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AN AIRAH PUBLICATION



**Sweet
job!**

Ammonia
the magic
ingredient
for Haigh's
Chocolates

Skills

WORKSHOP

Silver brazing

Future *focus*

8 *trends set to transform our industry*



SWEET JOB!

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Facilities like this are only very rarely installed around the world.

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Chances are your first introduction to chocolate making came courtesy of the 1971 film adaptation of Roald Dahl's *Charlie and the Chocolate Factory*. While chocolate waterfalls are still the stuff of childhood dreams, **Sean McGowan** discovered there is magic to be found in the real world of confectionary.

Haigh's Chocolates has been an icon of South Australia since founder Alfred E. Haigh opened the doors to the company's very first store in King William Street, Adelaide, in 1915.

Like Willy Wonka himself, Haigh must have been a hero to many kids in those dark days of the First World War.

Despite the woes of the world, the business boomed. Even during the war years, when supplies were limited and sugar rationed, Haigh's Chocolates managed to keep trading by making boiled sweets and wrapped toffees for the armed forces.

Over a century later, Haigh's Chocolates is Australia's oldest family-owned chocolate maker. It remains committed to the art of premium chocolate making, operating from its factories in the Adelaide suburbs of Parkside and Mile End.

RECIPE FOR GROWTH

In 2016 the company made plans to expand its Mile End chocolate processing plant. Having provided air conditioning maintenance to Haigh's retail shops and existing warehouse for a number of years, Cold Logic was approached to develop refrigeration specifications for the new multi-million dollar factory.

Once expanded, the plant would have the capacity to produce 2,000 tonnes of milk and dark chocolate per year – up from the 700 tonnes produced previously.

The project was broken into multiple stages, and following a competitive bid process, Cold Logic was awarded the contract to supply and install the refrigeration plant to the first stage.

And the success or failure of the whole facility hinged on this key piece of work.

“The chocolate-making process relies on the skills of the chocolate makers, quality cocoa beans – and the ability for precise temperature control in chocolate conches, which requires an appropriate cooling and heating system,” says Haigh's Chocolates' project engineer, Shaina Reeder.

Stage 1 included the installation of one reciprocating compressor to cater for the increased production of chocolate from raw cocoa beans – the most important process in the manufacture of chocolate, where temperature is critical.

“On projects such as this, cooperation is extremely important, especially when the client is also the project manager,” says Cold Logic's Dr Michael Riese.

“Facilities like this are only very rarely installed around the world, and while there may be some specialist companies that can help with the project tracking side, subject matter expertise is invaluable.”

As luck would have it, Cold Logic's project engineer Laura Fortuna attended university with Reeder and studied for the same degree. As a result, each had a very good knowledge of the expertise the other brought to the table.



Laura Fortuna is a finalist in the ARBS Young Achiever Award, to be presented at this year's ARBS Industry Awards in Sydney on May 9.

"We speak the same technical language and have the same body of knowledge to work off," says Fortuna. "It meant I was able to concentrate on Cold Logic's scope of work, without having to constantly question requirements or educate the client about refrigeration."

CONSTANT CRAVINGS

In consultation with Reeder, Cold Logic determined that the loads of the new facility would be relatively constant, without any rapid changes in demand.

The Stage 1 project addressed this base load through the installation of one compressor operating at +2°C SST (saturated suction temperature) on ammonia, and a single low-temperature surge vessel.



The ELK unit that controls the tempered water supply to the conches.

"The system uses a condensing plate heat exchanger to reduce the ammonia charge onsite, and to use some of the waste heat for heating water to 27°C, with two gravity-fed plate heat exchanger evaporators used to create 12°C and 7°C water," says Fortuna.

The 540kW load has been met using a single, six-cylinder reciprocating compressor on a variable-speed drive. Fortuna says any changes in demand were considered to be gradual and did not need the rapid capacity variations often provided by a screw compressor.

Because the chocolate is transported in the process through jacket pipes, Cold Logic also determined it necessary to install a 610kW hot water boiler discharging water to 65–70°C. Three storage tanks at 7°C, 12°C and 65°C were used to buffer out any fluctuations and changes in demand.

"Continuity and even control were the guiding principles in the design of Stage 1, hence it was important to have dedicated storage and buffer tanks that would reduce any spikes in demand," says Fortuna.

As the water temperature supplied to the chocolate conches is one of the critical factors in the chocolate-making process, a dedicated storage tank and custom tempering loop was designed to deliver water at between 11°C and 12°C at all times.

Cold Logic designed a safety system to meet the current Australian Standards that govern the use of ammonia refrigeration systems, which have been in effect since October 2016.

As well as the use of ammonia leak detectors and pressure relief valves, pressure and temperature transducers form part of a customised control system that was developed between Cold Logic and Tristar Electrical.

According to Fortuna, the sensors are used to control the general operation of the refrigeration plant as well as act as "safeties" to avoid dangerous operating conditions.

