



Figure 1: Uncoated collagen fibrils exhibiting the triple helix banding pattern. (Viewed at 50000x magnification).

Microscopical studies in leather manufacture

Part 3 of 4: Post tanning

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The post tanning processes largely dictate the physical characteristics of a leather such as strength, softness extensibility and colour. These processes can be monitored using both light and electron microscopes. The penetration of fatliquors and retannages is monitored through examination of the leather fibres, and elemental mapping of the cross section using X-ray microanalysis and histology. In the absence of coatings the fibrils in the leather exhibit the triple helix banding pattern associated with collagen⁽¹⁾ as shown in *Figure 1*.

Typically, the thickness of these fibrils is between 100nm and 150nm prior to any treatment. The homogeneity of fat liquor penetration can be monitored, however, by examining the fibrils at different points through the cross section, and comparing the thickness of the coating on the individual fibres. This thickness is dependent on various parameters such as chemical offer, degree of opening up and type of fat. Examples of the fibrils in two different types of leather are shown in *Figures 2 and 3*.

These leathers were made for footwear and the fibrils examined in the middle of the section just below the grain corium junction.

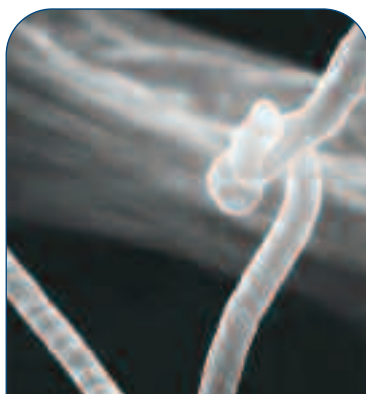


Figure 2: Coated fibrils in a water-resistant shoe upper leather. (Viewed at 25000x magnification).



Figure 3: Coated fibrils in a heavily oiled water-resistant leather. (Viewed at 10000x magnification).

The coating thickness of the two examples varies from 400nm to 1500nm, the differences being due to the end use of each leather. For example, *Figure 4* exhibits a very heavy coating of fat being an American heavily oiled waterproof leather.

Certain fatliquors and retans can also be monitored using X-ray microanalysis to map their penetration through a cross section of leather, and this has proved to be a particularly useful technique for studying water proof leathers⁽²⁾. Waterproofing treatments often contain elements such as silicon and phosphorous, and these can be traced. The penetration against the water resistance of the leather has thus been used to show why leathers given similar treatments perform differently. A typical X-ray spectrum for water-resistant leather is shown in *Figure 4*.

Certain fatliquors and retans can also be monitored using histological techniques. Sudan IV can be used to stain certain fatliquors as shown in *Figure 5*, and methylene blue for the penetration of some syntans as shown in *Figure 6*. Alcovar red stains polyurethanes red and can be used to examine for the presence or penetration of polyurethane in a section of leather. The penetration of polyurethane

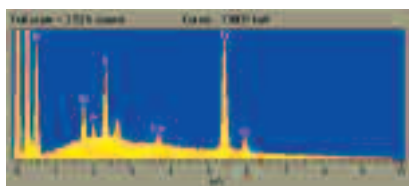


Figure 4: X-ray microanalysis spectrum for a waterproof leather showing the presence of silicon and phosphorous in the leather.

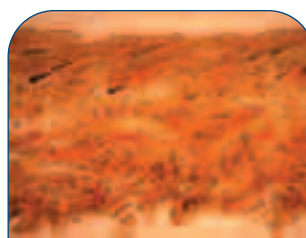


Figure 5: Penetration of fatliquor into leather structure using Sudan IV.



Figure 6: Penetration of syntan into leather structure using Methylene blue.

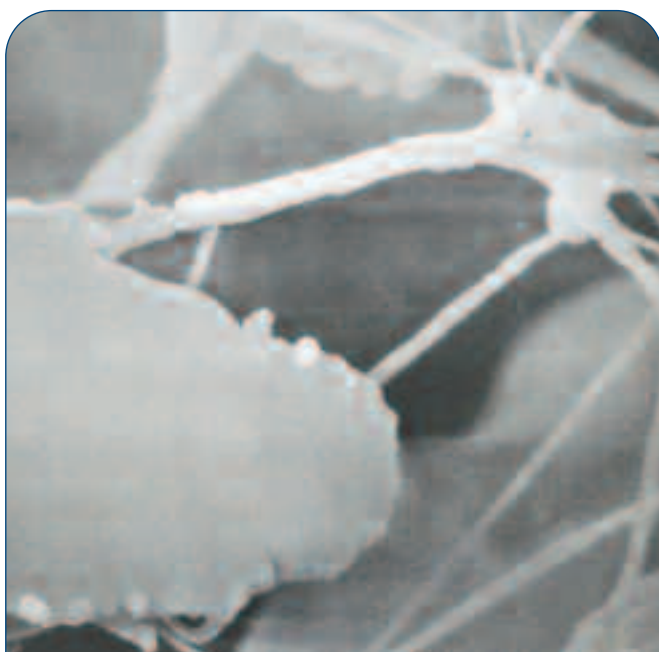


Figure 7: Particulate penetration of PU.

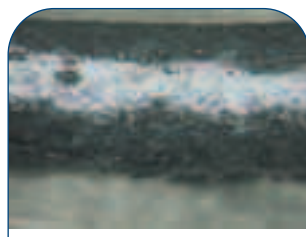


Figure 8: Surface dyed leather.

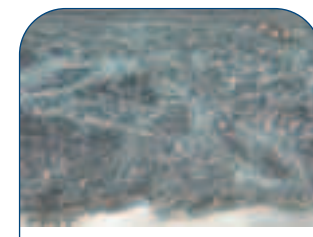


Figure 9: Through dyed leather.

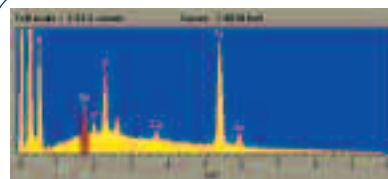


Figure 10a (left): Spectrum indicating the presence of aminosilane in the leather.



Figure 10b (right): Map of aminosilane treated leather. Green indicates the presence of aminosilane.

impregnants used to increase the strength of leather has been monitored⁽³⁾ by this technique.

The SEM has also been utilised for this work via examination of the cross section of the leather. By studying the fibrils in the section at relatively high magnification (5000 -10000x) the resin could be seen as a particulate coating. The penetration of the polymer into the leather could thus be ascertained as shown in Figure 7.

The depth of dye penetration can be measured using the binocular light microscope, and a comparison between a leather with a surface dyeing and one through dyed is shown in Figures 8 and 9 respectively.

X-ray microanalysis has proved to be a particularly useful technique in the development of novel dyeing processes based around silane technology^(Legend 1). The leather is examined for the presence of silicon, a component of the aminosilane treatment, using the microanalysis technique. A map of the cross-section of the leather is then made monitoring both the concentration and penetration of silicon through the leather. A typical map and spectrum monitoring the process are shown in Figures 10a & 10b.

The technique has been used to correlate fastness results with the silane treatment and as a tool in the development of the process, to optimise the conditions under which the aminosilane

is added to the leather.

Post tanning processes are vital in the production of high quality leather and utilising microscopical techniques to carry out research in this field will help in the development and improvement of these processes.

Legend

1. Silane technology has been investigated by BLC for improved fastness properties with acid and direct dyes. The amino silane increases the number of dye fixation sites within the leather,⁽⁴⁾ with the added benefit of increased depth of shade. Recent studies have tried to incorporate the aminosilane into the dye, with the aim of developing a dye with superior fastness properties.

References

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