



# Australian supermarket first

After successful natural refrigerant system trials in three environmental concept stores, Coles is opening a new store in Sydney's west which features the first ammonia and carbon dioxide cascade refrigeration system in an Australian supermarket. **Sean McGowan** reports.

Coles Ropes Crossing is among a new wave of Australian supermarkets. The store is taking part in the Green Cooling Council's greenhouse gas abatement project, along with several other supermarkets around the country.

The project, which received \$2 million in Federal Government funding last year, is trialing natural refrigerant technologies in five supermarkets across the country (as EcoLibrium® reported in its May 2008 issue).

These systems include a cascade R404A and R744 (carbon dioxide) system, another cascade system using R134a and R744; and a sub and trans-critical system using R744.

Modelling carried out as part of the project has shown that a carbon dioxide / ammonia cascade system provides

significant benefits when total equivalent warming impact (TEWI), capital cost and annual running costs are considered.

According to Paul Lang, retail development environment manager for Coles, the company has recognised the need to develop an alternative refrigeration program for many years, and sees the exclusive use of natural refrigerants as the next logical step.

"We have used cascade carbon dioxide / R507 and cascade carbon dioxide / R134a previously. To progress to a 100% natural system by using a cascade carbon dioxide and ammonia plant is a natural progression in our refrigerants program," Lang explains.

"As these types of refrigeration installations are not yet mainstream, all of the carbon dioxide systems we have

installed can be considered as operational R&D plants. We hope that a number of the learnings and improvements from these plants can be incorporated wherever possible into future developments."

## LEARNING FROM EXPERIENCE

The retail sales area of Coles Ropes Crossing in Sydney's western suburbs contains 63 doors of frozen food, 120 metres of multi-deck display cabinets, eight cool rooms and two freezer rooms. The store's refrigeration load is 33kW of freezing and 248kW of medium temperature refrigeration.

The company says it has learned a lot through the operation of its first environmental concept store at Gisborne in Victoria, which features a cascade



Paul Lang

carbon dioxide / R507 system. The company has since installed the same system at Winmalee in New South Wales, and R134a was used as the high side refrigerant for its Rouse Hill store (also in New South Wales) last year.

According to Paul Sheahan, senior executive for business development at Frigrite, (Coles' main refrigeration partner on the natural refrigerant program thus far) while the basic cascade process has remained the same through all these projects, there have been a

number of refinements made for the Ropes Crossing design.

While the Gisborne store featured two separate carbon dioxide cascade systems rated at 50% of the total load each, maintained by two parallel racks of reciprocating compressors with a small charge of R507, Ropes Crossing features one carbon dioxide system with an equal split cascade maintained at condition by two separately controlled screw packs operating on ammonia.

"As part of our development program we have been monitoring the energy saving results from increasing the operating plant carbon dioxide liquid temperature from Gisborne's design of  $-10^{\circ}\text{C}$ . As a result, Ropes Crossing is set up to maintain carbon dioxide liquid at  $-7^{\circ}\text{C}$ ," says Sheahan.

The Gisborne system is now being modified to maintain the same condition, and power monitoring results are expected to be available soon. Several control software upgrades have also been implemented to enable the team to fine tune plant operation.

One of the major discoveries made from the Gisborne experience was that the capacity of the high stage of the cascade

had a major impact on plant reliability and operation.

"At Gisborne, the capacity of the R507 stage was generous and this caused a lot of issues with short cycling and unstable cascade conditions that forced us to review the design."

The result is that one compressor is now locked out of the control strategy, and can only function when the ambient temperature is above  $26^{\circ}\text{C}$  or if there is a major rise in vessel pressure that falls outside of the operational set point.

The lesson, Sheahan says, is to not oversize the system as it will become grossly oversize when operational.

## LEAK PREVENTION

Being the first carbon dioxide / ammonia refrigeration installation of its type in an Australian retail environment, a considerable amount of development work was required to complete the Ropes Crossing project. Because ammonia is toxic, one of the team's major concerns has naturally been the threat of a refrigerant leak. Carbon dioxide can also cause problems if it leaks, as it is heavier than air and can displace the oxygen in a room if a large quantity escapes the refrigeration system.

## COVER FEATURE



Rooftop condensers



Rooftop emergency shower and eyewash facility

## OTHER INITIATIVES

Coles says the Ropes Crossing refrigeration plant design is expected to result in a carbon dioxide equivalent emissions reduction of 700 tonnes per year, compared to a conventional Coles store which features a standard refrigeration system of similar configuration (taking into account typical average refrigerant leakage rates).

The store will also feature a number of other environmentally sustainable design (ESD) initiatives including refrigeration cases incorporating twin air screens and automated night blinds to further decrease energy consumption, and LED lights to reduce energy consumption and waste heat load into the refrigerated space.

“LED lights can also be turned off in a cool environment, unlike fluorescents which have real trouble relighting in a glass door freezer case application,” explains Lang.

“As such, the glass door freezer case aisles are fitted with motion sensors that turn the freezer lights off when no motion is detected, further increasing energy savings.”

Lang says that in addition to the alternative refrigeration projects currently underway, rain-water harvesting and other initiatives will be introduced in coming years.

“ESD principles are slowly becoming more accepted and expected in the building industry, with many developers and councils requiring ESD items to be included in developments,” he says. “I wouldn’t say that ESD is part of business as usual just yet, however, we are working towards including these principles into more and more projects where possible.”

Importantly, Coles states that it sees the ability to retrofit refrigeration plant in existing stores as a “crucial next step” in its natural refrigerants program. As such, the company says it will work with industry to trial the retrofit of natural refrigerants into a store as part of their refurbishment program. ■

To counter the effect of any leak, the carbon dioxide side of the system has been installed in the building’s internal plant and features a backed up leak detection system with low-level air extraction. The ammonia plant has been installed in a purpose built rooftop container plant room, with a gas detection and water scrubber system installed to prevent any ammonia escaping to the atmosphere in the event of a leak.

An emergency shower and eyewash facility is also provided at the ammonia enclosure level.



Inside the carbon dioxide system plant room

According to Sheahen, the quick and competent training of staff and associates in relation to natural refrigerants proved to be an enormous challenge.

“The hazardous nature of R717 (ammonia) has required us to complete an extensive amount of training in ammonia system operation and best handling practices,” he says.

“Our own division at Oxley Refrigeration is heavily involved in ammonia systems on a daily basis so this experience base was directly involved. We are also working closely with the International Institute of Ammonia Refrigeration and our local industry leaders in ammonia systems who had input into the system design and construction, including Bitzer who have been a great support.”



Contained rooftop ammonia plant room

While a great deal of thought went into the design of the plant layout to ensure public safety, specific installation and commissioning procedures also had to be developed.