The Blundstone boot: saved from obscurity by clean technology tanning.

Making more of Australia's leather

Fiona Conroy

Fifteen years ago, the future of a small Hobart tannery looked grim. But thanks to technologies developed at CSIRO's Leather Research Centre, the boot's now on the other foot.

Australia's iconoclastic Blundstone boot, for decades indispensable in outback pubs and dusty stockyards, these days has a firm grip on the mass market as an essential fashion item for urban teenagers.

The surge in popularity of the elastic-sided work boot has been a boon for the Cuthbertson family, which owns the Blundstone factory and produces half the leather for the boots from its Hobart tannery.

Family member Doug Dickenson says the tannery was built in 1848 and is one of the few tanneries to take raw cattle hides through to finished leather. Fifteen years ago, however, the future of the small tannery was uncertain.

'The tannery was built when the environmental standards were not as demanding as they are today,' Dickenson says. 'The machinery was old and we had to decide whether to invest in improvements to cut tannery effluent and increase productivity, or shut the plant.

'We started working with scientists from CSIRO's Leather Research Centre in 1974 and developed ways of incorporating new technology into the tannery. They did a first-class job: without their help we would have closed down.'

The Cuthbertson Brothers' tannery introduced a recycling drum which made it possible to reuse tannery chemicals, and installed a CSIRO system, known as Sirolime, which cuts down the tannery effluent and allowed the company to extract the cattle hair and use it as a farm fertiliser.

The transformation at the Hobart tannery represents an overall move by the Australian tanning industry, supported by the Leather Research Centre, to cut pollution and increase efficiency. A cleaner, more efficient Australian tanning industry producing quality hides and skins has the potential to add millions of dollars in Australian exports by value-adding to hides and skins, says the centre's deputy leader, Catherine Money.

At present, only 20% of Australia's 30 million wool skins and 50% of cattle hides are processed in Australia. The rest are exported. Of the seven million cattle hides produced each year in Australia, only one million are processed through to finished leather. About half are exported after salting while. The rest are exported in a partially processed stage known in the trade as 'wet-blue'.

'There is enormous interest in increasing the amount of skin and hide processing in Australia but the capital and running costs of effluent disposal plants, combined with strict regulations, are deterring expansion in the tannery industry,' Money says.

Clean technology tanning

New technology at various stages in tanning has been embraced in the centre's project called Clean Technology Tanning.

Money says the project, partly funded by the Meat Research Corporation, will build on earlier developments and aims to further reduce water consumption, cut effluent, and allow faster, cheaper tanning. She believes the project has the potential to cut tannery waste by at least 50%.

'The tanning industry is an important industry for Australia because it is all about value-adding,' Money says. 'Hides and skins processed here are worth a lot more to Australia than tonnes of unprocessed hides and skins being exported for processing overseas.'

Support for a growing trade

Australia's hides, skins and leather industry has expanded substantially in recent years, due largely to an increased focus on export markets. In 1992, the industry achieved combined export earnings of $800 million. In the past year, exports of bovine leather have doubled and exports of sheepskin leather have increased substantially.

Helping the industry to maintain its international competitiveness is a key responsibility of CSIRO's Leather Research Centre in Melbourne. The centre has a range of advanced analytical techniques, spectroscopy, microscopy and sophisticated pilot-plant facilities for conducting tannery trials and testing new processing methods. Its 25 scientists and technicians have expertise in all aspects of tanning and leather-making.

Major research at the centre involves lessening the environmental impact of hide processing; improving the processing and properties of tanned wool skins; developing new processes for making sheep skin leather with improved properties for high-quality end uses (such as clothing and bag leather) and reducing salt in tannery effluent. The centre also assists industry with day-to-day problems associated with leather processing and technology.

The work of the Leather Research Centre is supported by funds from tanners, the Meat Research Corporation and the Department of Industry, Technology and Regional Development.

Contact: Gayle Crosbie or Dr Peter Gordon, CSIRO Division of Wool Technology Leather Research Centre, Private Bag 10, Rosebank MDC, Clayton, Victoria 3169, (03) 542 2364, fax (03) 542 2363.

