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SK Refrigeration Pioneering Adoption of Opteon™ XL40 in Large Charge Sizes Providing Energy Efficient Solutions for the Cold Chain.

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WALSH MUSHROOMS

Introduction

Walsh Mushrooms Group is one of the largest suppliers of fresh mushrooms and substrate in Ireland and the UK. They are a vertically integrated food business, each week supplying over 500 tonnes of fresh mushrooms to the UK marketplace, growing over 150 tonnes of fresh mushrooms in Ireland and the UK and producing close to 2,000 tonnes of substrate for Ireland and the UK market.

Their head office is in Gorey Co Wexford, where they have manufactured their substrate for nearly 40 years.

Walsh has growing and packing operations in Golden Co Tipperary, Bury St Edmunds, Suffolk and Evesham, Worcestershire.

Employing close to 400 people across the four sites and the group has grown rapidly over the last five years.

Walsh Mushrooms clean and process approximately 250 pallets of fresh mushrooms per day prior to dispatch to retail and hospitality trade.

Their main priorities as a business are efficient processes and product quality.

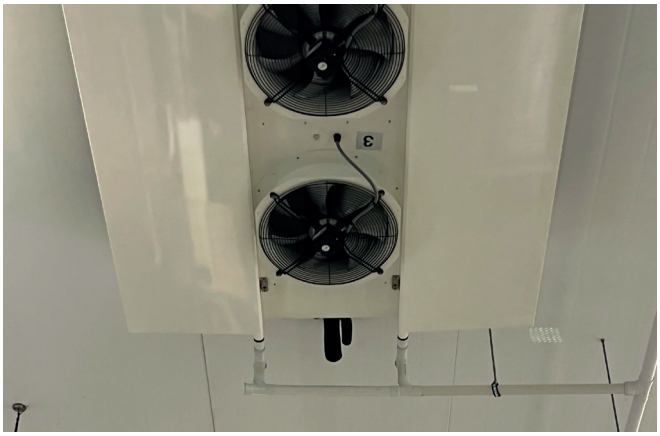
The project brief

"Walsh Mushrooms are a service/ maintenance contract holder with SK Refrigeration and Heating Ltd. Owing to the existing equipment regularly breaking down due to age and condition. R-22 refrigerant alternatives are becoming harder to obtain or coming in at £75 - £100 a kilo in terms of cost (with a significantly high GWP); the customer requested options for replacement moving forward. They also wanted a solution or refrigerant that would be somewhat future-proof with the ever-increasing pressure on GWP and quota."

Matt Dolphin, Director, SK Refrigeration

Project objective

To demonstrate the practical application of large charge sizes of A2L refrigerants in large commercial cold storage, whilst maintaining **compliance with EN378 and PED / PES(R).**



Executive Summary

Today it is well known that the pressure on refrigerants from F-Gas regulations and the drive to reduce carbon dioxide equivalents (CO_2eq) will require systems to be designed with low Global Warming Potential (GWP) refrigerants in mind. Failure to do so will result in quota levels severely limiting the refrigerant available for new installs and maintenance. High GWP refrigerants will use a disproportionate quota and consequently be very expensive.

Today the plan is to further reduce quota by 69% from the 2015 baseline in 2024.

Add to this the possibility of:

1. Additional cuts to quota in 2024 as proposed by the F-Gas review
2. The expected exponential increase in Heat Pump installations in the UK/EU
3. The inclusion of Metered Dose Inhalers requirements into the quota

From this, it is clear that our industry has to adapt and adopt low GWP solutions rapidly.

Global events in 2022 have added further pressure on the choice of available refrigerants through the cost and supply of energy and the Actual Global Warming (GWA) impact of the energy consumed, including the percentage of fossil fuels used to generate this power.

Consideration of direct emissions (refrigerant leakage), indirect (emissions from power supply) and increasing energy costs are now more important than ever when deciding on equipment specification.

