



Safe and fully redundant:

Opteon™ XL20 (R-454C) solution
for a freezer



Westfalen



“Modernise and enlarge the freezer” was the order placed by an airline caterer with Birgels Kälte und Klima Rhein-Main GmbH & Co. KG. The customer was initially asking for a fully redundant CO₂ refrigeration system. Birgels also designed a system with Opteon™ XL20 (R-454C) for the customer. “Once compared, the advantages of the Opteon™ XL20 (R-454C) concept outweighed, although it took a certain amount of persuasion,” reveals Benedikt Maas, site manager for refrigeration and air conditioning at Birgels.

But what exactly were the advantages of the R-454C concept?

50% lower electrical connected load

The advantages start with the system’s power supply: the electrical connected load of the R-454C system was 50% lower compared to the CO₂ system. Therefore the already existing electrical distribution could be used. The Bitzer Ecolite systems, which offer excellent energy efficiency in combination with the R-454C, made this possible.

Low GWP (< 150 points)

R-454C is a low-GWP refrigerant of the latest generation, which has a particularly low global warming potential of 148 points. This means the refrigerant is not affected by the F-Gas Regulation bans and is future-proof in the long term. The quota for launching new refrigerants on the market is linked to the GWP value. Below 150 points is considered very low and has a positive impact on the availability of the refrigerant. In contrast, refrigerants with higher GWP values will be affected by supply bottlenecks and price increases in the coming years.

Safety through four individual units

The customer was initially concerned about the safety classification of the refrigerant: R-454C is assigned to safety class A2L, which means that its flammability is classified as “mildly flammable”. It is therefore a flammable refrigerant. Something that had to be taken into account when planning the plant but was easy to mitigate: so that no additional protective measures had to be taken in accordance with DIN EN 378-1, site manager Maas decided on four individual units with 11 kg filling charge each.

The advantage of this measure: should the worst case scenario occur and the entire filling quantity of a circuit leak within the cold store, no ignitable mixture can form. The refrigerant R-454C has a LFL value of 0.293 kg/m³ and a practical limit of 0.059 kg/m³.



However, if the entire filling quantity leaks into the cold store, the concentration is only 0.013 kg/m³. According to DIN EN 378-1, the filling quantity is therefore within the permissible limit of table C2.

Calculation: maximum filling quantity according to DIN EN 378-1 table C2

(Access category C, other applications, location classification II):

$$\begin{array}{rcl} 20 \% \times \text{LFL} & \times & \text{room volume} \\ 20 \% \times 0.293 \text{ kg/m}^3 & \times & 870 \text{ m}^3 \end{array} = 50.98 \text{ kg}$$

If the value is >25 kg, it is limited to 25 kg.

High plant availability thanks to failover

The division into four individual units brought yet another benefit. The redundancy of the plant requested by the customer is provided by a fail-safe system of two circuits. With a planned stock turnover of 25% per day, the cold store can operate with two refrigeration systems. This gives the plant a backup of two systems, which ensures an enormously high level of operational reliability. The solution also offers many advantages in service. In addition to the high level of safety, service and maintenance can also be carried out during operation without any restrictions. Should a circuit be shut down for servicing, cooling can still be guaranteed without restricting ongoing operation. If, in exceptional cases, the stock turnover in the cold store is higher, the system can call up the additional cooling capacity of the backup.

30% lower acquisition and operating costs

Another major advantage was the cost: The purchase price of the system was 30% lower than that of the CO₂ refrigeration system planned as an alternative. Lower service, maintenance and operation costs are also expected.

“The overall concept won over our customer,” says site manager Maas, looking back on the project. “We will continue to work with R-454C. And our customer has also requested another R-454C system for their next project.”

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LFL

LFL stands for Lower Flammability Limit and indicates how high the minimum concentration of the gas in the air needs to be to produce an ignitable mixture.

Practical limit

The practical limit is the maximum acceptable amount of refrigerant in an area occupied by people.



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