

# Supermarket refrigeration going natural

In 2005, Coles Supermarkets opened its first 'environmental concept' supermarket featuring a cascade carbon dioxide refrigeration system. Two years on the technology has undergone significant improvement to better serve the local market, while internationally it promises to receive widespread adoption by the world's retail heavyweights, as Sean McGowan reports.



Supermarket refrigeration accounts for a significant 1% of Australia's total electricity consumption, and this figure is reported to be higher in Europe and the United States.

Therefore, it's not surprising to find supermarket chains worldwide clamoring to adopt new technology which promises to cut their energy costs, while at the same time, address their corporate responsibilities to the environment and the communities who shop with them.

The knight in shining armour looks set to be carbon dioxide (CO<sub>2</sub>) refrigeration systems, which are often used in a cascade design with fluorocarbon refrigerants such as R507 or R134a.

A cascade system using ammonia is also on the agenda according to one of Australia's leading supermarket refrigeration specialists, Frigrite Refrigeration.

"We have traveled the world investigating system design and have developed solutions that best suit the Australian market. We installed the first CO<sub>2</sub> systems in Australia, with another four systems installed in new supermarkets since," says Andrew Reid, national account manager for Frigrite.

"Due to economic constraints, the cascade CO<sub>2</sub> systems installed in Australia best suit the energy and environmental expectations, however, further development is underway in finding improvements to the current concepts, which may involve a fundamental system design change and alternate refrigerants to those currently being used."

Reid says supermarket chains have acknowledged the importance of meeting environmental and community expectations as the general awareness of these two aspects increases.

"We have worked hard in reducing the capital expenditure of environmental refrigeration systems, which at this time result in marginal additional capital expense over conventional refrigeration systems. However this is more than offset by reduced running expenses and we are continuing development with a view to bringing capital outlay in line with current conventional systems."



## The ascension of natural refrigerants

In April 2005, Australian supermarket chain Coles launched its first 'environmental concept' store in Melbourne's semi-rural suburb of Gisborne. A key plank to this store's sustainability profile was the installation of refrigeration cabinets utilising CO<sub>2</sub> cascade technology.

This project, considered not so much as 'the' solution so much as a work in progress, combined the work of Coles, Frigrite Refrigeration, Danfoss Australia, Bitzer Australia and the CSIRO.

According to Paul Lang, energy project manager for Coles Supermarkets, the natural refrigerant experience has been a positive one which continues to be fine tuned.

"We worked with Frigrite to install the first systems at Gisborne and Winmalee in 2005. It was very important for both Coles and Frigrite to ensure the units were reliable, otherwise natural refrigerants would get a bad name and the program would be in jeopardy," explains Lang.

"Our experience so far has been very encouraging, with these sites essentially research and development sites, providing learning experiences for both ourselves and Frigrite. While some improvements have been made to each system since commissioning, the stores really haven't missed a beat."

While Lang makes it clear that in most cases energy efficient projects require a return on investment to be achievable, those involving natural refrigerants also require patience and nurturing.

"We do understand, from a natural refrigerants point of view, the industry is still in its infancy and in these cases sometimes the economics are not always there on a pure pay-back basis. However Coles has been keen to see the development of a natural refrigerants industry and as such has invested in a number of systems to support the industry."

This positive attitude by the Australian supermarket industry, Reid says, should result in the independent supermarket sector also embracing this technology as awareness and confidence in the systems grows.

"We have made significant improvements in every conceivable aspect of the complete system since the first installation. From case design, to system and control philosophy, the improvements have resulted in better efficiency of the CO<sub>2</sub> systems and lower power consumption over conventional systems."

Reid says depending on system design, Frigrite has been able to achieve around 13% improvement in efficiency over conventional refrigeration systems.

"Improvements are incremental however it is not unrealistic to expect 15% in the near future and 20% thereafter. In a controlled environment, higher efficiency improvements are possible."

## The international experience

Internationally, natural refrigerants are being explored by many European supermarket chains in a bid to dramatically cut their greenhouse gas emissions.

In the United Kingdom, the Tesco group has pledged to halve the amount of energy it uses per square foot in its UK based stores by 2010 (using 2000 as a base year). It is expected to reach this goal as early as next year.

"As a growing international business, we must set an example by measuring and reducing our greenhouse

gas emissions," says Tesco chief executive officer Sir Terry Leahy. "By setting targets that stretch our business. And by committing to do this in a public way, so we are transparent and fully accountable for what we achieve."