Lower GWP refrigerants are a recognized and important alternative to HFCs and "industrial natural" refrigerants when considered a total system solution to the pressures on our industry and society.

Opteon™ refrigerants are a low-GWP and energy-efficient HFO/HFC blend and provide sufficient performance to replace legacy and interim replacements but with a GWP significantly lower.

With a GWP of just 238, Opteon™ XL40 can deliver a sustainable solution for the CO_2eq phasedown and, therefore, a good choice to replace these interim refrigerants. Furthermore, the refrigerant characteristics allow for large installations, such as industrial cold storage, whilst continuing to meet the requirements of EN-378 Safety Standard.

Client Considerations and Concerns

- ✓ Sustainability
- ✓ CapEx
- ✓ OpEx
- ✓ Proofing
- ✓ Ease of maintenance (system architecture)
- ✓ End-user aspirations for green agenda strategy

Alternative Solutions Considered

CO_2 was rejected due to:

1. Capital cost of equipment and installation
2. High energy costs (high cost of ownership)
3. The high value of product stored, and the loss of product or quality proved to be too high a risk in the event of CO_2 charge loss due to high ambient temperatures
4. Risk in the event that there are repeated CO_2 shortages

NH_3 Rejected due to:

1. High capital cost
2. System complexity in this market
3. Higher operating costs
4. B2L refrigerant - toxicity
5. High maintenance cost

Solution Adopted

A2L Opteon™ XL40 (240kg Total)

1. Acceptable Capital Cost
2. Lower Operating Costs using energy efficient refrigerants
3. Lower Environmental impact due to Low Energy Consumption in a Fossil Fuel Rich Energy Supply Chain
4. Familiar System architecture and easily maintained
5. Confidence in Product Quality
6. Low maintenance cost

Legacy Plant

- 20-year-old pack with 3x compressors suppling 3x Coolers & Condensers per hall.
- The pack was initially installed with an R22 charge and later upgraded to R-422D (Freon™ MO29).
- Total Charge 250 kg.
- The compressors have also been changed out over the years and replaced with re-manufactured semi hermetic compressors.

New Installation

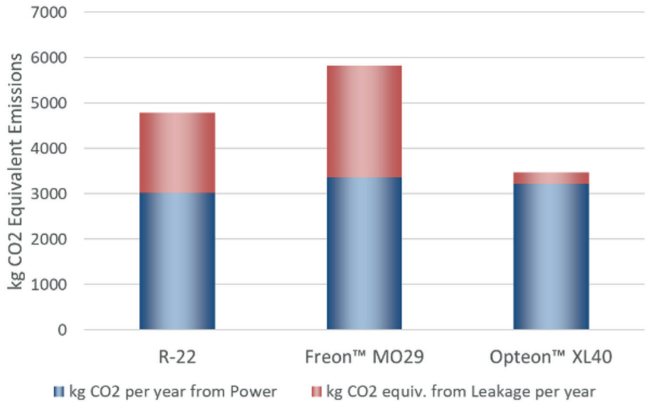
- Conditions
- Hall 1 = +4 °C ▪ Hall 2 = +6 °C
- Evaporator Temp -5 °C
- Condensing Temp 40 °C
- Subcooling 2K
- Total Superheat 25K
- 4 circuits 60 kg Per Circuit R-454A Opteon™ XL40 (240 kg Total) Supplying 2 halls.
- 8 off Evaporators supplied by Kelvion (CDK-453-8BE-FX28)
- Controllers - Temp controllers Eliwell ID985LX , Danfoss Superheat controllers EKE 1C
- Total Charge 240 kg
- Halls 1 & 2 have the same sized equipment delivering 95 kW of cooling duty per hall
- The evaporators are supplied by four Bespoke Condensing Units powered by Copeland Stream Semi-Hermetic Compressors
- Each condensing unit having been designed, qualified and certified for use with A2L refrigerants by Peter Woods F.InstR Technical Director at Wolseley Custom Build
- The units are UKCA labelled

