MEAT PROCESSOR FUELS ITS FUTURE ON SLUDGE

Proving 'there's money in muck', Silver Fern Farms and Energy For Industry are successfully turning sludge from waste water into a renewable biofuel.

"It's helping us meet our environmental obligations with a smile" – Marthinus Hendriks, Silver Fern Farms' Engineering Manager

About this energy efficiency project

Key features

- NZ's first bubbling fluidised bed boiler on this small scale
- Uses sludge extracted from waste water as a renewable biofuel
- 8.5MW generates a third of the site's steam
- Developed by Energy For Industry under a 15 year build, own, operate arrangement for Silver Fern Farms

Key benefits

- Saves $3.5m capital cost for extra composting plant
- Economic solution to higher water discharge standards
- Replaces a 46-year old coal fired boiler
- Avoids 9,500 tonnes of CO_2
- Reduces particulates and sulphur dioxide emissions

Other applications

Food processing eg. poultry

Wool scouring.

This innovative project developed and owned by Energy For Industry lets Silver Fern Farms enjoy valuable extra environmental benefits while still meeting its normal business case criteria.

A new bubbling fluidised bed boiler has resolved a serious Resource Management Act compliance problem and saved significant capital expenditure. The new process has also allowed Silver Fern Farms to reduce its dependence on coal, avoid 9,500 tonnes of CO_2 emissions annually and enjoy significant improvements in air discharges.

"It's helping us meet our environmental obligations with a smile," says Marthinus Hendriks, Silver Fern Farms' Engineering Manager.

While this is New Zealand's first sludge-fuelled bubbling fluidised bed boiler, the technology is well proven internationally. Neither is there anything unique about the situation. It's an option that can easily be replicated by other NZ meat processors along with many other businesses whose operations create large quantities of problematic sludges or bio-solids.

The background

Silver Fern Farms is one of New Zealand's big five meat processors, with 21 plants around the country. The Finegand site, near Balclutha, is its largest facility processing around 60,000 cattle a year and 1.4 million sheep and lambs. At the peak of the season, the Finegand site employs around 1,000 workers.

Maintaining hygiene in meat processing creates considerable quantities of waste water. This has to be stripped of blood, protein, fats and other impurities before it can be disposed of. This in turn produces a sludge which is usually turned into compost for agriculture.

"It was a matter of thinking about sludge in a different way." – Rebecca Osborne, Energy For Industry Project Manager

The industry as a whole is facing increasing pressure to raise standards and reduce environmental impacts. The Finegand site was feeling that pressure in the form of stricter standards on treated effluent discharges into the Clutha River being imposed by its local authority, the Otago Regional Council.

These higher standards would result in two thirds more sludge for disposal, creating a 10,000 tonne a year headache for Silver Fern Farms.

The challenge

The capital cost involved with composting so much sludge were daunting, around $3.5 million and it was doubtful there was sufficient demand for the end product locally.

"There is chronic oversupply in the market and we were already having trouble disposing of compost," recalls Marthinus Hendriks. "It's also a visually unattractive business and very smelly, even for a rural area."

This looming issue came up in an unrelated meeting with Energy For Industry.

Energy For Industry is a business unit of Meridian Energy that specialises in developing and supplying sophisticated on-site energy solutions for New Zealand industry.

Energy For Industry undertook to evaluate options that might help the company.

The innovation

Energy For Industry came back and recommended that with steam coagulating and centrifuging, Silver Fern Farms could turn its sludge into a biofuel that could easily be burned by a bubbling fluidised bed boiler.

A bubbling fluidised bed combustion system replaces the simple fireplace-style grate of traditional boilers with an air-suspended bed of particles – for Silver Fern Farms this means Clutha River sand. Hot air is forced up through the bed which at high enough velocities exhibits fluid-like properties, hence the term 'fluidised'.

Bubbling fluidised bed combustion is already well proven overseas for its ability to handle relatively poor fuels including those with high moisture and ash contents.

In New Zealand, at least one bubbling fluidised bed boiler has been operating since 2004, a 35MW unit at Pan Pac Forest Products in Hawkes Bay, fuelled with hogged wood. However the technology on this smaller scale and using sludge as fuel was a new concept for New Zealand.

"It was a matter of thinking about sludge in a different way," says Energy For Industry Project Manager Rebecca Osborne. "Sludge from Silver Fern Farms waste water treatment plant has around 8% solids content. Driving out the moisture with steam and a centrifuge increases that to around 45%. That's when using sludge as a fuel becomes viable, particularly with bubbling fluidised bed technology."

The solution

Energy For Industry's solution, which was commissioned in June 2008, involved replacing a 46-year old coal-fired boiler. Their new 8.5MW purpose-built bubbling fluidised bed unit uses Babcock and Wilcox technology supplied under licence through RCR Energy Systems. Delivering 12 tonnes of steam per hour at 15.5 bar (g), it supplies a third of Finegand's steam requirements.

