Leather and Hides

A multitude of problems confronted the U.S. leather industry in the 1940's and 1950's. Well over half of America's shoes were being soled with nonleather materials. A variety of fabrics and synthetic materials were being used for the uppers. In addition, industry practices were often careless and wasteful. Far too many hides were spoiled by improper handling and curing before they reached the tannery. Others were damaged by insects and parasites.

Inside tanneries, researchers from the Eastern lab found little uniformity in the way leather was made. Many tannery processes were slow and outmoded. Remarkably little was known in the industry about the chemistry of tanning; those in the trade simply knew from experience what had worked in the past.

New formulas for coloring and dying leather were badly needed, as were better tanning compounds. And one of the most

Saving Leather-Bound Books

Library of Congress officials a few years ago were looking for better ways to preserve rare books bound in leather. Too many bindings were drying, cracking, and crumbling. Variously blamed for the damage were exposure to light, excessive dryness or humidity, and sulfur dioxide in the air. Librarians turned for help to the ERRC, where three researchers developed a brand new formulation—a silicone emulsion to mat down and heal the abraded areas of aging leathers. The formula also prevents water or oil from entering or leaving the leather. The bindings will require periodic treatment.

ERRC chemist Frank Scholnick shows examples of leather cured with short zaps of ultraviolet light or electron beams. Curing leather with radiation is nonhazardous, nonpolluting, and more energy-efficient than conventional leather finishing with solvent chemicals.

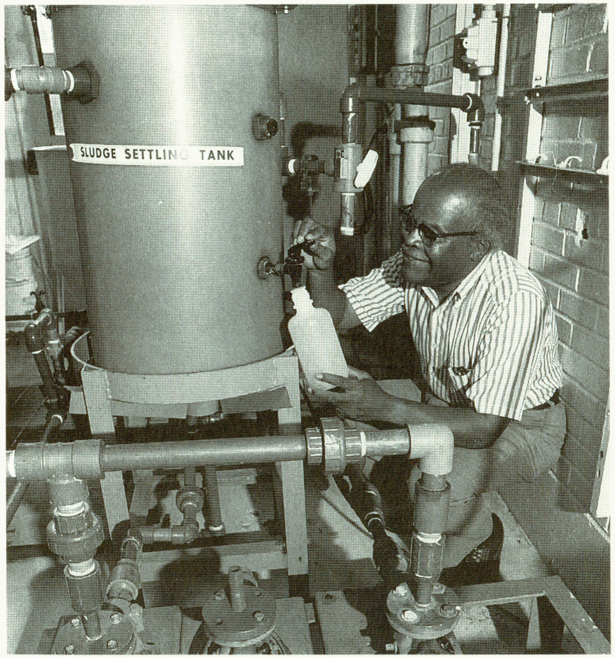
pressing needs was for ways to dispose safely of tannery wastes. Pollution of streams by the leather industry, observed the 1939 USDA research survey, "is daily becoming more acute and urgent."

Obviously, there was much work to be done, and over the years, ERRC scientists have made discoveries and improvements in practically every area of leather chemistry and manufacture. One of the most important came in 1956, with development of a new tanning agent—glutaraldehyde. It produced a softer, more durable product than tanning with chrome, and it was resistant to the adverse effects of perspiration and chemicals. It also proved compatible with all major tanning agents.

The glutaraldehyde process was first adopted commercially in 1958, just 2 years after its discovery. By 1965, some 30 U.S. firms were using the new tanning agent, mostly to tan the upper leather in shoes. In time, they found other applications, including tanning deerskin to make it easier to stitch. One use that proved of special benefit to bedfast invalids was the manufacture of shearlings, which are sheepskins processed into leather with the cropped wool remaining on the skin. Shearlings had long been used to line suede sheepskin coats but lost ground over the years to synthetic fibers. Recently, however, the genuine article has started to gain in popularity.

