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From chill to grill

CO₂ refrigeration at
Illawarra Smallgoods

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FROM CHILL TO GRILL



A highlight of the project is the specially designed CO₂ rack, switchboard, pump station and 200L buffer tank – all incorporated into a shipping container.

Owned and operated by the Hutton family since 1921, Illawarra Smallgoods is an icon of the region. Now the business has turned to natural refrigerants to better cater for growing demand while future-proofing its investment. **Sean McGowan** reports.

Illawarra Smallgoods has overcome many challenges throughout its 100-year history.

From the Great Depression of the 1930s, to the rationing of meat during the Second World War, and the emergence of supermarkets that resulted in many traditional butcher shops closing, the business has weathered plenty of storms and emerged stronger.

Now specialising in large-scale manufacturing of sausages, corned silverside, hams, frankfurts and other meat products, Illawarra Smallgoods has enjoyed strong growth in recent years.

So when the Wollongong-based company needed to expand its production and throughput capability to better serve its supermarket clientele, attention quickly turned to a refrigeration system in need of overhaul.

“We were facing a few issues simultaneously,” says Thomas Hutton, manager of sales and human resources at Illawarra Smallgoods – and a descendant of company founder Gordon Hutton.

“Our existing production facility had reached capacity, our existing loadout was over capacity and highly complicated, and the refrigeration system for those areas was ageing.”

The solution was the construction of a new facility that would double the existing production space by utilising the pre-existing cold storage site for production.

“We would also nearly quadruple onsite cold storage – dramatically increasing production capacity and allowing us to simplify loadout operations for our storeman,” says Hutton.

Having serviced the site for five years, West Refrigeration – specialists in supermarket cold storage and food processing – were called in to advise on a new refrigeration system.

“The new facility at Illawarra Smallgoods would expand their cold storage with 448m² of new freezer space and 488m² of combined chiller, loadout and corridor space,” says David West, Affil.AIRAH, managing director at West Refrigeration.

As well as expanding capacity, Illawarra Smallgoods wanted an energy-efficient refrigeration design that included the use of non-toxic, natural refrigerants.

“From the get-go, the customer wanted to ensure the new addition to their facility would be future-proofed,” explains West.

“They could see the benefits of CO₂ as a low-GWP (global warming potential) refrigerant, and as a low-cost alternative to traditional HFC refrigerants.”



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OUTSIDE (AND INSIDE) THE BOX

In choosing a new refrigeration system, Illawarra Smallgoods had some minimum conditions.

First, the company was determined to use a refrigerant that was not being phased down. That meant the two standout options were ammonia (R717) or CO₂ (R744). Second, the refrigerant of choice had to be as energy efficient as possible due to existing power limitations on the site, and the company’s will to lower overall site emissions.

Finally, it needed to be a simple, safe application that would not impact the local community.



The modular design allowed for the entire system to be installed much faster than a conventional system.

“Most of the site storage is low temperature – which CO₂ is highly efficient for,” says Hutton. “The rest is medium temp, where ammonia is more efficient.

“It eventuated that while both options could meet our power requirements and would tick all boxes, we made our choice of CO₂ based on our experience with West Refrigeration and the systems they specialise in.”

Once the project team decided to adopt a transcritical CO₂ system, a new plant deck was designed to maximise the internal facility’s storage area. This consequently required a unique plant design to suit the space.

“The compressor rack and switchboard needed to be enclosed, as there was no traditional plantroom allowed for,” says Mark Ward, Affil.AIRAH, project manager for West Refrigeration.

This led West Refrigeration to call on Bitzer Australia for assistance.

Together, the two companies developed a modularised design incorporating a pre-installed transcritical CO₂ rack, switchboard, pump station and 200L buffer tank contained within a 40-foot shipping container.

The entire plantroom could then be crane-lifted as one unit onto the condenser deck, with a gas cooler located beside it.

“Our work, both locally and internationally, has demonstrated that transcritical CO₂ systems can fulfil



Transcritical CO₂ refrigeration design in 40-foot container.