The tanning process

The aim of tanning is to stabilise a protein, known as collagen, in the skin to stop the skin from degrading. The processes involved vary depending on the type of leather produced. These include 'wet-blue' from cattle hides, dewoolled or fellmongered pickled pelts from sheep skins, wool skins, finished leather and sole leather.

Chromium III is the most widely used tanning agent, but other products used in tanning include vegetable extracts for the production of sole leather, fish oil for chamois and syntans (synthetic tanning agents). Syntans are used in tanning to give leather specific properties.

The different processes mean the effluent from tanneries can vary, but all still contain basic material which is removed from the hide or skin, including dirt, grease and proteins such as blood and hair.

This biological component makes tannery effluent high in total dissolved solids (TDS), suspended solids (SS) and biological oxygen demand (BOD). Tannery effluent can also contain salt, chrome, nitrogen, ammonia and sulfur compounds.

Tanning also uses large volumes of water: conventional wool skin processing can use 400 litres a skin and wet blue production in the past involved 30 litres for every kilogram of cattle hide. Improved tanning techniques have cut the water use of tanneries and wet-blue processing now uses 10 litres of water per kilogram of hide.

Producing conventional wet-blue cattle hides involves four distinct operations which are carried out in giant rotating drums. These four stages take hides through a series of processes involving enormous changes in pH or acidity.

The first step involves liming using a solution of sulfides and lime at a pH of 12-12.5 for about 12 hours to dissolve the hair.

The next two stages after liming involve dropping the pH of the hides to less than three to prepare them for chrome tanning. The hides are washed in water which removes some of the alkali, then are delimed to drop the pH to nine. In traditional leather processing this is done by adding large amounts of ammonium salts.

After deliming, the hides are given an enzyme treatment known as bating and are then pickled using large quantities of salt plus formic acid and sulfuric acid. They are then treated with a chrome salt to produce wet-blue leather. 'Wet blue' can be stored for months before the final stages of being processed into finished leather.

Research at the centre has centred on short term preservation, liming, deliming, pickling and chrome tanning stages as areas where tannery effluent can be dramatically reduced.

Short-term preservation

The conventional method for preserving hides and skins after slaughter involves salting or brining. Each year tonnes of salt are used to preserve hides and skins. The salt is then washed out before processing. The salt ends up in tannery effluent and is a particular problem for tanneries in inland Australia where dissolved salts are causing serious land and water degradation.

CSIRO has pioneered alternative methods for the short-term preservation of skins and hides using chilling or chemicals. Hides and skins can be stored for up to three weeks at 0°C, while a range of chemical preservation techniques make it possible to store hides for up to six days at 25°C.

Sirolime dehairing

Conventional processing uses sulfides and lime to dissolve the hair from cattle hides. It has high biological oxygen demand and high levels of nitrogen, ammonia, sulfide and suspended solids.

CSIRO's Sirolime cuts the effluent problem by removing the intact hair rather than dissolving it. The hair can be kept and the processing liquid can be recycled to cut the tannery effluent and reduce costs.

Cattle hair has been used as a fertiliser overseas and by the Cuthbertson Brothers' tannery in Hobart. CSIRO is working with an Australian company to develop a pelleted slow-release, highly organic nitrogen fertiliser for the nursery and horticultural industries.

CO2 deliming

Once the hair is removed, the hides are delimed by dropping pH from 12-12.5 down to pH 9 by adding large amounts of ammonium salts, which lead to ammonia in tannery effluent. An ammonia-free deliming process using carbon dioxide (CO_2) has become popular with European tanners who process hides split to half normal thickness.

The Leather Research Centre has developed a rapid CO_2 deliming process to suit full thickness Australian hides and in collaboration with CIG Ltd, has produced a range of different CO_2 deliming technologies to suit different tanneries and environmental restrictions.

In Australia, CO_2 deliming is cheaper than using ammonia, cuts chemical costs, produces less effluent, is safe, easy to use and produces better

quality leather with fewer wrinkles.

Victorian Hides and Skins Producers at Laverton have been operating the ammonia free CO_2 deliming system for more than a year.