The first screening of sludge from the waste water treatment plant is still composted since it can contain oversize contamination that would be very difficult for the boiler feed systems to handle.

But it leaves some 7,000 tonnes of sludge to be burned, reducing the composting to manageable levels.

"Only having to compost 3-4,000 cubic metres is a big relief," says Marthinus Hendriks.

Sludge is coagulated using saturated steam injection and decanting to produce de-watered sludge at about 45-50% solids content.

Steam coagulation and centrifuging is familiar to the meat industry, although its application for de-watering waste water sludge is new. It was chosen over other options such as belt presses on the basis of pilot work to prove the waste water treatment process at Silver Fern Farms' Belfast plant.

Finegand's de-watered sludge is blended with wood residue from local sawmills. The residue is necessary to increase the total solids volume and allow the installation of an economically-sized boiler.

Around 9,000 tonnes of wood is used per year – about the same volume that would have been used in the composting, where it supplies the carbon necessary for the chemical process. However, while composting ideally requires sawdust, the boiler can handle a wider variety of wood residues, reducing supply risk.

Making the finances work

Silver Fern Farms invested $14 million in a new waste water treatment plant with extra de-watering capabilities.

But it saved the $3.5 million capital for the plant and other costs that would have been required to handle the extra composting.

Silver Fern Farms also enjoys steam supply from Energy For Industry's brand new, $6.8 million boiler at no capital cost, in a commercially innovative 15 year build, own, operate partnership.

> "Only having to compost 3-4,000 cubic metres is a big relief" – Marthinus Hendriks, Silver Fern Farms' Engineering Manager

The Energy Efficiency and Conservation Authority (EECA) supported this project by providing a capital grant towards some of the costs.

"The combination of innovation and technology allows businesses to manage their energy use and emissions – and improve their bottom line." comments Mike Underhill, EECA Chief Executive. "The adoption of suitable technologies can drive change. EECA works actively with industry to support new technology and encourage the widest possible uptake."

Under the arrangement, the upfront costs of developing, building and commissioning were met by Energy For Industry, who retain responsibility for overall plant management and maintenance. The investment is recouped in stages over the 15 year term through an operating charge.

This build, own, operate arrangement was crucial. It enabled the project to achieve the life-cycle cost outcomes Silver Fern Farms required for all projects and meant a beneficial but still discretionary project could proceed when it would otherwise not.

Positive outcomes

The bottom line for Silver Fern Farms is that the project has achieved its financial criteria: it has matched the alternative cost scenario involving the extra composting and upgrade of the coal-fired boiler plant to meet air discharge consent requirements.

This finance-neutral result has been accompanied with valuable environmental benefits – outcomes that may well turn out to have valuable economic impacts.

The bubbling fluidised bed-fired boiler replaces a 46-year old coal fired boiler, reducing coal consumption by about 5,100 tonnes a year – about 170 truck-and-trailer loads a year. This has avoided 9,500 tonnes of CO_2 emissions alone, something which could have financial value in future if an emissions trading scheme or carbon tax is introduced.

Other air discharges at the site have also improved significantly the result of two factors. The coal displaced was, known for a relatively high sulphur content. And the plant itself includes a flue gas baghouse which filters particulates out of the exhaust gases.

Overall, fine particle (PM10) emissions have reduced by 22 tonnes pa and sulphur dioxide emissions by 110 tonnes pa.

The bubbling fluidised bed project has saved the company the consent issues arising from the visual and odour impacts of a large composting plant. It has also avoided the logistics associated with processing and marketing large volumes of compost.

"The approach was the technically more challenging option, but also a more environmentally and financially friendly option in the long term," says Marthinus Hendriks.

Conclusion

Silver Fern Farms, Energy For Industry and their other partners have proven the meat industry can use bubbling fluidised bed technology to turn a waste product with air quality and other adverse impacts into a valuable renewable energy resource.

"It's definitely reproducible," comments Rebecca Osborne. "Any business that creates sludge or waste could potentially benefit. Obvious candidates are other meat processors, the poultry business and wool scouring – but there are many more."

Photography supplied by Energy For Industry.

EECA enables organisations to increase their domestic and international competitiveness by adopting energy efficiency and renewable energy practices.

We work with businesses to identify the opportunities for energy management that are available to them and help them develop energy management action plans to make the most of these opportunities.

Good energy management has many benefits for businesses, including lower costs, increased productivity, reduced greenhouse gas emissions and a positive effect on the brand.

We have a particular interest in:

- encouraging new or under-used technology that can make processes more efficient
- projects that reduce greenhouse gas emissions, and
- developing the wood fuel industry.

For more information, contact us directly – see details below.

Energy Efficiency and Conservation Authority contact details:

EECA HEAD OFFICE: PO Box 388, Wellington, (04) 470 2200
EECA AUCKLAND: PO Box 37444, Parnell, Auckland, (09) 377 5328
EECA CHRISTCHURCH: PO Box 8562, Christchurch, (03) 353 9280