Source: BITZER Australia.

all aspects of what the client was looking to achieve," says Ian Suffield, Affil.AIRAH, national engineering manager at Bitzer Australia.

Additionally, Illawarra Smallgoods established early in the design phase that it preferred a warm glycol system for the low-temperature (freezer) evaporator defrost over a traditional electric defrost.

"This is perfectly suited to transcritical systems," says Suffield.

"There is an abundant amount of heat available for this process, which in turn reduces the need for large storage tanks that are typical when this is being applied to HFC and sub-critical CO₂ systems."

RACK 'EM UP!

The transcritical CO₂ rack is made up of three low-temperature, semi-hermetic compressors, four medium semi-hermetic compressors and three parallel semi-hermetic compressors.

The total freezer design load is 67.556kW @ -26°C saturated suction temperature, and a combined medium temperature load of 115.300kW @ -6°C saturated suction temperature.

The gas cooler is V-shaped with humidification pads to make use of the evaporation effect.

The rack is also fitted with a vertical glycol pump that circulates glycol through one side of a rack-mounted plate heat exchanger with discharge gas on the other side.

"One of the most significant challenges for use was to deliver the rack pre-fitted into the container – this was new territory for us," says Suffield.

LESSONS FROM THE PROJECT

West Refrigeration's managing director David West, Affil.AIRAH, shares the lessons he took from the installation of the transcritical CO₂ refrigeration system at Illawarra Smallgoods.

Transcritical CO₂ is the answer moving forward. With the assistance of Bitzer, Danfoss and the commitment from our commissioners, the plant has proven to be efficient, effective and reliable.

Warm glycol defrost is an effective alternative to electric defrost for freezer rooms.

It's important to ensure all members of the service team have suitable training to understand the operation of a transcritical CO₂ plant. We needed to ensure that all the necessary information is at the service technicians' disposal, so the plant continues to operate efficiently. ■

"Our main concern was the safety of technicians working within the space. That meant considering and designing access, lighting, and ventilation – as well as fitting the equipment within the container."

Bitzer used 3D-design software to provide a visualisation of the equipment layout to West Refrigeration and Illawarra Smallgoods, and demonstrated that serviceability and ongoing access to vital components could be assured.

According to Hutton, the implementation of the system on a new build was challenging because of the small installation window in the builder's schedule.

"Compounding this were constant delays fuelled by ongoing wet weather, which kept pushing the schedules back," he says.

But the fully contained, modular design of the refrigeration system ended up being a huge advantage. Once the timing of the installation was locked in, the entire system could be installed within just two or three crane lifts.

"This meant the work onsite primarily consisted of running pipes, and so was completed very quickly," Hutton says.

UP AND RUNNING

Since the new transcritical CO₂ refrigeration plant at Illawarra Smallgoods was commissioned in March 2021, it has reportedly operated extremely well. The benefits of a lower temperature defrost are also evident in the conditions inside the freezer room.

"CO₂ has proven to be extremely effective for us," says Hutton.

"We have had some hot days, during which the system did not exhibit any signs of strain. The issues that have come up have been simple to fix and have really just been part of the commissioning process."

Now, 18 months into its operation, West Refrigeration continues to tune the new system for operational and energy efficiency gains.

"We would not hesitate to use CO₂ for our next installation," says Hutton. ■

The V-shaped gas cooler makes use of the evaporation effect via humidification pads.



PROJECT AT A GLANCE

THE PERSONNEL

- ▲ Client: **Illawarra Smallgoods**
- ▲ Refrigeration Contractor: **West Refrigeration**
- ▲ Refrigeration Plant Design: **BITZER Australia**

THE EQUIPMENT

- ▲ Compressors: **BITZER Australia**
- ▲ Condensers: **Guntner**
- ▲ Controls: **Danfoss**
- ▲ Evaporators: **Guntner**
- ▲ Pumps: **Grundfos**
- ▲ Sensors: **Danfoss**
- ▲ Tanks: **Masterflow**
- ▲ VSDs: **ABB**