



East coast chill factor

Aldi supermarkets in Victoria, New South Wales and Queensland are reducing their greenhouse gas emissions by using R290 hydrocarbon chest freezers in their retail frozen food departments.

Aldi supermarkets feature 22 to 24 chest freezers, typically arranged in an island pattern within the layout of stores. Each of these chest freezer units houses a self-contained hermetic compressor with variable speed drive.

They use aluminum evaporator tubes, which are encased around the inner lining of the freezers, and feature a no-fin tube condenser embedded in the outer skin, and a small EC fan de-super heater.

An automatic hot gas defrost evaporates any defrost water and eliminates the need for external piping or drain connections.

And with only a single-phase plug-in connection, the units require very little layout preparation. In the event of a future store rearrangement, the units are highly flexible.

The majority of units are configured for freezer duty. However, each store incorporates two dual-temperature units, which can operate on either chiller or freezer duty.

ENERGY SAVING AND EMISSIONS REDUCTIONS

Using R290 propane refrigerant, these units have a global warming potential (GWP) of 3 per kg of refrigerant. In comparison, an F-gas R404a-based system has a GWP of 3260.

‘Greenhouse gas emissions savings of approximately 17 tonnes per year, or 170 tonnes over 10 years, can be made by using the R290 option.’

The electrical efficiency of the R290 system is equivalent to a two-stage R404a system, particularly for locations in southern states, where the extra heat emission in the store air conditioning is more than offset by the reduced heating requirements in winter.

Using the total equivalent warming index (TEWI), a comparison of the options is made in the table below. A CO₂/R134a cascade system would use slightly less energy, but has a very similar overall TEWI due to refrigerant leakage allowance.

The table overleaf shows that greenhouse gas emissions savings of approximately 17 tonnes per year, or 170 tonnes over 10 years, can be made by using the R290 option.

In this case, the savings results from the lower GWP of refrigerant leakage. If a figure of 3 per cent for leakage is used in the R404a case, savings are still in the order of 12 tonnes per year; 17 tonnes of greenhouse gas emissions is equal to approximately six average cars traveling 13,700km per year.

SAFETY ASPECTS

The chest freezers have a very small refrigerant charge (110g each), are factory-sealed and have the necessary design approvals for use in Australia. ■

CASE STUDY

	COMPARISONS OF REFRIGERANT OPTIONS		
	R404a two-stage system	R290 chest freezers	CO ₂ / R134a cascade
GWP refrigerant	3260	3	1300 (R134a)
n = operating life (years)	10	10	10
m = charge in kg	80	2.6 [22 units]	30 (R134a)
L = leakage per year (%)	5	2	5
α = recycling factor	0.85	0	0.85
β = CO ₂ emission kg per kWhr Vic	1.22	1.22	1.22
E _{ann} = energy cons in kWhr per year	48,429	48,315	48,219
TEWI (Due to leakage per year, in tonnes)	13	0	2
Recovery losses per year	4	0	1
Indirect TEWI due to electricity consumption per year, in tonnes	59	59	59
Total TEWI per year (Tonnes CO ₂)	76	59	61
Tonnes of CO ₂ saved per year compared to R404a standard	0	17	15
<p>Note: TEWI = (GWP x L/100xnxm) + (GWPxm(1-α_{recovery}) + (nxE annual xβ) = Leakage + recovery losses + energy consumption Recovery losses are a measure of the refrigerant that is not recovered at the end of the equipment life.</p>			

TECHNICAL INFORMATION

Approximate refrigerant charge: **110g per unit**

Compressor: **Danfoss hermetic variable speed**

Condenser: **No-fin tube type with EC fan de-super heater**

Date plant commissioned: **2006 onwards**

Design temperature: **-18°C to -23°C standard or 0°C to +20°C for dual temperature**

Net contents per unit: **881 litres**

Nominal power consumption: **450W per unit**

Refrigeration plant capacity: **0.5kW per unit or approx 11kW per store**

Refrigerant: **R290 hydrocarbon**

This case study was prepared by the AIRAH Natural Refrigerants Special Technical Group. For more information about AIRAH STGs, go to www.airah.org.au