Case Study

Aldi Stores

Chest Freezers Hydrocarbon Refrigerant

End User

Supermarket retail frozen foods.

Location

Typical Aldi stores in Victoria, NSW and Queensland.

Type of Plant

In a typical store, chest freezers are arranged in an island pattern with 22 to 24 chest freezers per store. Each unit has a self contained Danfoss hermetic compressor with variable speed drive. The units use aluminum evaporator tubes encased around the inner lining of the freezers and have a no fin tube condenser also embedded in the out skin. These units have automatic hot gas defrost and evaporate away any defrost water so no external piping or drain connections are required.
The only connections are a single phase plug in connection which means very little pre preparation is required for the layouts and they are highly flexible for future store rearrangements.
The majority of units are configured for freezer duty, although each store incorporate two dual temperature units which can operate at either chiller or freezer duty.

Technical Information

Date plant commissioned	From 2006 onwards
Refrigeration plant capacity	0.5 kW per unit or approx 11 kW per store
Refrigerant type	R290 Hydrocarbon
Compressor type	Danfoss hermetic variable speed
Condenser type	No fin tube type with EC fan de super heater
Approximate refrigerant charge	110 g per unit
Design temperature	-18 to -23^{0}C standard or 0 to +2^{0}C for dual temperature
Net contents per unit	881 litres
Nominal power consumption	450 W per unit

Energy Saving and Emissions Reductions

By using the R290 Propane refrigerant these units have a Global Warming Potential of 3 per kg of refrigerant compared to 3260 for an F-gas R404a based system. 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 concept of Total Equivalent Warming Index (TEWI) a comparison of the options can be made. It can also be seen that a CO_2 /R134a cascade system would use slightly less energy but has a very similar overall TEWI due to refrigerant leakage loss allowance.

	R404a 2 stage system	**R290 Chest freezers**	**CO_2/ R134a Cascade**
GWP Refrigerant	3260	3	1300
n=years operating life	10	10	10
m=charge in kg	140	2.6	30
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) Tonne	23	0	2
Recovery losses per year	7	0	1
Indirect TEWI due to electricity consumption per year Tonne	59	59	59
Total TEWI per year Tonnes CO_2	89	59	61
Tonnes of CO_2 saved per year compared to R404a standard	0	17	15

The above shows that a savings in greenhouse gas emissions of approximately 17 tonnes per year or 170 tonnes over ten years can be made by using the R290 option. The savings results in this case from the lower GWP of refrigerant leakage. If a figure of 3% for leakage is used for the R404a case the savings is still in the order of 12 tonnes per year.

17 tonnes of emission is equal to approximately 6 average cars traveling 13,700 km per year each.

Safety Aspects

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