

An aerial photograph of a vast, green agricultural landscape. In the foreground, a large herd of black and brown cows is grazing in a field. A dirt road winds through the fields. In the middle ground, there are several white buildings, likely farm structures, and a small cluster of trees. In the background, a wide, light-colored river flows through the landscape under a clear sky.

# Massive DEVELOPMENT

More evidence of the extraordinary growth of dairying in Canterbury is rising from the landscape just west of Darfield. The 41-metre-high milk powder site, which is expected to be ready to start processing milk by August, is being built by dairy giant Fonterra as part of a two-phase project to deal with growing milk processing demands in the region.

*Productive pastoral farming is critical to New Zealand's economic prosperity.*

Stage two of the development has just begun and will involve constructing what will be the world's largest dryer capable, once it reaches peak production in 2013, of processing an additional 4.4 million litres of milk per day into 720 metric tonnes of powder for export – twice the first plant's processing capacity. Taken together they represent an investment of \$500 million, easily the largest in New Zealand's dairying history.

Why is Fonterra spending so much on a greenfields project at Darfield? Quite simply, with milk flows increasing by four to six per cent per year in the South Island, the new development will help future proof Fonterra's operations. Even as construction proceeds on the first dryer, it looks likely that it will reach capacity sooner than expected, which explains why work is already underway on stage two.

Currently, tankers have to transport milk from the region to the Clandeboye site near Timaru, or even further afield to the Edendale plant in Southland. Once the first stage of the Darfield site is up and running, those same tankers will travel no further than a 40-kilometre radius of the site to pick up milk. This will result in reducing the distance tankers are driven by 20,000 kilometres per day, with a further reduction of 10,000 kilometres once stage two of the project is complete.

It promises to be a state of the art facility. GEA Process Engineering, a firm headquartered in Denmark and with years of experience designing process solutions for the dairying, brewing, food, pharmaceutical and chemical industries around the globe, won the tender for the main process contract and spent 12 months on the design.

Clint Brown, Project Director for GEA, who had a team of 30 locally and internationally based staff working on the Darfield design, says the design process incorporated "revolutionary" advanced modelling techniques that should produce a highly efficient plant. For commercial reasons he can't elaborate in any detail, although he offers a few hints.

"The challenge with this project has been around the design side. We're using a lot more of design modelling technology

these days, and it was a question of getting that sorted first before tackling the mechanical side. It's really driven the efficiency of the plant, and changed some of the thinking in terms of the geometry to something far more streamlined.

"Overall it's very important that the concept is clear and that significant thought goes not only into the plant design, but also into the overall efficiency of the facility. Having the ability to expand is always a key design concept, as is an efficient and safe build methodology. Our building partner Ebert Construction worked very closely with us to crystallise what could and couldn't be done, so the design was really a team effort."

Exactly how much more efficient is the new plant likely to be? "I couldn't put a number on it," he says. "But the technology we're dealing with is far more advanced than even five years ago, and that's coming from research and development within GEA. It's world leading."

The development couldn't come at a better moment for Canterbury's post-quake recovery. In Darfield, 35 kilometres west of Christchurch and smack in the heart of the Malvern district's pastoral farming land, the greenfields project has already resulted in a boost for local businesses. During peak construction, around 450 contractors will be employed on-site. Once running, Fonterra expects the 12 hectare complex to provide around 160 jobs, and \$780 million of milk powder revenue per year.

Speaking to *The Press* about the Darfield development, Canterbury Employers' Chamber of Commerce Chief Executive Peter Townshend predicted that in time it will add a "couple of billion dollars a year in the economy", and said it demonstrated how far the dairy industry had evolved in the province. Canterbury, once almost exclusively sheep and cropping country, now accounts for 15 per cent of dairying's output and is second only to Waikato in terms of herd size.

Mr Brown says Fonterra has played a crucial role in the design, providing his team at GEA with invaluable experience taken from its other milk powder sites.

"In the past we've designed a plant, the customer has taken it over, and

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as suppliers of the technology we often don't hear about the results one year, two years, three years on. This time they've brought some analysis of performance to the table. I think it's been a real partnering relationship. They've helped our engineers with things such as providing access for maintenance, making sure that all valves are at exactly the right height, and so on. They've also brought in some important health and safety aspects, problems that they've had at other plants and that we've tried to resolve on this one."

Just as importantly, he adds, the company's operational experience has helped GEA to come up with a factory that should be very efficient in terms of operating costs.

"We've designed this plant with the thought of the total cost of ownership – in other words, not only capital cost but operational cost, too – and so we've done a whole lot of design work to streamline the plant in order to make it really workable for Fonterra in terms of operations, and to provide good access for maintenance.