"The system returns into safe mode status long before any mandated safety features, such as pressure relief valves, take effect," she says.

FROM BEAN TO BAR



The use of quality cocoa beans is the first secret to making quality chocolate, and Haigh's Chocolates is one of just a few chocolate makers in Australia to produce chocolate from raw cocoa beans instead of semi-processed beans.

Like wine grapes, cocoa beans have different flavour characteristics depending on the variety, area of origin and processing procedures.

Haigh's sources the very best cocoa beans from around the world. In 2014, it was the first Australian-owned chocolate manufacturer to achieve international UTZ certification for the use of ethically and sustainably farmed cocoa beans.

Stage 1 Roasting

Raw cocoa beans are received at Haigh's Mile End factory and roasted in 200kg batches at high temperature to enhance the colour and flavour, while removing moisture and bacteria.

Stage 2 Winnowing

After the beans are cooled to approximately 60°C, the outer husk of the bean is cracked and removed in a process known as winnowing that leaves small cocoa "nibs".

Stage 3 Milling

The cocoa "nibs" are then ground under heat and pressure to form a liquid cocoa mass, which is warm, dark and bitter. This liquid is pumped into one of six storage tanks that hold a variety of different cocoa liquors.

Stage 4 Mixing and refining

Depending on the recipe, batches of cocoa liquor are mixed with icing sugar and milk powder (if making milk chocolate) to create a chocolate paste. This is then fed through a two-roll refiner that reduces the particle size to 100 micron. A five-roll refiner is then used to reduce the mixture's particle size further, turning the paste into an extremely fine powder (18 micron).

Stage 5 Conching

The conching machine is a large, deep and heated mixing vessel in which the chocolate undergoes hours of aeration and mixing. The exact nature of this process is a closely held secret, as even small changes in temperature variation and profile can affect the taste, smell and palatability of the finished product.

Source: Haigh's Chocolates



A view of the main factory showing two five-roller refiners on the left and two conches in the background.

GOOD THING, SMALL PACKAGE

One of the major challenges of the project was the design and installation of the new refrigeration plant within a pre-designed plantroom, located in the heritage-listed building shell at Mile End.

Fortuna says this determined the layout of certain pieces of equipment, as well as clearances from walls.

“Due to the nature of the existing building envelope, there was also only limited space for the plant’s pipework, which had to accommodate both the process and services,” she says.

Additionally, as this was the first stage of a multi-stage project, access pathways had to remain available so more equipment could be installed later.

Maintenance access was also a major consideration in the plantroom layout.



Inside the plant room showing the low pressure surge accumulator and plate heat exchangers.

“While there is plenty of space now, once the final stage of the project is complete, the plantroom will be packed tightly,” Fortuna says. “So the stairs to the switchboard room have already been made removable to provide access to the compressors in the future.”



CHOCOLATE, RIGHT ON TIME

As on most projects, delivery timelines for critical path equipment placed pressure on both Cold Logic and the various equipment suppliers.

For example, a titanium condensing plate heat exchanger ordered through a local supplier had to be manufactured in the USA, adding weeks to the delivery timeline. Combined with quality assurance issues and scheduling changes at the factory, it meant the plate heat exchanger arrived just before the new plant was to be commissioned.

“Only a small group of contractors in Adelaide work on food manufacturing facilities, and everyone knows everyone,” says Riese. “Sometimes this really

makes it easier to work around each other, ask for help and make small changes to the schedule.”

The new refrigeration plant was commissioned in two stages.

Pre-commissioning was completed to ensure that the refrigeration plant worked as designed, and that signals were being sent and received correctly. Once the process side was started up and loads were applied to the plant, a second stage of commissioning was undertaken in liaison with the process machinery supplier.

For this reason, Fortuna says only a small amount of fine tuning was required prior to the new facility opening in late March 2018.

The Mile End facility is now the largest cocoa bean processing plant in Australia, and the most modern facility of its kind in the southern hemisphere.

According to Haigh’s, it will allow the company to almost triple its previous throughput, facilitating expansion into Australia’s eastern states.

As ambient temperatures change and throughput within the facility increases over time, Cold Logic personnel are expected to monitor the new plant and undertake fine tuning of the control parameters.

While they’re doing that, they’ll be able to savour the sweet smell of success. ■

PROJECT AT A GLANCE

THE EQUIPMENT

Boiler: Automatic Heating

Compressor package: Cold Logic

Compressors: Hasegawa

Condensers: BAC

Evaporators: Eka-Kool

Process machinery: Bühler Group

Pumps: Grundfos

Sensors: Danfoss/ECEfast/IFM

VSDs: Danfoss

THE PERSONNEL

Client: Haigh’s Chocolates

Controls: Cold Logic / Tristar Electrical

Mechanical services design: Cold Logic

Mechanical services contractor: Cold Logic