CASE STUDY

Where there's heat there's a saving

Whenever heat escapes it is a potential cost saving going begging. For the Clive Scouring Company in Napier, capturing heat formerly released to atmosphere has turned out to be worth more than $100,000 a year. Clive Scouring took advantage of an Energy Efficiency and Conservation Authority (EECA) grant to reduce the risk of a technology little used in its industry. This resource details the positive impacts it is having on a business operating in a highly competitive environment.

Scouring is an important first step in taking wool from the sheep's back to finished product. It is a water-based process that removes grease, dirt and other contamination before carding and spinning. These stages produce yarn that is used in New Zealand and around the world for carpets, textiles and apparel.

The scouring process involves immersing the wool in hot water with detergent. Rakes mechanically transport it through large bowls which each has a squeeze press at the end. A typical scour line has at least six large stainless steel bowls, half of them heated for washing, the remainder dedicated to rinsing the wool.

Effective scouring requires relatively high volumes of water that must be maintained at 70–80°C. At Clive Scouring it is heated using steam produced by gas-fired boilers. There are other uses for the steam in the plant, but keeping the scouring water heated is the biggest drain.

The energy required to raise water in the quantities required from the typical 16°C at its artesian bore source to 80°C or so was a major input cost for the business.

At the same time, flue gas from the boilers was being released to atmosphere at approximately 250°C, and water from cooling the hydraulic presses was going to waste at 22°C. Capturing energy from these two sources and using it to preheat the incoming water has proved to be a highly effective solution.

Intense competition driving efficiency

Scouring is an intensely competitive business. So much so that of the 13 scours operating a decade ago, hectic rationalisation has reduced the number by more than half. While New Zealand's overall wool clip has declined, scour capacity has declined even more, leaving the remaining firms busier than ever.

Survival in this changing environment has meant linking up with a major carpet mill or exporter. It has also involved heavy investment in plant and machinery to maximise energy efficiency and reduce costs.

Today, there are six wool scours in New Zealand, owned by three companies with a scour apiece in both the North and South Islands.

The three North Island scours are all located in Napier/Hastings, where the island's wool industry is largely centralised.

Napier-based Clive Scouring Company is a division of Clifton Wool Scour Ltd, itself a subsidiary of Godfrey Hirst, Australasia's largest carpet manufacturer.

Clive Scouring employs 70 to 80 staff at peak periods, when it operates 24/7, reducing to around 60 over a five- or six-day week in quieter times.

Clive Scouring and the other two Hawke's Bay scours are all of similar capacity. As a result, the three businesses are intense rivals, always looking for an edge.

Control panel

Boiler 2

Kevin and colleague beside the large bowls containing wool during the scouring process

Seeking new opportunities

Like the other scours, Clive Scouring had been constantly reviewing its plants' processes to drive the continued efficiency gains the company needed to stay competitive.

"We'd tried pretty much all the obvious opportunities," recalls General Manager Kevin Pike. "The only options were to look outside the square and try things that hadn't been done in our industry previously."

In this environment, a suggestion by its boiler servicing contractor, Eastern Boiler Services, that the business should explore EECA grants and harnessing waste heat at the Clive Scouring unit fell on responsive ears.

"Of course we knew about exchangers," says Kevin Pike. "The difficulty was installing a set-up on our particular application. There was no guarantee it would work. However, when it became clear there was some funding available to offset some of the risk, it all came together."

Coming out of the ground at 16°C, Clive Scouring's artesian water needs up to 64°C of heat added before it can be used for the scouring process. Until recently the temperature gain has been provided solely by steam raised in the gas-fired boilers.

Now, Clive Scouring has reduced its gas requirements by recycling energy and using waste heat from two other sources.

The biggest saving came from installing a heat exchanger to capture heat from the flue gas of one of the plant's boilers.

Extends smaller boiler's season

Clive Scouring Company operates two gas-fired boilers, with only one in use at any given time. Boiler 1 is a 5MW installation. Boiler 2, the unit to which the heat recovery was applied, is smaller, with a 3.6MW output.

As a general rule, the plant tried to use the more economical Boiler 2 as much as possible. However, Boiler 1 had to be brought online during periods of peak demand, when Boiler 2 simply couldn't provide the steam required, or in winter when low ambient temperatures left it struggling to achieve the required output.

With the incoming water for scouring preheated, Boiler 2 can now meet the plant's steam demand year round. Not having to use Boiler 1 is expected to have a big impact on annual energy costs.

The system: capturing coolant water

The hydraulic presses at the plant use water from the bore as cooling fluid. Water that has been warmed through the hydraulics of the wool presses is transferred to a new 'make-up' tank.

Instead of being discarded, this diverted water provides a small, but easily won, 6°C gain.

