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Coopers Brewery in Regency Park, SA, with the new maltings plant in the foreground.
(Photo source: Ahrens Group)

TRUE BREW

The craft beer sector is booming with around 400 craft brewers now operating across the country. This growth locally and worldwide has, in part, led Coopers to open a $65 million maltings facility in Adelaide. **Sean McGowan** reports.

Yes, I'll admit it. I'm a devotee of craft beer.

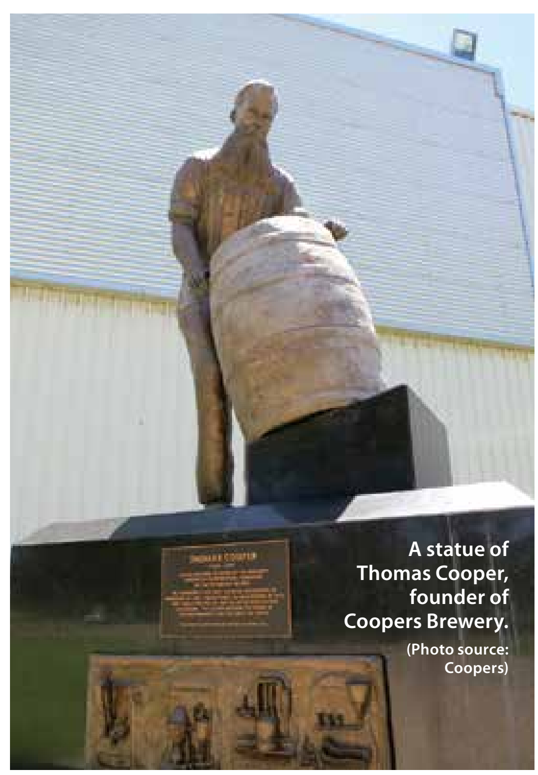
No, I don't have a hipster beard, nor do I wear chinos rolled up to my ankles. I don't own a bicycle either. But I do enjoy craft beer. And a quick glance in my fridge proves it. Surrounding a six-pack of something safe to keep the old man happy are colourful cans reminiscent of 1970s soft drink containers and bottles of pale ale brewed in towns I can't find on a map.

Of course, my conversion from the conservative took some doing. I mean, Jedi Juice and Krush don't really sound like beers do they? But despite my initial misgivings I was ultimately swayed by their artisan appeal. I'm appreciative of the art of brewing, of the subtle flavour variations achieved from simple ingredients like malted barley, and the fact that someone, somewhere has had a go.

And I'm not alone.

While overall beer sales in Australia have reportedly hit a 65-year low, craft beers are bucking the trend. Sector revenue is reported to soon nudge $500 million a year, based on annualised growth of almost 10 per cent.

It's this growth that has contributed to Coopers deciding to return to the maltings business after a 16-year hiatus. It has done so in a big way too, with the construction of a $65 million purpose-built facility at its Regency Park site in Adelaide. Once again Coopers will have full control over one of the key ingredients in its beer: malt.



A statue of Thomas Cooper, founder of Coopers Brewery.
(Photo source: Coopers)

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STATE-OF-THE-ART DRAUGHT

The project represents the single biggest investment in the company's 155-year history, and is considered the most technically advanced maltings in the world. Built by South Australian firm Ahrens Group and spanning some 13,000m², the facility houses the world's best equipment sourced from Germany. It is set to produce about 54,000 tonnes of malt a year.

Coopers will use about 17,000 tonnes in the production of its own beer products, with the balance sold to domestic and export customers, including the many independent brewers of craft beer looking for reliable malt supplies.

"South Australian farmers are recognised as producing some of the best malting barley in the world," says Coopers managing director Dr Tim Cooper. "We will be looking to establish strong relationships with them into the future."

Dr Cooper says particular care and attention was given to the aesthetics of the new maltings building.

The facility also features a number of innovations, including enclosed conveyors, advanced process control and monitoring.

"In terms of water usage, process control and automation," Cooper says, "this is the most advanced maltings in the world."

THE MALTINGS PROCESS

Malt is a key ingredient in the production of beer, along with hops, yeast and water. As well as affecting the flavour, sweetness and aroma of the brewed beer, malt also affects its colour – the darker the malt, the darker the beer.

At Coopers, malt is produced in a multi-stage process that germinates and processes barley, enabling specific sugars and enzymes to be accessed.

Stage 1: From the farm

Barley is received at the plant from farmers and checked, graded, cleaned and stored in grain silos on site.