"It comes down a whole lot of small things. For example, we've aligned floor levels across the facility so that access to each floor doesn't involve getting out of a lift and having to walk up some stairs, even though traditionally a plant doesn't actually sit on those floors. We've pushed the levels and the plant around to make it all work.

"In terms of the plant itself, we've spent a lot of time with our builder optimising the layout to make sure it's efficient, ensuring the process isn't compromised and that we hit all our targets around operability and maintainability. We've



Top: Even under construction the new 41-metre-high drier building towers over the stainless steel milk silos. Middle: A three dimensional render provides an aerial view of what the Darfield site will look like once stages one and two of the project are complete. Bottom: The drier cones in the foreground were developed during stage one of the project. All images courtesy of Fonterra.

been very precise in order to get all the equipment in the building closer together, for example. There are none of the gaps that might require operators to use a platform or a gantry. Traditionally with plants you've had to use those elements to get access to some areas, but we've changed levels and realigned hatches and points of access to ensure the operators won't need to climb over things to get in. It's taken a lot of drawing technology to get to that level of accuracy."

For Fonterra, the plant at Darfield represents its first greenfields development in 14 years. Design manager Steve Keelty describes it as a relatively complex project. "It's a greenfields site, so everything has to be designed and built, including all the services, civil works, administration function, and on top of all that the main process contract for the milk powder plant itself is relatively large-scale."

In his role as the design manager, Mr Keelty has acted as the linkman between Fonterra and GEA, and managed the design and quality reviews. He, too, characterises the relationship as a productive partnership.

"GEA have developed successful projects for us in the past and they have a very strong technology base for designing milk powder dryers. So there was a lot of trust there. And of course we've been operating these plants now for many years so we have an in-depth knowledge about their maintenance, operation and service requirements.

"My role, which is a new one and has involved a real learning curve, has been to share some of that knowledge with GEA to make sure that our experience is captured in the design. We've been able to bring them technical knowledge in terms of the milk powder products we intend to make there, so the design could be optimised to produce them most efficiently. We've also been able to give GEA direction on a selection of good reliable equipment. Finally, when it comes to whole design of the plant, the mechanical installation and layout of equipment, we've helped GEA arrive at the best design so we have a plant that is fully maintainable, accessible and operational."

How innovative is the design for Darfield? Mr Keelty notes that taken as a whole, Fonterra has opted for low-risk, proven solutions. "These plants operate continuously, '24/7', for an extended period of time so from an engineering design point of view, we've needed to ensure the proposed design is going to meet those operational requirements. There's been a big focus on reliable equipment, and we've also done extensive equipment failure mode analysis to ensure we have appropriate redundancy in the right areas. The result should be a plant that is reliable, without breakdowns and unplanned stoppages."

"But obviously we don't want to stifle any engineering advances," he adds, pointing out that GEA hasn't built a large plant for Fonterra since 2003. "Since that time they've been building other plants around the world, developing new technology and making improvements in efficiency and operability. The great thing on this project is that we've been able to install some of those important

developments that GEA have made over those intervening nine years.

"What we've done, though, is to apply a risk-based change control process to those. Basically any suggested new technologies for Darfield have been subjected to that process to determine if we will proceed. It's been a great way to capture good ideas, and then apply some rigour to evaluate the risk and benefits before making any decisions."

There's only so much scope for a radically new approach when it comes to a milk drying plant, it should be noted. The proven formula involves five elements, starting with milk reception then evaporation, followed by drying, packing and palletising. The first two at Darfield – pumping raw milk into silos, followed by separation and standardising, then evaporation – won't look awfully different from any other plant.

"The dryer, however, is one big area where GEA have offered us innovation," Mr Keelty says. "There have been some significant developments there in terms of how the operators interface with the