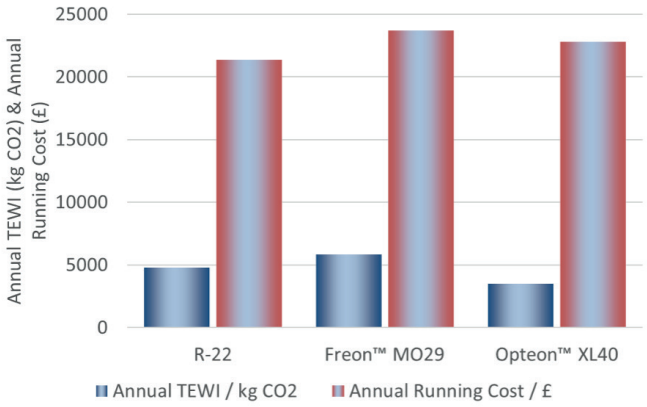
Performance and Major Findings

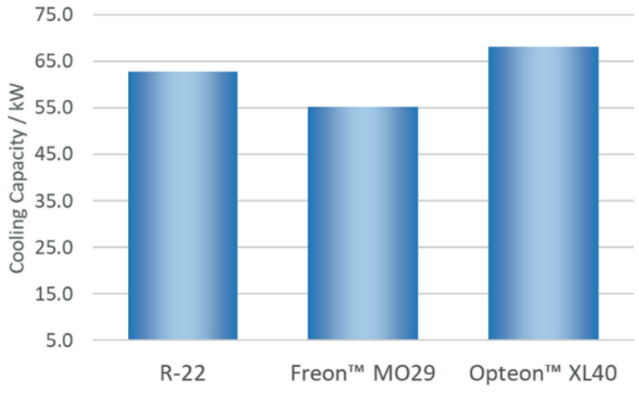
A like-for-like assessment of the legacy system would not give a fair representation due to its age and level of deterioration. Instead, a comparison was made using the characteristics of the new condensing units against the new and old refrigerant properties to show results on a comparable basis.

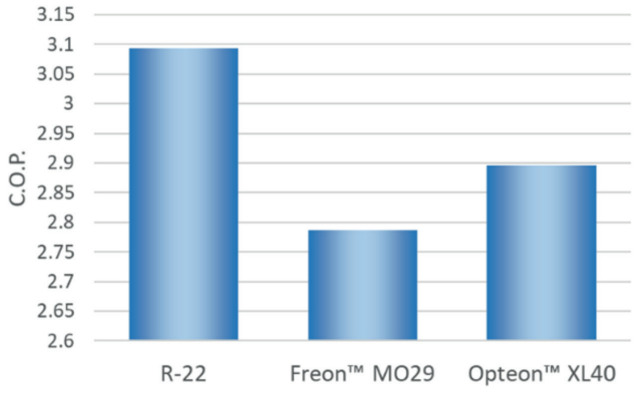
Figures per circuit.

		R-22 R22	Freon™ MO29 r422d.mix	Opteon™ XL40 r454a.mix
GWP (AR5)		1760	2470	**238**
Flammability		A1	A1	A2L
Gas Group according PED		2	2	1
Mean Evaporating Temperature	°C	-5,0	-5,0	-5,0
Evaporating Pressure	bar.g	3,205	3,228	3,970
Compressor Discharge Temperature	°C	104,7	77,9	**92,9**
Mass Flow	kg/s	0,391	0,504	0,435
Cooling C.O.P.		3,09	2,79	**2,90**
Evaporator Glide	K	0,0	2,6	4,5









Results R-422D v's R-454A	
Indirect Co_2kg/yr	-3,80%
Direct CO_2kg/yr	-90%
Running Cost (£0.24/kWhr)	-3,80%
C.O.P	3,90%
Cooling Capacity kW	23%