When tanned with glutaraldehyde, shearlings resist the detanning action of water and deterioration from alkaline chemicals. These properties led hospitals in the 1960's to use shearlings to prevent and cure bedsores. The wool was placed in direct contact with the patient's skin, where it quickly absorbed and dissipated perspiration, providing the patient comfort and promoting healing. In tests in several hospitals and nursing homes, the shearlings retained their original shape and resiliency after repeated launderings in heavy-duty hospital washers and dryers. They could be used for as long as 28 months. Today, shearlings and leather tanned with glutaraldehyde continue to be used for such disparate purposes as bedpads, golf and batters' gloves, and paint rollers.

In the 1980's ERRC engineers built a 150-foot-long, two-story continuous-beamhouse processing pilot plant at the Wyndmoor laboratory. The project was part of an accelerated effort to upgrade tanning technology in the United States. The beamhouse is where hides are prepared for tanning by cleaning and soaking them, removing the hair, and, in the case of cattlehides, splitting them. The procedures followed in the typical beamhouse had remained virtually unchanged for centuries and were described by ERRC engineers as "laborious and inefficient." The new pilot plant automated these age-old processing operations. It also made unnecessary the many manual batch steps that expose beamhouse workers to noxious chemicals. Recently, with research completed, the Wyndmoor pilot plant was sold and installed in a commercial tannery.



Developing a more economical process to treat sulfide-laden tannery wastes, Joseph Cooper, an ERRC research chemist, collects biosludge from settling tank. He will then examine a sample under a microscope to determine the efficacy of microbes in the anaerobic treatment system.

The ERRC also developed a way to apply finishes to leather with quick bursts of ultraviolet or electron beam radiation. The process, unlike conventional curing and finishing methods that use lacquer, is nonpolluting, since there are no solvent fumes to escape into the air outside the plant. Further, the equipment is safe to operate; built-in shielding protects the workers.

The process ingrains finishing chemicals into leather as it moves through radiation equipment on conveyor belts. Many different colors and textures are available. Radiation curing saves at least 60 percent of the energy cost of conventional leather finishing, which requires the slow evaporation of solvents in 100-foot-long drying ovens. Scientists anticipate further savings in plant space and labor. The system has been tested in commercial tanneries. Like the automated beamhouse, it is part of a long-term research project aimed at returning a competitive edge to U.S. leather industries.

During the 1970's, an ERRC team of chemists found a way to marry leather to plastics, creating a chemical bond between protein molecules in the leather and a molecule of plastic. The process, known as graft polymerization, results in a stronger, higher quality product that is more receptive to dyes.

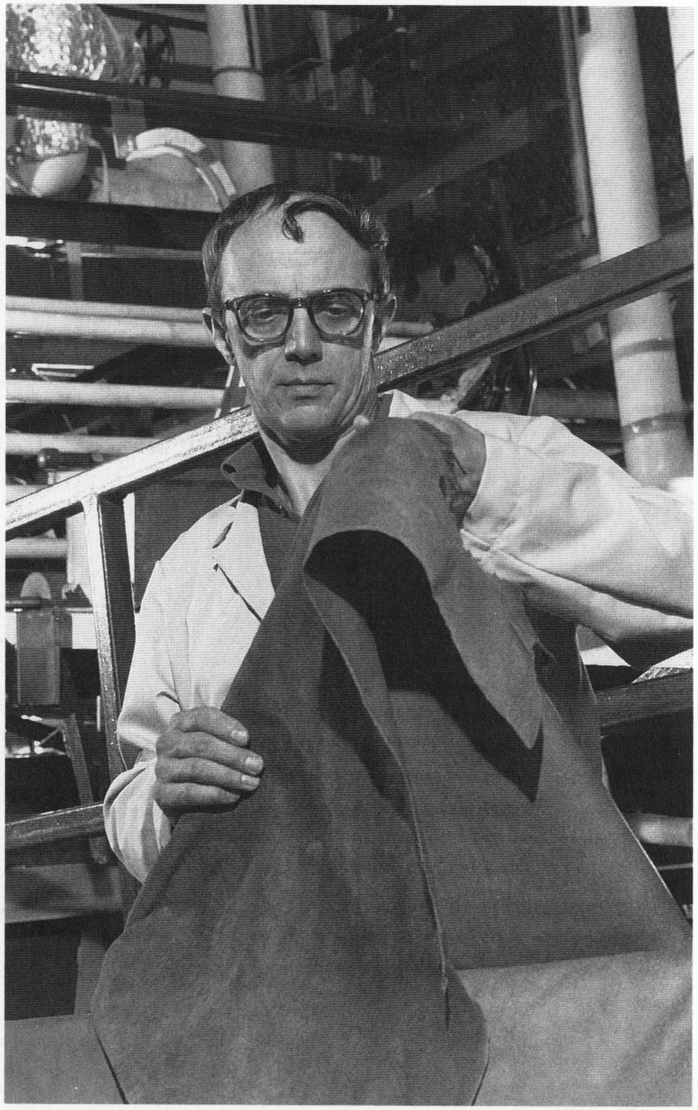
ERRC scientists have also come up with a new treatment for tannery wastes that contain sodium sulfide, a toxic chemical used to dehair hides. A compact, oxygen-free reactor uses bacteria that eat the waste. Chrome shavings, which are formed when leather tanned with chromium sulfate is trimmed or buffed, also pose a worsening waste problem. Landfill operators today are increasingly reluctant to accept the shavings, fearing eventual contamination. A new process developed by an ERRC team employs a bacterial enzyme commonly used in laundry detergents to separate the chromium in the shavings from the animal protein in the leather. The chromium can then be filtered out to form a solid chromium cake. It now seems likely that the chromium can be treated chemically so that it can be reused by the tannery. In addition, the protein product left behind after the chromium is removed may prove a bonus; it has potential as an animal feed additive or fertilizer.