Stage 2: Steeping

At Coopers, 180 tonnes of barley (in three 60-tonne batches) are steeped – a process of immersion in water and aeration, which elevates the moisture levels in the grain from 10 per cent to 40 per cent to stimulate germination.

Stage 3: Germination

After steeping, the barley is moved to one of four germination vessels, where it is left to germinate over the course of four days under strictly controlled conditions. The grain is continually turned to avoid "felting" as roots appear.

It is during this period that the internal structure of the grain is transformed by biological processes to allow the carbohydrate in the grain to become available to hydrolysis during the brewing process.

Stage 4: Kilning

The germinated grain is kiln-dried to reduce water content to less than 5 per cent and stop germination. The roots are removed (deculmed) and the malted barley is cleaned and tested. This process is where the flavours and aromas of the malted barley emerge.

Stage 5: Storage

The malted barley is then stored for future use by the brewery or sold to domestic and export brewers.

Source: Coopers Brewery and Cold Logic

CRITICAL LIQUIDS

The water used in production is sourced from saline aquifers located deep beneath the brewery and desalinated on site. Power is mostly drawn from Coopers' on-site co-generation plant, which also provides recovered heat for the kiln.

Critical to the maltings process is a large refrigeration plant, designed and installed by Adelaide-based industrial refrigeration specialist, Cold Logic.

Cold Logic's relationship with Coopers began with the maintenance of the company's old Leabrook brewery more than 30 years ago. This led to Cold Logic assisting Dr Cooper and his team in the establishment of the $40 million Regency Park brewery in 2001.

Maltings refrigeration plant room showing the three custom-built compressor packages.
(Photo source: Cold Logic)

"Our strong focus on expert service has ensured the reliability and longevity of their refrigeration plant to provide some of the best-brewed beers in Australia," says Cold Logic's Dr Michael Riese. Accordingly, Cold Logic was the obvious choice to set up the refrigeration plant serving the new maltings facility. The plant is particularly important in three stages of Coopers' processes.

"Firstly, the refrigeration plant is sized to supply chilled water to the actual beer brewing process at a rate of 100,000 litres every two hours," Dr Riese says. "Secondly, the plant chills 360,000L of RO (reverse osmosis) water from 30°C to 15°C each day to be used in the steeping process. And lastly, the chilled water is used to condition air during the germination and steeping process, which forms the main load of the plant throughout the day."

For this third process alone, Cold Logic expects to see a throughput of 2.5ML of chilled water on an average 25°C day at Regency Park.

With chilled water used around the clock as part of the maltings process, the key challenge for Cold Logic was to design a system that could cope with peak loads during hot weather to ensure 100 per cent production rates. Conversely, the system also needed to cater to reduced heat loads on cold days, or when there is reduced throughput in the system.

To cater for this, Dr Riese says the overall plant is designed to accommodate a flow rate of 130L/s of 6°C chilled water. However, he says instantaneous flow rates observed on the maltings plant during commissioning have ranged from 20L/s to 95L/s on medium to hot days.

"To cope with varying instantaneous chilled water requirements, it was important to avoid short cycling while at the same time stage the compressors and evaporative condensers in such a way as to avoid rapid changes in motor speeds," says Dr Riese.

Low-pressure ammonia surge vessel in the maltings refrigeration plant room.
(Photo source: Cold Logic)

Two gasketted plate heat exchangers used in parallel for chilling water in the primary circuit.
(Photo source: Cold Logic)

CLOSED LOOP

The closed-loop water system features separate hot and cold tanks, each with a capacity of 175,000 litres.

By using separate tanks, Dr Riese says the loading on the refrigeration system can be optimised and controlled to reduce potential power spikes that may result from rapidly ramping the system up or down.

"One of the main objectives of the system is to supply chilled water to the brewing process," he says. "So a reservoir is effectively created between the two tanks, ensuring the brewery will have sufficient chilled water available at all times."

The system is designed around a separate primary loop, which maintains the fill level and temperature of the cold tank, with the process side controlled by the brewery system.

"Our cooling system receives a cooling call, which then activates the secondary pumps and controls on delivery pressure," says Dr Riese. "A number of fully stainless-steel pumps are sized to accommodate different parts of the system. And depending on criticality of their function, are either deployed in a duty-only or duty and standby configuration."

The chilled water system is controlled on tank levels and the plate heat exchanger leaving temperature. Pump speeds are controlled on the delivery pressure to minimise the energy required.

