption of the EU by 20 % by 2020

Benefits

- Reduction in energy consumption (COP values of 3 to 6 are possible)
- High supply temperatures in combination with high output
- Environmental friendliness from the use of natural refrigerants
- Life cycle of over 20 years
- Profitable amortization period
- Low overall operation costs

Examples

- Supply of hot water for industrial processes
- Provision of hot water for cleaning work: for example, in slaughterhouses
- Pasteurization processes in the dairy industry
- Central heating and domestic hot water in commercial buildings
- Heating or cooling of greenhouses
- Facilities for which heat and cold are both required at the same time





The name of our company – GEA Refrigeration Technologies – indicates a focus on the development and manufacture of cooling systems. Our specialists, however, are also well qualified and experienced in work with heat pumps. In fact: heat pumps and refrigeration systems operate on the same physical principles, and key components in both systems include such elements as compressors and heat exchangers.

In touch with your needs

Our compression heat pumps



GEA Grasso FX P heat pump

Compression heat pumps

They are the heart and, literally, the pump of the heat pump: piston and screw compressors by GEA Refrigeration Technologies. The compressors are especially designed for the great final compression pressure in a heat pump. They offer condensation temperatures that are effective not only for operation of the low-temperature heating system, but also for the supply of process heat.

With the necessary big picture, but also with love of detail – this is how GEA Refrigeration Technologies creates its products. They embody the knowledge of generations – expertise in technology and, above all, in its application. After all, your success is our success. And this means that you can place your trust in our technology.



Control systems

Control systems often remain unnoticed, since their performance cannot be measured in impressive kilowatt ratings. But they can be expressed in intelligence – which assures the reliable and efficient operation of a heat pump and helps to find the optimal operating point, save energy, determine machine running times and capacity utilization, and consequently enable status-oriented maintenance. Our sophisticated open- and closed-loop control system generates maximum benefits for you.

Service and spare parts

Regular service – status-oriented and plant-specific – guarantees that you profit from life-cycle costs as low as possible: and from high plant availability. At the same time, even the most reliable plant needs a spare part now and then. And it must be available whenever you need it. We have therefore set up support points throughout the entire world that keep on stock the normally required wear, spare, and replacement parts that you need for GEA Refrigeration Technologies products. This means that small-scale repairs never become large-scale problems.

Customized solutions

The selection shown in our heat-pump reference projects proves that our products make a great number and variety of solutions possible. They are consequently gentle on the environment and on your bank account. We could individually plan your facility for your own needs. When will you ask us?

*Would you like to learn more about us
and our solutions? Then go to GEA Refrigeration
Technologies at www.gea.com.*



We live our values.

Excellence • Passion • Integrity • Responsibility • GEA-versity

GEA Group is a global engineering company with multi-billion euro sales and operations in more than 50 countries. Founded in 1881, the company is one of the largest providers of innovative equipment and process technology. GEA Group is listed in the STOXX® Europe 600 Index.

