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A significant improvement in leather processing

In research recently posted to ES&T's Research ASAP website (esdt050720a), scientists from India's Central Leather Research Institute (CLRI), the largest institution of its kind in the world, describe an important step forward in reducing the water pollution from leather processing. Because the technology is green and has potential to increase the leather's economic value, experts believe it has real promise.

Typically, sodium sulfide and lime are used to remove hair from cowhides in the production of leather. The hair is completely degraded by the process, but a sludge is left behind, says Dennis Shelly, the director of the Leather Research Institute at Texas Tech University. This protein-rich sludge is the top pollution problem of the industry and is a much bigger concern than wastes that contain the chromium used in leather tanning, he says.

"From a waste-loading perspective, the dehairing issue is a larger magnitude," explains Gary Sawler, director of the University of Tennessee at Knoxville's Center for Environmental Biotechnology. "You must remember that many of the very active countries in tanning are developing countries with much more limited capacity for treatment, let alone advanced waste treatment."

CLRI's new enzyme-based technology preserves the hair, and this should significantly decrease the environmental impact of leather processing. Shelly says, "If you can save the hair without dissolving it, you will reduce the chemical oxygen demand of the waste stream. And that's moving in the right direction." Shelly explains. CLRI says that the process, which uses the commercially available enzyme Biobact, reduces the chemical oxygen demand of the resulting wastewater by 53% and total solids by 25%.

"Solid waste management is the need of the hour in the tanning industry," says T. R. Rao, director of KKSK Leather Processors Ltd., an Indian firm that has been field-testing CLRI's new technology and deems it promising. Even since the Indian Supreme Court ordered the closure of more than 500 tanneries in and around Tamil Nadu in 1999, the tanners in India are really looking for "greener" leather processing, says Jommalagadda Raghava Rao, the paper's corresponding author. "Development and commercialization of clean and green leather processing is a major thrust of our group, as well as [the institute's] top priority," he adds. Only China's leather industry is larger than India's, Shelly says. He estimates that the leather industry is worth at least $1 trillion worldwide, annually.

The new technology helps sidestep some of what Rao calls "do-undo" approaches in leather processing. For example, the conventional approach uses lime to swell hides, then removes the compound to reduce the swelling. CLRI's new enzymatic technology avoids this step. Moreover, it can be coupled with an enzyme-based fiber-opening step so that the process "completely avoids "undoing" steps," Rao says. KKSK Leather Processors is also testing this enzyme-based fiber-opening technology.

CLRI's new dehauling process also uses significantly less production water—practically none," Sawler notes. "I believe this is an approach that can be used in many places where bulk production processes are available. These enzymes are cheap and easy to make and are very stable," he says. For all of these reasons, that technology will be easier to put in place than chromium alternatives," he says.

The hair preserved by the new process can be used in the manufacture of brushes, rugs, and carpets, as well as in biocomposting, shampoos, animal feeds, and natural sunscreens. Rao says. Shelly adds that CLRI has also patented a technique for using the keratin from the hair in the tanning process.
An important side benefit of the enzymatic dehairing process is that it leaves more product, increasing the area of the leather by 8% compared with conventional processes, according to Rao. He estimates that tanners could get the equivalent of about U.S.$265 for each metric ton of raw hides they process. An increase of 8% is significant, Shelly agrees. The technology is also likely to be marketable because a growing number of automotive and furniture manufacturers, particularly in Europe, are demanding that leathers be produced using the greenest possible technologies, he says. "There are companies like Mercedes that require a nonchrome tanned leather," he points out.

CLRI is also actively investigating alternatives to the chromium used in conventional tanning, Rao says. The institute has developed a method based on vegetable tannins (Environ. Sci. Technol. 2004, 38, 871-879) that they are testing as part of an entirely "bio-based" method of leather processing, he says. —KELLYN S. BETTS