Three ammonia compressors, with a total concurrent operating capacity of 3600kWr at design conditions, have been installed on site. Two units act in a lead-lag arrangement and the third compressor on stand-by.

These are matched by three evaporative condensers installed on the rooftop some 24m above the plant room. Each condenser is 6m long and 3m wide, and features two axial fans connected to individual VSDs (variable-speed drives) for speed control. In an Australian first, these units use two condensing coils at approximately 6m in length (rather than four coils at 3m in length). This reduces the number of valves and amount of pipework required – ultimately reducing the capital cost and areas of possible wear or failure.

"For a plant of this size that operates around the year, energy conservation and efficiency was a major component of the design and the control system," says Dr Riese.

To improve energy efficiency of the three evaporative condensers, they are operated in parallel at the minimum appropriate fan speed. Two gravity-fed gasketed plate heat exchangers are used for the heat transfer and the surge drum fed for a ceiling-hung liquid receiver.

A floating discharge pressure control system has been implemented to maximise the energy efficiency of the overall system.

"Using a variable-discharge pressure-control system maximises the performance and realises additional efficiency gains on colder days throughout the year," says Dr Riese. "By implementing the correct control system, we achieve steady flows and loading on the plant without large spikes in power drawn."

LESSONS FROM THE DESIGNER

Dr Michael Riese from Cold Logic reveals some of the key lessons from the project.

1. A full understanding of the customer's requirements and intended operation of the entire process and facility is essential to design a refrigeration plant that is the most appropriate for any given circumstance.

   The original design specifications are only the beginning, and significant discussions with the client are essential to realising the best value – both considering capital expenditure and ongoing operating costs.

2. Expert designers, engineers and trade staff are essential to the success of the project. Specialists in ammonia refrigeration are scarce in Australia, and having the best people on board makes projects easier, more successful, more commercially viable and reduces errors.

3. A good relationship with the head contractor is essential to the overall success of the project. The refrigeration project at Coopers was only $3.5 million out of an overall $65 million project budget. The head contractor is generally chosen from the construction trade and as such, often has very little knowledge of the ins and outs of industrial refrigeration contracting. In this case, there have been excellent relations with Ahrens Group, which allowed us to accelerate and prioritise individual parts of the install as needed, without any major delays for any of the parties involved.

4. Communication to the client, the head contractor and employees is key. By ensuring that everyone is up to date and abreast of any potential issues, there are no surprises – making the project a success for everyone involved.

Three evaporative condensers, first of their specific type for BAC in Australia. (Photo source: Ahrens Group)

REDUNDANCY

With the Coopers malting facility operating 24/7, all year round, redundancy was an important aspect of the chilled water plant design. It resulted in one permanent stand-by compressor being used to provide 50 per cent redundancy.

"Although we are using all three evaporative condensers in a parallel mode, the system is designed to be able to run on two condensers at full capacity," says Dr Riese. "The expansion valves are split in two, again to allow for servicing and in an emergency, with the plant able to operate on one valve for part of the time."

Given that a number of the fully stainless-steel pumps used at the facility were made to order in Europe, with a lead time of up to 26 weeks, redundancy here has also been important. To this end, pumps that are not readily available off the shelf in Australia are deployed in a duty/stand-by configuration to ensure the facility can continue to run following a pump failure.

SWEET SMELL OF SUCCESS

The new facility was officially opened on November 30, 2017 by His Excellency, the Honourable Hieu Van Le AC, Governor of South Australia. Since the opening, commissioning on the process side has continued, and the loading on the refrigeration plant gradually increased under the watchful eye of Cold Logic.

"Our engineers have monitored and tuned the system on an ongoing basis," says Dr Riese. "This is done via remote computer access for the most part, but has required the occasional visit on site to adjust physical valves and other control items."

With thanks to Tom Bullock, project manager for Coopers Brewery. ■

Tours of the site are available – go to coopers.com.au for details. (Photo source: Coopers)

PROJECT AT A GLANCE

THE EQUIPMENT

Compressors: Mycom

Controls: Siemens

Cooling coils: Cabero

Evaporative condensers: BAC

Hot and cold tanks: A&G Engineering

Plate heat exchangers: Alfa Laval

Pumps: Grundfos

Sensors: Endress+Hauser, OneTemp

VSDs: Danfoss

THE PERSONNEL

Client: Coopers

Controls: Cold Logic/Tristar Electrical

Head contractor: Ahrens Group

Mechanical services design: Cold Logic

Mechanical services contractor: Cold Logic

Processing equipment: Bühler