The company faced strict guidelines on the amount of ammonia permitted in effluent and had to limit production. By adopting an ammonia-free, CO_2 deliming process, the company has been able to increase production, simplify effluent management and reduce labour and capital costs.

CO_2 deliming has also been adopted by wet-blue processors in New South Wales, South Australia and Queensland. Kangaroo-skin processors and fellmongers are also using CO_2 deliming.

Low salt pickling

After deliming and bating, hides and skins are pickled, before tanning. Conventional pickling involves adding salt, formic acid and sulfuric acid to lower the pH. Large quantities of salt are used to increase the ionic concentration of the pickling solution and prevent the hides from swelling.

Salt pickling uses 6% sodium chloride (if liquors are not recycled) on a hide-weight basis. This adds up to 4500 tonnes of salt for the 75 000 tonnes of cattle hides processed in Australia each year. Sheep skins need larger quantities and much of the salt used in pickling ends up in tannery effluent.

Leather Research Centre scientist Dr Peter Pojer and his assistant Chi Huynh are developing an alternative pickling processes which uses sulfuric acid and a synthetic alternative to salt. Preliminary trial results look promising and it appears the synthetic compound will be inexpensive.

Tanning uses large volumes of water. Improved techniques have cut water use in 'wet-blue' processing by 30%.

Reducing chrome effluent

Pickling is the final processes before tanning and chromium III is the most widely used tanning agent. Chrome is cheap, simple to use and produces superior tanned leather which is very stable. There are unnecessarily stringent restrictions on chrome levels permitted in tannery effluent, according to Money.

One of the earliest technologies developed at the Leather Research Centre was the direct recycling of chrome tanning liquors. The process has been adopted by many Australian tanneries, including Cuthbertson Brothers in Hobart, which is reducing its costs while cutting effluent levels of chrome and salt.

Pojer and Huynh have tested alternative tanning treatments to replace chrome and have successfully developed a process involving aluminium and a synthetic vegetable tanning auxiliary, or syntan, capable of stabilising the aluminium in tanning.

Polishing the wool process

Two new wool-processing techniques that will reduce effluent pollutants will be marketed by CSIRO, ICI Australia and the Australian Wool Research and Promotion organisation.

The process, Sirolan-LTD, is a low-temperature dyeing process headed for Asian countries that buy substantial volumes of Australian wool. By using a special chemical to treat wool before actual dyeing, Sirolan allows dyeing at a lower than normal boiling temperature. This reduces both the amount of required energy and the quantity of unused dyestuffs discharged from a factory. It also reduces fibre damage, yielding softer and longer-wearing garments.

Sirolan-LTD has recently been launched in Australia and New Zealand and the joint venture partners are now aiming their initial exports to Japan and Korea. The new process was invented and developed by Dr John Rippon and Frank Harrigan at the Division of Wool Technology.

The second project, Sirolan-CF, is a waste treatment process that uses a chemical flocculant to remove up to 95% of the wool wax and up to 99% of the soil from the waste water. The process was developed by Dr Brett Bateup and Dr Jock Christoe, who tested and demonstrated the process at various wool scours around Australia. It is particularly suited to Australian wool scouring plants as local wool is produced in hot, dusty conditions and thus contains relatively high proportions of soil.

The process can be set up fairly cheaply and easily. Unlike effluents from conventional processing, the discharge does not contain iron or aluminium residues. The sludge produced in the process is easy to handle and biodegradable, so further processing into commercial by-products is simpler.

Contact: Pat Naughtin, CSIRO Division of Wool Technology, PO Box 21 Belmont, Vic. 3216, (052) 47 2611, fax (052) 47 2657.

More about tanning

Money C A (1994) Tannery Waste Management. *Waste Management and Environment*. 5: 84.

White HF Money CA Poole JM & Karamoshos D (1993) Carbon dioxide deliming of thick hides. XXII Congresso Iultcs – 16 A 20 De Novembro De 1993, Porto Algegre (Brasil): 558-591.

Money CA (1991) Tannery Waste Minimisation. *Journal of the American Leather Chemists Association*. 86: 227-244.

Minimising Tannery Waste. *Leather in Asia*. April-June, 1992.