The company has now built three energy efficient stores in the UK, intended to test new equipment and ideas that can be rolled out across the business. The most recent, in Wick, opened in November 2006 and has since delivered a carbon footprint 50% lower than standard stores of its size.

As part of this program, Tesco has recognised refrigerant gas as being a significant contributor to its carbon footprint and has set about phasing out HFCs in large-scale refrigeration by trialing natural refrigerant solutions in a number of its stores.

"As a food retailer, refrigeration currently accounts for over a third of our direct carbon footprint in the UK," says Leahy. "The vast majority of large refrigerators in the food industry currently use HFC refrigeration gases. These were introduced as a replacement for the ozone depleting CFCs and HCFCs – but we know that HFCs are extremely potent greenhouse gases."

"We are therefore leading a programme to phase out their use. We have so far installed two alternative non-HFC systems – one based on CO<sub>2</sub> and one combining CO<sub>2</sub> and hydrocarbon refrigerants. We are sharing what we learn with all interested parties to speed up and promote the use of natural refrigerants."

According to Gordon Lacey, Asia Pacific business development manager for Swedish humidity control specialists Munters, Tesco Thailand is also set to undertake a CO<sub>2</sub> store as part of their rapid development, while competing UK giants Sainsbury and ASDA have also run successful trials, with ASDA enjoying success with an ammonia and carbon dioxide cascade plant delivering higher efficiencies at its distribution centre.

"Legislation in the UK is a driving influence, with building regulations demanding 10% renewable energy to be generated on site. Fuel costs also rose by 46% in 2006," says Lacey. "While Asia lags behind, they use high efficiency systems like water cooled chillers as there is less concern for the community with *Legionella*."

Meanwhile in the United States, Wal-Mart, the world's biggest company with a turnover of around \$US300 billion, is considered to be a leader in sustainable retail design, making a number of pursuits to enhance refrigeration system efficiency, while opening around 200 stores per annum.

"Wal-Mart has placed an emphasis on individual system optimisation via minimising the operating compression ratios, as well as putting in place the highest practical operating suction pressures, and the lowest practical discharge pressures," says Lacey.

"Enabling both the suction and discharge pressure to continuously float as opposed to fixing these parameters, has helped achieve higher efficiency. They have also designed an efficient method of continuous compressor capacity modulation to accommodate the constantly variable evaporator load."

Lacey says standards like ASHRAE 90.1, which has prohibited reheat since 1999, indicate the country's approach to responsible action.

"The community has driven this in the USA and companies like Wal-Mart market their social responsibility heavily, and want to be seen to contribute to the energy issue by opening up all their energy saving analysis, allowing supermarket designers' access."



Paul Lang



Andrew Reid

## Where to for Australian supermarkets?

Wal-Mart's heavy promotion of its environmental gains is in stark contrast to the Australian supermarket industry, which has largely kept activity under wraps.

With energy costs forecast to increase significantly in coming years, however, the focus on supermarket refrigeration efficiency will only magnify in coming years.

"On both fronts (energy and refrigerant) costs are going to increase so it is important to reduce refrigerant charge and refrigeration energy usage to mitigate against these cost increases," warns Lang.

"We see the natural refrigerants program as key to both these issues. In ten years' time, we hope that natural refrigerants are the norm rather than the exception as the cost of equipment comes down and service technicians in the industry become trained to deal with (these) systems."

In the meantime, any widespread adoption of energy efficient systems utilising natural refrigerants will be hampered by the large capital cost, and the fact that these systems are difficult, if not impossible, to retrofit into existing stores.

"The biggest challenge in installing a CO<sub>2</sub> system in a refurbished store is that to maximise efficiency, almost every component needs to be replaced," explains Reid, adding that this problem diminishes the economic viability of a CO<sub>2</sub> system.

As such, only new supermarkets will be able to take advantage of whatever lessons can be learned from the Coles experiences, leaving existing stores open only to the replacement of inefficient equipment.

"At this stage we have not considered a natural refrigerant system for a refurbishment as they are difficult to retrofit. For refurbishments we replace older, less efficient equipment with new, more efficient compressors, condensers, controls, valves and associated equipment," adds Lang.

"We have also trialed re-commissioning of a number of older stores for energy savings, with encouraging results." ▲