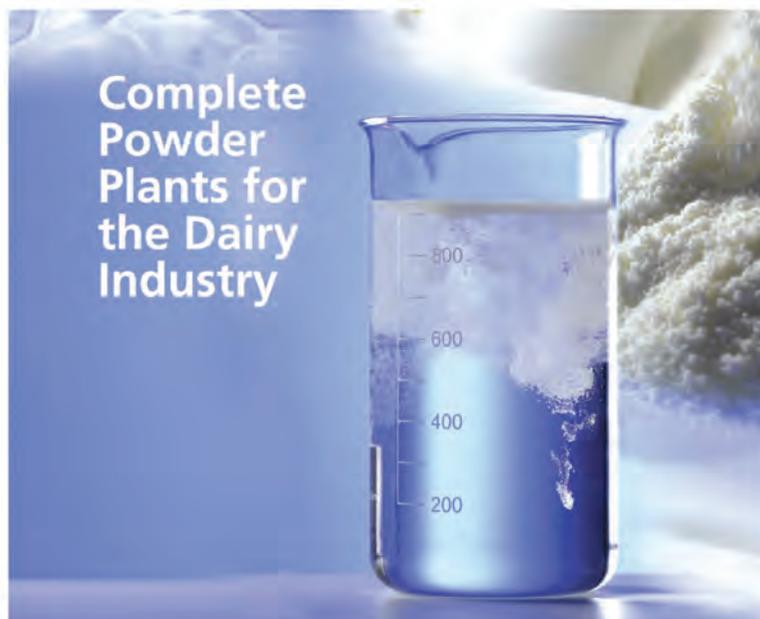
plant – in particular at the top of the dryer where the operators are dealing with setup of high pressure equipment. The design solution offered by GEA provides significant improvements in health and safety, and allowed for efficient turnaround of the process equipment.

"Another is in terms of the layout, where we've been able to minimise the total building footprint as a result of some improvements in the components that go into the plant. The second dryer at Darfield will only be around eight metres higher than the first, but will have twice the processing capacity."

From GEA's perspective, Mr Brown agrees that the core components themselves aren't necessarily revolutionary to his firm, and the real breakthrough at Darfield lies with the new plant's layout, operability and maintainability. His team spent a lot of time with Ebert Construction ensuring those elements were just so – and it also employed some cutting edge software to achieve optimal design.

# GEA

## engineering for a better world



Few industries are as demanding as the dairy industry when it comes to powder processing. That's why we've learned how to blend experiences with innovation to offer complete solutions that deliver to the strictest standards. A GEA Niro plant provides everything you need, from reception, storage and evaporation to spray drying, powder handling and packaging – with the efficiency and reliability you can expect from a single supplier. For a partner that knows powder, talk to GEA Niro.

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Former CEO Andrew Ferrier and Selwyn District Mayor, Kevin Coe tour the Darfield site in May 2011. Image courtesy of Fonterra.

“When it comes to using technology to design our plants we’re at the sharp end. We use top-end computers for our advanced modelling, and for design and integration we use leading edge technology again. We use multiple design software packages, including Inventor, a package that models components in three dimensions. Over the last five years we have seen plant design software come a long way, being tweaked to become something really useful – living in a virtual world, being able to see it all in three dimensions, that’s a massive advantage in design today.”

Fonterra, too, has made use of GEA’s modelling software. By setting up 3D personal computers within its Operations and Reliability team offices, the customer has had full access to images of plant layout before anything was constructed. Mr Keelty comments that “the GEA engineers have been very open to working with us to achieve the best design, and ultimately that has minimised any rework onsite during mechanical installation”.

He points out that with the second stage of the project following so closely

on the heels of the first, it was never likely there’d be any significant additional innovation. “It’s much more about refinement of the use of the technology.”

Expectations for performance are high. As of August, the first dryer should be producing milk powder around the clock seven days a week, with a target of 85,000 tonnes of whole milk powder a year bound for markets in Asia, the Middle East and Africa. When the second stage of the project comes on line it will provide almost twice that processing capacity, shading the “ED4” plant at Edendale, currently not just Fonterra’s largest, but the largest in the world.

Mr Keelty says Darfield will also be ahead of the curve when it comes to automation as well. “It’s an area that has seen significant advances in technology over recent years and the outcome for the plant control system is a high level of automation. That means our operating team can focus on producing high quality product, and not get side-tracked by a multitude of manual tasks.”

The biggest efficiency gains, in stage two, however, will arise from the fact

that the plant is going to be so much closer to its catchment area. Fonterra plans to build a rail siding for stage two, so product can be transported directly to the port at Lyttelton, leading to a further transport reduction of around 8,000 kilometres per day. “We’ve got a very efficient supply chain there. The hope is that it will result in milk powder being produced that is far more efficient from an energy use and transportation perspective.”

Mr Brown adds that staff, too, should notice an appreciable difference working in the new facility. “They should find it a lot easier to get around and far easier to maintain and operate. And it’s been a real team effort. What really stands out for me about this project is working with Fonterra to use that operational knowledge that they have acquired over many years in the design process. It’s all about working with your customer to get the best possible solution. I wouldn’t say we have all the details sorted, because there’s always room for improvement, but I think we’ve got a pretty damn good plant.”

✉ WRITER Matt Philp