

Fine-tuned refrigeration - fine tuna

Refrigeration technology at its best - corrosion protection and hygienic requirements dictate style of air-cooler



Line of Business:	Industrial Refrigeration
Application:	Fish Product Cooling
Country / City:	Germany / Sassnitz (Ruegen Island)
Fluid:	NH ₃ , CO ₂ , Glycol
Product:	Wall/ceiling unit cooler GHN, Ceiling air cooler DGN, Wall/ceiling air cooler GGN, Drycooler GFH, Fin and Tube heat exchanger (finoox) GCO, Condenser GVH

In mid-2003, Europe's most modern and Germany's largest fish-processing centre went into operation in Sassnitz on the island of Rügen. It not only secures a great proportion of Germany's herring-catch quota, but also creates 150 mostly skilled jobs. The novelty is that almost all routine work is automated, with work processes like those in a high-tech company. The trade media are already talking about the "factory of the future". The refrigeration technology is equally visionary. The actual refrigeration takes place in a separate engine house,

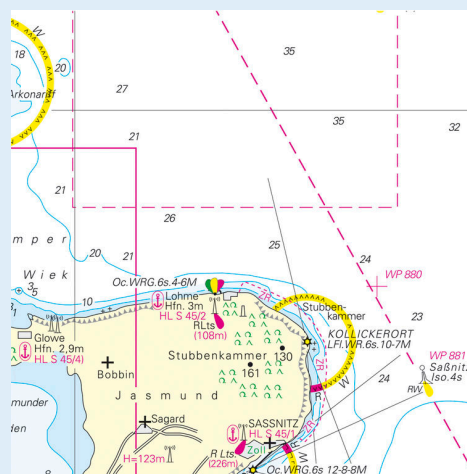
using the natural refrigerant NH_3 , and the cooling is distributed to the deep-freeze store and the many storage and processing rooms by means of the secondary refrigerant CO_2 or the coolant propylene glycol.

Güntner not only delivered 136 air coolers for various application areas and power classes, but were also able to contribute to the extremely short construction time of only nine months needed for the refrigeration system through a very high degree of flexibility in manufacturing, just-in-time delivery, and assistance in the case of last-minute change requests.



Sassnitz fish-processing centre: Europe's most modern fish factory, with a processing area of 14,000 sq. metres and a deep-freeze building of 7,000 sq. metres.

In the mid 90s, the Netherlands' deep-sea fishing company Parlevliet & Van der Plas B.V. recognised the synergic effects of fishing, fish processing and closeness to market, and saw Sassnitz as the ideal location for a fish-processing centre in this context. And more: Sassnitz also offered all the infrastructural opportunities for extending the market to Poland, the Baltic states, Scandinavia and, via Russia, to the Asian fish consumers. Add to that the prospect of subsidies from the structural funds of the State of Mecklenburg-Vorpommern, the Federal Republic and the European Union, which would secure the Sassnitz location in the long term. This even preserved a portion of the German herring quota, which would otherwise have been distributed among other Baltic states.



High-tech and fish fillets

The Sassnitz fish-processing centre was planned on the principle of as much automation and technology as possible, and only as much manual work as necessary. This seems to have been achieved in every respect, because the trade press hailed the "Sassnitz fish shop" as the "factory of the future", with processing technologies "like from another planet". Fish are "pumped" from the trawlers into the factory, sorted by species and size by video image recognition, and automatically filleted and packed. Waste and remnants are processed to fish meal and fish oil on site – with no smell detectable in the surroundings, because the entire waste air from the fish factory, which is air-conditioned at low pressure, does not escape until it has passed through several stages of filtering.



Fully automatic: Sorting system: Landed fish are sorted by species and size for further processing. Hanging from the ceiling are 6 Güntner glycol unitcoolers, Type S-GGN 071A.

The customers thought carefully about the procedures in fish processing in the early stages of planning, as demonstrated by the smooth logistic processes, with automated shelf vehicles and forklifts apparently steered by magic in the production area and the deep-freeze store.