Salt, which is used to prevent spoilage in fresh hides, is one of the leather industry's most serious environmental pollutants. Wyndmoor scientists developed an experimental curing method in which acetic acid and sodium sulfate replace the salt. The cure not only reduces the amount of salt waste by about 97 percent, but it also produces cattlehides that make better leather.

Saline pollution has been further reduced by relocating the initial steps of leather manufacture closer to packing plants in the South and West. The moves permit uncured hides, known as blue stock, to be taken directly to tanneries without first salting them or packing them in brine. The change came about in part as a result of a joint study conducted in the 1970's by ERRC researchers and USDA economists.

After passing through the first of three conveyors in the pilot plant for continuous beamhouse processing, a hide with hair loosened by chemicals is ready for the unhairing machine. ERRC mechanical engineer Wolfgang Heiland operates the control panel, moving the hide to the second conveyor.

A sample of finished leather from the continuous beamhouse is checked for quality by James C. Craig, ERRC chemical engineer and project leader.



Unlike most tannery wastes, one byproduct of leathermaking has turned out to be useful—even to save lives. Collagen, a fibrous protein found in the offal that accumulates when hides are prepared for tanning, is colorless, tasteless, odorless, and nonallergenic. ERRC researchers have developed several purified collagen products from unused parts of the hides. They include food and cosmetic ingredients and an artificial skin that helps burn victims heal.

Certain tannery pollutants occasionally pose a hazard to tannery employees as well as to the public. The air in several tanneries was found to contain a dangerous amount of a nitrosamine, a cancer-causing substance. A team of ERRC scientists, already experienced in tracking and preventing nitrosamines in food, quickly determined the source of the air contamination in the tanneries. It was produced when diesel exhaust fumes from forklift trucks combined chemically with a compound used to unhair hides. The problem was eliminated by replacing the unhairing chemical with one that wouldn't react with chemicals in the exhaust.

Scientific detective work also tracks down the cause of hide and skin defects that each year ruin all or part of many hides. One type of leather, for example, appeared normal but broke under the stress of shoe manufacture. ERRC researchers traced the weakness to a genetic defect in a strain of Hereford cattle. The answer to the problem will have to come from crossbreeding or selective breeding.

In another instance, large numbers of scaly, scabby hides were turning up from several southwestern States. ERRC scientists linked the defects to an insect outbreak. As a result, ranchers in the Southwest began using appropriate insecticides. ERRC leather detectives also traced cockle, a seasonal defect of sheepskins, to infestations with keds, a parasitic insect. After it was demonstrated to sheep producers that keds not only lowered the value of the skin but also caused sheep to grow more slowly, sheep farmers began treatments to decrease or halt the infestations.