



Low GWP Solutions in Industrial Refrigeration

**Clauger xGrenco Ibérica
chooses Opteon™**

**Retrofit of existing system to
R-454C**



Energy Efficiency and Safety are factors that are gaining more and more importance, especially in the context of global carbon reduction goals to fight climate change.

Refrigerant gases are among the many application areas that the industry considers when evaluating environmental impact and costs/benefits. The current challenge is to ensure that the refrigerants incorporated in the system design meet long-term standards and **environmental protection** and **safety regulations**.

THE ESSENTIAL ROLE OF LOW-GWP REFRIGERANTS

Adopting low Global Warming Potential (GWP) refrigerants may not be enough to enable the reduction of emissions, since the indirect emissions resulting from the electricity consumption of refrigeration systems are a much greater contributor to climate change than the direct emissions from the refrigerant itself, making the energy efficiency a vital factor when selecting a low GWP solution.

The current generation of low GWP refrigerants has been designed to be versatile between applications, offering the greatest synergy between technologies. This means that specific installation types are not subject to using one type of refrigerant. And now there is greater potential to achieve the lowest possible Total Equivalent Warming Impact (TEWI).

In a sector as essential as industrial refrigeration, energy efficiency and the reduction of emissions, both direct and indirect, are a very important factor when planning the environmental and sustainable development strategies of companies, alongside maintaining the highest safety standards.





CLAUGER xGRENCO IBERICA, leading company in the industrial refrigeration sector, with an extensive international presence and with branches in the largest Spanish cities, has been selected by an important chemical company to upgrade its chlorine liquefaction plant's refrigeration system to comply with the latest EU regulations and internal sustainability standards while improving overall performance. After evaluating several low GWP options the contractor chose **Opteon™ XL20 (R-454C)** as the best alternative to retrofit the aging system initially designed for R-22 that had already been retrofitted to R-507A in the past.

The decision

The F-Gas Regulation and current energy efficiency trends prompted the client to change the R-507A refrigerant for another that better addresses the more stringent requirements coming. R-507A has a GWP value of 3.985, which by today's standards is very high, contributing greatly to the greenhouse effect in the event of a leak. In addition, due to its high GWP, in Spain it is taxed with €59.78/kg. The low future availability and high cost, as well as environmental impact and safety, made it advisable to find a replacement solution as soon as possible.

After careful evaluation of all alternatives for the applications, the decision was taken to move away from the outdated R-507A refrigerant to a new sustainable (<150 GWP), Opteon™ XL20 (R-454C) belonging to the A2L safety class.

With this change, the company's main objectives have been attained, namely:

- Reduce environmental impact by effectively reducing direct emissions
- Reuse existing systems, contributing to the circular economy
- Maintain or improve energy efficiency
- Maintain security throughout the process
- Reduce refrigerant cost for future needs
- Minimize the investment cost in system adaptation (a new system is not necessary)
- Minimize action time during the intervention
- Ensure refrigerant supply for the rest of the system's useful lifetime
- And all this guaranteeing the necessary refrigeration capacity for the production process

WORKING IN AN EXISTING FACILITY

Calculation Basis

The bases used to calculate the refrigeration installation are the following:

| | |
|---------------------------------|------------------------------------|
| Current Refrigerant: | R-507A (GWP = 3.985) |
| New Refrigerant: | R-454C (GWP = 148) |
| Power: | Alternating, 3 phases, 400 V 50 Hz |
| Condensation system: | Water condensation |
| Wet bulb temperature: | 23°C / 26°C |
| Condensation temperature: | 35°C |
| Installation application range: | +5°C / +40°C (ambient temperature) |

Design memory

The Refrigeration installation is made up of three **Bitzer** screw-type compressors, with single-stage compression, with the refrigerant described above. The condensation of hot gases from the discharge of the compressors is carried out in two water condensers. All condensed liquid refrigerant is stored in a HP receiver.

Chlorine liquefaction is carried out through a shell & tubes heat exchange, in a flooded gravity regime. The cooling capacity of the mentioned exchanger is 203 kW, with R-22 refrigerant.

The current installation, according to the user's record book, has a load of 1470 kg of R-507A, which is recovered by **Clauger** staff and sent to a competent entity for cleaning or destruction, issuing the corresponding certificate.