Environmentally compatible refrigeration technology with natural refrigerants

The fish-processing centre being a subsidised investment, it was necessary to invite tenders for the project as a whole and for all partial work at a European level as defined in VOB (contracting rules for award of public works contracts). The functional invitation for tender usual in such construction projects had the advantage that the bidders were able to introduce new ideas and technologies, especially with regard to energy efficiency and environmental protection. In the area of refrigeration, the concept presented by Axima refrigeration, Lindau, was the most convincing, both technically and economically.

This concept is structured as follows (see box “Refrigeration equipment in figures”):

- Cooling with the natural refrigerant ammonia (NH_3) in a separate machine house, atmospherically separated from the processing area
- Transmission of the cooling via an NH_3/CO_2 cascade on the principle of a pump system to the refrigeration and freezing equipment, with a -42°C axis for the frosters and deep-freeze store, and a -8°C axis for the $+2^\circ\text{C}$ refrigeration rooms
- A cold glycol line with -1°C flow/ $+5^\circ\text{C}$ return to supply the $+16^\circ\text{C}$ and $+18^\circ\text{C}$ refrigeration rooms
- Warm glycol at 30°C flow temperature and 20°C return temperature generated by an NH_3 heater for defrosting the air coolers in the $+2^\circ\text{C}$ refrigeration rooms, and as a protection against sub-freezing in the deep-freeze store
- Hot-gas defrosting on the basis of CO_2 for defrosting the frosters.



Factory of the future: The floor vehicles are guided inductively, as if by magic.

In this NH_3/CO_2 propylene-glycol refrigeration plant, Axima Refrigeration combine the high-energy efficiency of NH_3 cooling with safe and easy-to-handle CO_2 . Wherever a CO_2 application would have been too elaborate because of the pressure, the refrigeration experts chose glycol as the coolant. An elaborate safety concept protects the CO_2 circuits from rising pressure should the cooler fail. At -42°C , for instance, the pressure of the CO_2 is around 9 bar; at -8°C – typical of the supply to the aircoolers in the $+2^\circ\text{C}$ refrigeration rooms – the designed pressure is around 28 bar. If the $+16^\circ\text{C}$ and $+18^\circ\text{C}$ rooms were also supplied via the CO_2 axis, the tube system would have to be dimensioned for 42 bar. In this case, it therefore makes more sense economically to use glycol as the coolant. For the hot gas defrosting of the frosters (used for the first time world-wide as a replacement for the otherwise usual electric defrosting) the tube system had to be dimensioned for a working pressure of 50 bar. The CO_2 hot gas defrosting is therefore used only for the frosters, and not for the aircoolers.

Air-cooling excellence

Fish processing is the area of food processing that makes the highest demands on hygiene, corrosion resistance, ease of maintenance and longevity. One could, of course, execute this kind of project in nothing but stainless steel, but neither is this material cheap, nor are buildings like the fish factory dimensioned for the tremendous weight of stainless steel piping and stainless steel aircoolers. For Güntner, as the supplier of all the air coolers for the Sassnitz fish factory and the associated cold storage, the customer's high requirements on hy-

giene and corrosion resistance, coupled with the calls of economy on the side of the system constructor, meant a stiff challenge. However, on the basis of years of cooperation with Axima Refrigeration it was met successfully.



Stainless: Cold storage: Aircooler in V4A stainless steel (SS316) with epoxy-resin-coated fin coil

Together, it was decided to select the aircoolers on the principle of as many standard products as possible, and only as many special versions as necessary. Where standard products from the Güntner range could not be used directly, individual parts and components were upgraded to meet the requirements of the fish factory. This affected in particular:

- Fans with stainless steel grilles
- Accessories, such as air-throw nozzles, in stainless steel
- Surface treatment of housings, fins and drip trays with powder coating



Unpacking and defrosting: Unpacking room: Reversible fans in the air coolers contribute to quality preservation during defrosting of frozen fish at precisely +2°C. Two S-DGN 046C in the hygienic version (epoxy-resin-coated fins) are in use.