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Savings in Direct and Indirect Emissions Over Predicted Lifetime of 15 Years

134
Tonnes Total
Direct CO_2 33.5 Tonnes Per Circuit

20
Tonnes Total
Indirect CO_2 5 Tonnes Per Circuit

£54,000
Total
Cost £13,500 Per Circuit

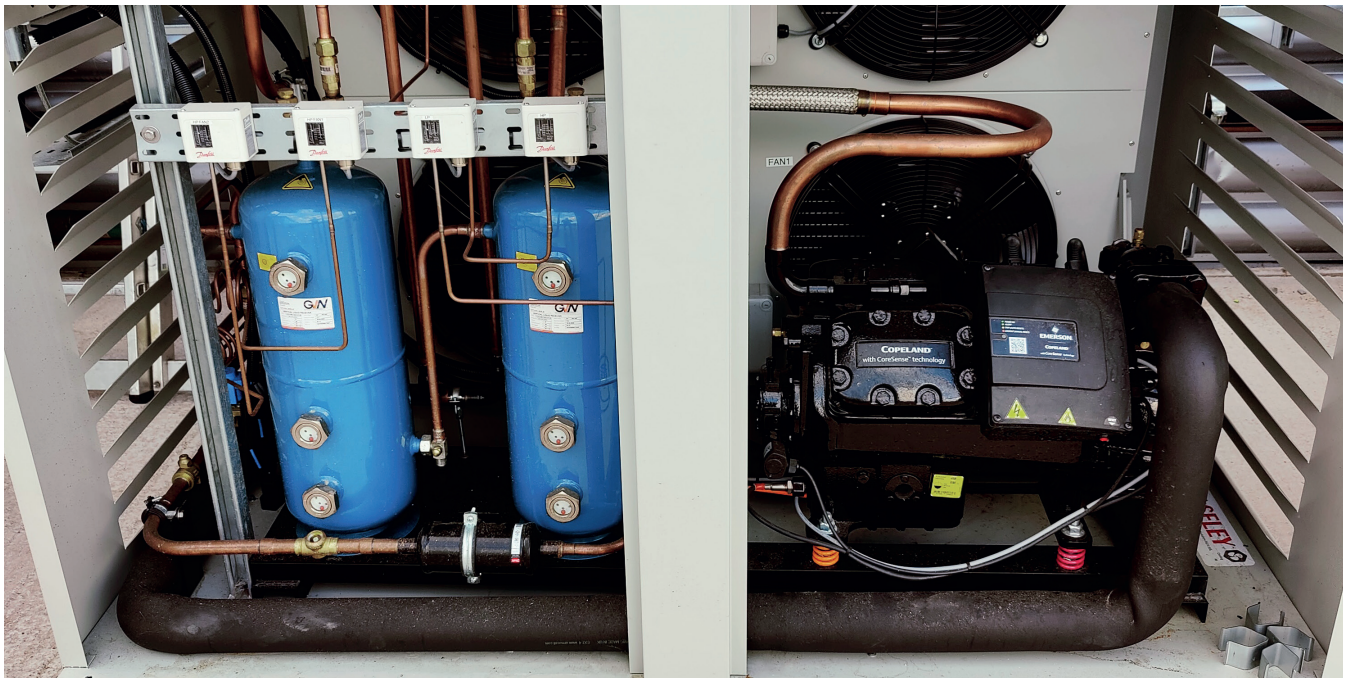
Conclusions

The project showed that large charge sizes are possible due to access category and room size.

We also proved the value of a full risk assessment, as with any other installation and which was carried out prior to commencing with the project.

The final choice of refrigerant and partners resulted in both CapEx and TCO being very acceptable.

The installation clearly demonstrates that projects of this type are not only possible, but also proven to be scalable and repeatable within the confines of standards and regulations and provide an excellent, safe and environmental solution to this part of the cold chain.



SK Refrigeration Heating & Cooling

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