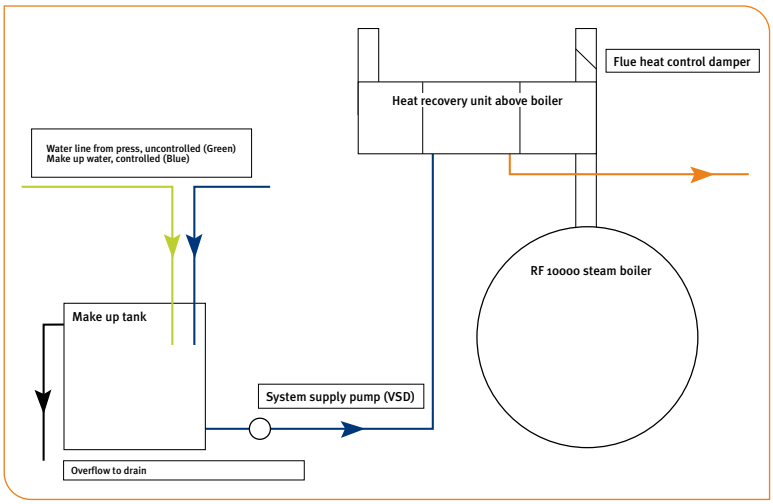
The system: exchanging heat from the flue gases

Energy from the flue gas is captured in a purpose-built hot water exchanger, designed by Advance Fintube X-Changers of Hamilton. The flue gas is diverted through the heat exchanger as water from the make-up tank is pumped through. The exchanger has been designed for a flue gas temperature of 300°C with a volumetric rate of 9,372kg/hr, providing a design capacity of 562kW. It is manufactured mainly of 316 grade stainless steel to minimise corrosion. In one measured week, it handled a flow of 1,064,620kg.

Installing the heat exchanger to capture the gas flue heat provided the biggest saving – previously the heat had been escaping at 250°C. Whereas the new system captures enough energy from this to preheat incoming water a further 33°C.

The combined effect of the two changes meant that the water now arrives for final heating much warmer – under test conditions, at 55°C. This reduces the gap to the optimal temperature for operation to 25°C, rather than the original 64°C.

The purpose-built hot water exchanger



Schematic of the Heat Recovery System

The system: pump-driven

The heat exchanger could potentially warm the water to higher temperatures, but that would take longer and the system needs to deliver water in sufficient quantities. This trade-off is managed by fitting a variable speed drive (VSD) to the pump. During the analysis it was programmed to achieve a 55°C set point.

One-year payback

Under the conditions of its EECA grant, the efficiency of the project was professionally assessed by an independent company, Power Solutions Ltd.

Constantly changing rates of production and ambient temperatures made it difficult to extract 'like-for-like' before and after comparisons. Instead, Power Solutions estimated the result based on a theoretical reduction in input energy.

It estimated that with less heat to make up, the total project – water capture and heat exchanger – reduced load on the boiler by 314kW. This would save Clive Scouring 190GJ of gas a week, delivering an estimated saving of at least $100,000 annually.

The simple payback calculation shows the capital cost will be recovered in one year. From year two, all the savings will go directly to the bottom line.

Actual savings were masked in the test period by Clive Scouring's need to maintain high-flame operation on Boiler 2 to maintain pressure at desired levels. However, the assessors predict being able to minimise usage of the large Boiler 1 will mean that annually there will be an overall reduction in gas consumption.

Reduced emissions

Extrapolating the weekly reduction in boiler input energy and the reduced gas use, the assessors estimate the project has reduced the company's annual CO_2 emissions by 516 tonnes.

Extra benefits: improved pressure

As well as providing the potential for worthwhile gas savings annually, Clive Scouring's heat recovery project has delivered other production benefits.

Boiler 2 often struggled to maintain its optimum pressure of 9bar (130psi) and operated on high fire for most of the time.

Pressure achieved was sometimes as low as 5.5bar (80psi) which caused several heating-related problems downstream in the process from time to time.

The new heat recovery system solved the overloading and Boiler 2 can now maintain its 9bar set point comfortably.

The increased steam pressure and temperature has reportedly had positive effects on the operation of the large steam-heated vessels in the scour. They're now meeting temperature set points and this should improve various aspects of production.

The increased pressure is also bringing benefits in other areas of the plant where the steam is used.

Overall, the assessors describe the exercise as "a very successful investment", with theoretical savings that are more than had been predicted in the business case.

Clive Scouring Company is certainly happy: "The project has surpassed expectations with regard to reduced gas consumption," says Kevin Pike. "We also believe there are some further benefits yet to be proven regards the quantum – including reduced CO_2 emissions from using less gas and reduced stack temperature and reduced carbon in the exhaust because more of it is trapped in the condensed flue vapour."

Savings

TYPE	SAVINGS
Reduced boiler load	314 kW (theoretical)
Gas consumption	190 GJ/week
Dollar	$100,000+ pa
CO_2 emissions	516 tonnes pa

EECA grants

EECA is keen to support energy efficient technologies that are available commercially but not yet commonplace in New Zealand.

Grants for demonstration projects are available to businesses in a range of energy intensive sectors. Grants can be for up to 40% of the capital cost of the project, to a maximum of $100,000 for each grant.

Grants are available to businesses operating heavy transport fleets, wood processing, basic metals, glasshouse crops, irrigated dairying, irrigated arable crops, food and beverage processing, fishing fleet operations and non-metallic products sectors.

Other businesses in which energy accounts for more than 5% of total business costs may also qualify.

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CONTACT EECA

For more information on EECA's technology grants and services, call 0800 358 676 or visit www.eecabusiness.govt.nz/eib