Because the whole fish factory is process oriented, almost every aircooler had to be individually dimensioned. This led to very few of the 136 units being really identical. Basically, each individual aircooler had to be closely inspected with regard to its location and purpose, including the possibility of draughts occurring in areas with a lot of staff, or particularly corrosive zones, such as the areas in which marinades are made or the maturing zones for the various fish specialties. The standard versions of the aircoolers were upgraded with the following accessories or variants:

- Evaporators designed for CO₂ pump operation
- Evaporators designed for brine operation
- Housing powder coated both sides
- Built-in climatisation coil for drying the room during cooling operation and after cleaning
- Brine defroster
- Folding drip tray
- Folding ventilator flap
- Fins with epoxy-resin coating
- Housing in V4A stainless steel (SS316)
- Single or double drip tray in V4A (SS316), folding
- Air throw unit in V4A (SS316)
- Fan nozzle in V4A (SS316)
- Protective cage, fan shaft and connector in VA or V4A (SS316)
- Ventilator with blades 650/36°
- Repair switch

- Reversible fan direction (for defrosting operation)

Almost all the rooms in the fish-processing centre are cleaned at night with a disinfectant solution, and then thoroughly rinsed. This cleaning includes all machines, even the air coolers. The basic ventilation of the rooms is not sufficient for the following drying, so so-called climatization coils have been built into the air coolers. The moist air from the room is cooled down in the air coolers, being dried in the process, and then heated again with warm brine. With this drying function integrated in the air coolers, each room can be cleaned and dried individually.



Bottle-washing system: Here, empty bottles are cleaned for reuse. The room has two Güntner S-GGN 046A.

Flexibility above all

Axima Refrigeration had only nine months for the work from the placing of the order, so practically every minute had to be used to assemble the elaborate refrigeration systems. Any delay on site meant changes in the construction logistics, with corresponding knock-on effects on the manufacturing at Güntner. Deliveries of certain air coolers, precisely allocated to certain rooms and already with a fixed shipping date, sometimes had to be put on hold at short notice because a consignment of air coolers - planned for a later date was needed urgently. Armin Metzger, in Project Management for refrigerator construction at Axima Refrigeration recalls, "Güntner proved to us, week after week, that they take their much-vaunted flexibility very seriously. The Güntner employees made the impossible possible. Cooperation between a plant constructor and a supplier just couldn't be better."



Highest quality requirements: Maturing room: Marinades containing vinegar and salt demand the use of unit coolers with V-4A (SS316) housings and tubes, and epoxy-resin-coated fins, Type S-GHN 071C. The fan plates can be folded down.

The uncomplicated, even collegial cooperation did not just happen. After all, this was not the first large contract with a tight schedule, a complex requirement profile and construction logistics that call for just-in-time deliveries. "We know each other from many projects, we work on call, everything is very non-bureaucratic yet professional. With plants like Sassnitz it's particularly important to be able to rely on your supplier," says Armin Metzger. In spite of alterations in the ancillary equipment or the specified delivery dates, all the aircoolers arrived at the construction site at the right time, in the right sequence, and in the right version. To eradicate any source of error right from the start, the respective room was specified on the type plates. Some 12 low-loader articulated lorries were used to transport the 136 aircoolers.

"CO₂ will make its mark in the deep-freezing sector"

For the refrigeration specialists at Axima Refrigeration, the FPC Sassnitz is the confirmation of their strategy of using only natural refrigerants. "Today, we are a step farther on with our CO₂ cooling concept. CO₂ has great advantages, especially in the area of deep-freezing, and is comparable to an NH₃ plant from both energy and economic points of view", Armin Metzger sums up. One main advantage of two-stage NH₃ coolers is the pressure of 8.3 bar at a vaporising temperature of - 45 °C, as opposed to NH₃, which has a vacuum of 0.4 bar at - 45 °C, making additional safety precautions necessary. Compressors and pipelines can also be smaller proportioned in the case of CO₂

systems. There is meanwhile a wider range of CO₂ compressors at a favourable price, so that the hitherto higher investment costs for CO₂ refrigeration plants are at least comparable with those for NH₃ systems, according to Metzger. In the case of skating rinks, the migration from NH₃ to CO₂ has already taken place. Metzger says, "The safety aspect of CO₂ is of greater importance than the energy efficiency in the case of skating rinks."

