

-CLOSING THE LOOP-

Circular Solutions for Sustainable Leather in Pakistan

Leather is one of the major pillars of Pakistan's economy, standing as the third-largest export sector and contributing approximately four per cent to the national GDP. While leather production utilizes hides and skins (a byproduct of the meat industry), it is not immune to environmental and social risks.

To secure future growth and meet evolving global standards, Pakistan must innovate and pilot practices that enhance the sustainability performance of its leather industry. One such practice is circularity, i.e., an approach that keeps materials in use for as long as possible by transforming waste into value, reducing resource consumption, and minimising environmental impact. It not only supports resource efficiency and strengthens environmental compliance but also reduces scope 3 emissions, an increasingly critical factor for long-term market access and global competitiveness.

Circularity offers multiple pathways to achieve this transformation and can be embedded at all stages of the value chain delivering strategic, environmental, and economic benefits.

Advantages of adopting circularity



Global competitiveness and long-term market access

Circular practices align the sector with tightening international sustainability standards and evolving buyer expectations, safeguarding access to high-value global export markets.



Resource efficiency and economic benefits

Optimising water, chemicals, energy, and raw material reduce operational costs and improves production efficiency. Waste-to-value innovations and by-product utilization create new revenue streams while lowering dependency on volatile inputs.



Improved environmental performance

Circular models reduce wastewater discharge, solid waste generation, and pollution loads, strengthening regulatory compliance and minimizing environmental risks.

WHAT WE DID AND HOW IT CREATES CIRCULAR VALUE

STEP 1: Waste stream identification

Wet blue shavings, a by-product of manufacturing leather products, are typically treated as low-value waste. In Pakistan, they are often disposed of in landfills or openly dumped as solid waste. These shavings are rich in collagen protein, making them a valuable resource. This means that wet blue shavings are a potential secondary raw material.

STEP 2: Protein extraction through controlled hydrolysis

In collaboration with PCSIR Leather Research Centre, wet blue shavings were subjected to alkaline hydrolysis at controlled temperature conditions to extract collagen-based protein. The process involved:

- Preparation of alkaline medium (NaOH, MgO, Ca (OH)₂)
- Thermal treatment (100°C for controlled protein breakdown)
- Filtration to isolate extracted protein solution

STEP 3: Conversion into protein-based surfactant

The extracted protein was chemically modified using lauric acid, hydrochloric acid, and sodium hydroxide under controlled heating and stirring conditions to synthesize a biodegradable surfactant.

Surfactants are widely used in detergents, cosmetics, pharmaceuticals, and leather processing. Many conventional surfactants are synthetic and non-biodegradable, contributing to aquatic toxicity and long-term environmental persistence. By producing a biodegradable surfactant from leather waste, the pilot provides a sustainable alternative to petrochemical-derived surfactants.

STEP 4: Testing for surfactant quality

The final product demonstrated:

- Surface-active (foaming) properties
- Stable composition
- Neutral or near-neutral pH suitability for industrial surfactant formulations

STEP 5: Reusing the wet blue shaving derived surfactant in leather manufacturing and testing for efficacy

The synthesized protein-based surfactant was applied within leather processing. This demonstrates that recovered waste can be integrated back into the production cycle. The thin leather crust was produced using the biodegradable surfactant and was tested against the leather produced from commercially available surfactant. Performance testing demonstrated comparable technical properties to commercially available surfactants, confirming feasibility for industrial application.

Economic and environmental value creation

Wet blue shavings are a low-cost protein source compared to virgin raw materials typically used in surfactant production. By valorising this waste stream, the pilot demonstrates the opportunity to reduce raw material costs, minimize disposal expenses for tanneries, and create potential new revenue streams through value-added product development. Moreover, the initiative reduces solid waste sent to landfill and lowers the environmental burden associated with leather by-products. By substituting synthetic surfactants with biodegradable alternatives, the pilot also contributes to reduced aquatic toxicity, improved wastewater quality, and enhanced compliance with environmental standards.

This pilot demonstrates a closed-loop manufacturing pathway where leather waste was transformed into a biodegradable surfactant and reintegrated into leather production – converting a disposal liability into a functional industrial asset.