Leather making is one of the oldest crafts performed by humankind. Although there is a world-wide trend to exploit alternative materials derived from other sources, leather still finds widespread use.

Tanning is the most important step in leather production. It is typically carried out in an aqueous environment in rotating drums. During tanning, collagen will fix the tanning agent to its reactive sites, as a result stopping the putrefaction phenomenon. Tanning can be classified into three groups: mineral tanning, vegetable tanning, and other organic tanning (aldehyde, quinone, oil, and synthetic tanning).

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What is lignin?

Lignin is a major component of vascular tissues in terrestrial plants: it is an amorphous, water-insoluble, three-dimensional aromatic polymer. It is found in higher plants, including ferns, but not in liverworts, mosses, or plants of lower taxonomic ranking. Wood and other vascular tissues generally contain 20-30% lignin, mostly found within the cell wall, where it is intimately interspersed with the hemicelluloses, forming a matrix that surrounds the orderly cellulose microfibrils. In wood, lignin in high concentration is the glue that binds contiguous cells, forming the middle lamella.

Lignin is the material that confers the qualities of rigidity and durability of wood.
this natural composite material, the cellulose fibrils provide tensile strength, and the hemicellulose and lignin provide cross-linking, binding the structure together.

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**Mineral Tanning**

Ono Suparno, Dept. of Agroindustrial Technology, IPB, 2005.

Four elements play a significant role in the modern leather tanning industry, i.e. chromium(III), aluminium(III), titanium(IV), and zirconium(IV), of which chromium(III) is the most important. Nowadays, more than 90% of the world’s leather is tanned with chromium, which is a consequence of the easy processing, the broad achievability and the excellent properties of leather. Tanning using Cr(III) sulfate can achieve shrinkage temperatures above 120°C. However, it also has considerable potential for environmental pollution.

The interactions of collagen with chrome have been extensively investigated since the end of the nineteenth century. The fundamental reaction is the formation of complex bonds with the ionised carboxyl groups of aspartic and glutamic acid residues on collagen fibres.

Other mineral tannages (Al(III), Ti(IV), and Zr(IV)) have similar reaction mechanisms to chromium, although reaction is dominated by electrovalent bonding, thus much lower shrinkage temperature is obtained than with chrome. The maximum shrinkage temperatures of leather tanned with Al(III), Ti(IV), and Zr(IV) salts are 79, 90, and 97°C respectively. The development of titanium and zirconium tannage is relatively new. Empirically, the chemistry of Ti(IV) is dominated by the titanyl ion TiO$_2^+$ and the species in the tanning agent are chains of (Ti-O)$_n$. Zirconium salts are characterised by eight-coordination and high affinity for oxygen, resulting in a tetrameric core structure; the basic unit of structure is four Zr(IV) ions at the corners of a square. The tanning powers of titanium and zirconium are similar and both are better than aluminium.

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Oil Tanning


Oil tanning is a very old way of imparting the properties of finished leather to skins. In modern oil tanning for chamois leather, the flesh split of the sheepskins are used as having desirable open fibre structure. After the usual beamhouse processes, they are brought to the isoelectric point, e.g. pH 4.5.


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