The fish-processing centre in figures

Total area of site:	12 hectares
Processing area:	14.000 m ²
Processing capacity:	800 tonnes of herrings / day
Sorting capacity:	35 tonnes per hour
Refrigeration capacity:	600 tonnes capacity: per 24 hours
Froster capacity:	240 tonnes per 24 hours
Deep-freeze storage Area:	7,000 sq. metres
Storage capacity:	22,000 tonnes herring
Storage temperature:	-28 °C
Fresh fish refrigerated storage Storage capacity:	3,000 tonnes of fish
Storage temperature:	0 °C

Refrigeration equipment in figures

Process	Power	Coolant
Deep-freeze store, room temperature -28°C	300 kW	CO ₂ at t ₀ = -42 °C
Plate froster by DSI Sami-fi with CO ₂ hot-gas defrosting	1.200 kW	CO ₂ at t ₀ = -42 °C
Frosting capacity 240 t per day, final stage 480 t per day		
CO ₂ hot-gas generator for defrosting plate froster	250 kW	CO ₂ at t ₀ = 10 °C
Room cooling for room temperatures of 0°C to 6°C	1.300 kW	CO ₂ at t ₀ = -8 °C
Propylene glycol for room temperatures of 12 to 18°C	2.000 kW	NH ₃ at t ₀ = -4 °C
Flow -1°C/Return 5°C	350 kW	NH ₃ at t ₀ = -4 °C
Iced water generation		
Warm glycol for defrosting and desiccation with waste warmth from the oil cooler of the screw compressors and NH ₃ hot-gas cooler	2.000 kW	Glykol at t ₀ = 30 °C

Advantageous Güntner services

Güntner supplied 136 aircoolers for various application areas and power ranges. Their flexibility, just-in-time delivery and competent assistance with short-notice alterations, helped to complete the construction of the refrigeration systems in an extremely short time.

Axima Refrigeration GmbH

Axima Refrigeration GmbH is a group that is active in all areas of cooling and refrigeration technology, with a close-knit sales and service network all over Germany. The company plans, manufactures, operates and advises on all kinds of refrigeration systems, refrigeration units and cooling towers.

Installed Components

- 3 NH₃ screw-compressor units at t₀ -45 °C and t_c -11 °C
- 3 NH₃ screw-compressor units at t₀ -11 °C and t_c 35 °C
- 1 NH₃ screw-compressor unit at t₀ -4 °C and t_c 35 °C
- 1 tube bundle cascade unit with leak monitoring of spaces, CO₂ at t₀ -42 °C/NH₃ at t₀ -45 °C
- 1 tube bundle cascade unit with leak monitoring of spaces, CO₂ at t₀ -8 °C/NH₃ at t₀ -11 °C
- 3 evaporative coolers with a power of 2,200 kW each
- 1 NH₃ separator at t₀ -4 °C/ t₀ -11 °C/t₀ -45 °C
- 1 CO₂ separators at t₀ -8 °C/ t₀ -42 °C
- 5 CO₂ pumps, -8 °C
- 4 CO₂ pumps, -42 °C
- 3 Cold glycol pumps -1 °C
- 3 Warm glykol pumps 30 °C
- 136 Güntner aircoolers for various areas of use and power ranges
- 2 EWK 900/09 cooling towers with cooling-water basin for fish meal plant
- 1 Fish-water cooler, marine version, for sorting system, with CO₂ at t₀ -3 °C/150 kW für 67 cu. metres salt water per hour
- 2 Split air-conditioning units for air-conditioning of PC server room, each 12.7 kW