In opinion of **Daniel Gil Jiménez**, technical office of **Clauger xGrenco Ibérica**, "We recommend the replacement of the current refrigerant R-507A, with the new refrigerant **R-454 C (Opteon™ XL20)**, with a lower

Global Warming Potential (GWP 148) and, consequently, it has no tax rate, with similar performance, as the current one, since it is the ideal refrigerant, to work in medium and low temperature regime, in the refrigeration installation. It is a highly energy-efficient refrigerant, as it has a better **COP** compared to the R-507A refrigerant. Ecologically, it is ideal, since it significantly reduces the TEWI, (which are the direct and indirect CO₂ emissions.)"

Work performed (Scope of supply)

Change of Refrigerant to R-454C in chlorine liquefier cooling group

1. Replacement of safety valves

Replacement of the three-way valves and safety valves, in each of the corresponding equipment, valid for the new refrigerant, including:

- High Pressure Liquid Receiver: one DN 20 three-way valve and two DN 15 safety valves for a pressure of 21 Bar.
- Oil separator: one DN 20 three-way valve and two DN 15 safety valves for a pressure of 21 Bar.
- Water condenser No. 1: one three-way valve DN 15 and two safety valves DN 15 (R2) for a pressure of 21 Bar.
- Water condenser No.: one three-way valve DN 15 and two safety valves DN 15 (R2) for a pressure of 21 Bar.
- Chlorine Liquefier (low): one DN 32 three-way valve and two DN 20 safety valves for a pressure of 19 Bar.
- Viewers and plugs are installed in the discharge of the new safety valves.



2. Refrigerant pipes

Safety valve outlet manifold:

A new discharge manifold is made for the safety valves, according to the evacuation capacity. Seamless drawn steel pipes, according to EN 10216-2 standard, quality P265GH or according to ASTM standard, quality A-106 grade B up to diameter 1-1/2", inclusive. Seamless drawn steel pipes, according to EN 10216-2 standard, quality P235GH for diameters equal to or greater than 2".

The steel pipes are supplied zinc-plated on the outside except for the accessories (bends, tees, etc.), which are supplied in black steel and are painted with a high-zinc content primer.

3. Changing dehydrator cartridges

The dehydrator cartridges of the existing filters in the liquid line are replaced. In addition, the holes of the thermostatic expansion valve are checked, according to the capacity with the new refrigerant.

4. PLC Program modification

Since the refrigerant is to be changed, the equivalent pressure-temperature ratio for the new refrigerant gas must be changed in the PLC.

5. R-507A refrigerant recovery, cleaning, and decontamination

The R507A refrigerant collected (1,470 kg, as recorded in the record book), are recovered to comply with current legislation. The system is then vacuumed.

The collected refrigerant is introduced into recovery cylinders, identified as recovered gas, and sent to a competent company, for destruction or cleaning, in an authorized plant. This authorized company will issue the corresponding certificate.

6. First refrigerant and oil filling

First loading of 1,470 kg of R-454C refrigerant, as well as replacement of polyolester oil (200 liters) for the compressors.

Opteon™ XL20 (R-454C) refrigerant has been supplied by KIMIKAL, S.L.

Compliance with safety regulations

Safety equipment

Machinery room

Replacement of the three-way valves and safety valves, in each of the corresponding equipment, valid for the new refrigerant, including:

- A leak detector according to the new refrigerant of the A2L group.
- An explosion-proof extractor (the existing one is used)
- Two self-contained breathing apparatus. (Takes advantage of the existing ones)
- An emergency shower and eye wash due to Chlorine presence.



External part of the circuit (Condenser)

- A leak detector according to the new refrigerant of the A2L group.

Opteon™ Efficient Economy

Beyond their low-GWP credentials, Opteon™ XL refrigerants, as long-term solutions, are developed to advance toward increasingly stringent emissions goals and provide clear advantages in system efficiency. Their versatility and thermodynamic performance ensure that these refrigerants can significantly reduce lifecycle costs and emissions in commercial and industrial refrigeration applications, all without compromising refrigeration performance or safety.



This information is provided free of charge and is based on technical data believed by Chemours to be reliable. Chemours makes no warranties, express or implied, and assumes no liability in connection with any use of this information. Nothing in this document should be construed as a license to operate or as a recommendation to infringe any patent or trademark.

© 2024 The Chemours Company FC, LLC. Opteon™ and any associated logos are trademarks or copyrights of The Chemours Company FC, LLC. Chemours™ and the Chemours Logo are trademarks of The Chemours Company.