



A new generation of washable leather: Reactive dyes for wet blue and wet white

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Leather clothing has a long tradition dating from prehistoric times to the present day, and the demands on garment leather have remained unchanged through the ages. Its main function is to protect the body and provide warmth, but its washability is also an important factor because it has to be kept clean. Ideally, it ought to be possible to remove all types of staining from the leather by washing, including contaminants such as perspiration, cosmetics and perfume. Garment leather has to retain its original properties after it has been washed or cleaned, no matter which cleaning process is employed. Specifically, it has to fulfil the following requirements:

1. The leather has to retain its softness after being washed.
2. The physical properties of the leather, such as its tensile strength, must not be affected by washing.
3. The leather has to remain dimensionally stable. In particular, it must not shrink when washed.
4. The leather must not change colour as the result of washing. It is particularly important that the dye does not fade.
5. The dye must not bleed out of the leather.
6. The leather must not discolour any materials with which it comes into contact. This depends on the dye's resistance to bleeding and migration.

Factors 1 - 3 are determined by the overall tanning process and the chemicals that are applied to the leather. A number of techniques are available to tanners, especially in the production of chrome-tanned leather, to ensure that consumers' expectations are fulfilled.

Factors 4 - 6 are clearly determined by the type of dye that is used. The fading or bleeding of dyes is the result of inadequate fixation. The preferred method at present is to use anionic dyes that primarily form ionic bonds with the collagen and with chromium at the sites at which it is fixed to the collagen. This is indicated in *Panel 1*.

These ionic bonds are weak, and they can be broken down by exposure to perspiration, or even just to water, during the washing process. This causes the colour of the leather to fade, and other materials such as textiles or synthetics can be discoloured by the dye that is released.

The result is that consumers are not completely satisfied with the performance of these leather garments and, to some extent, this has led to leather being replaced with other materials in this sector. The long-term viability of garment leather can only be assured by embarking on a process of fundamental innovation to develop new products and processes.

Immobilised dyes: Wet blue and wet white

Reactive dyes form covalent bonds with collagen. This causes them to become completely immobilised on the leather fibres, as they are fully resistant to changes in the electrostatic charge on the surface of the substrate. The resistance of the leather to everyday wear and tear is excellent, and no dye is transferred to any other materials it comes into contact with. This bonding mechanism is indicated in *Panel 2*.

This mechanism means that the same excellent wet fastness can be achieved on both wet blue and wet white leathers. ➤

Figure 1: Model for ionic bonding

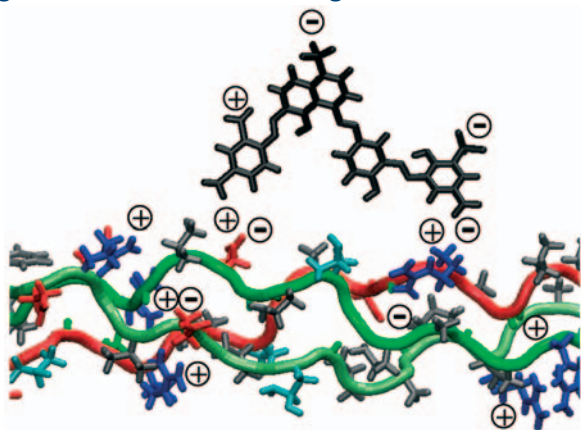
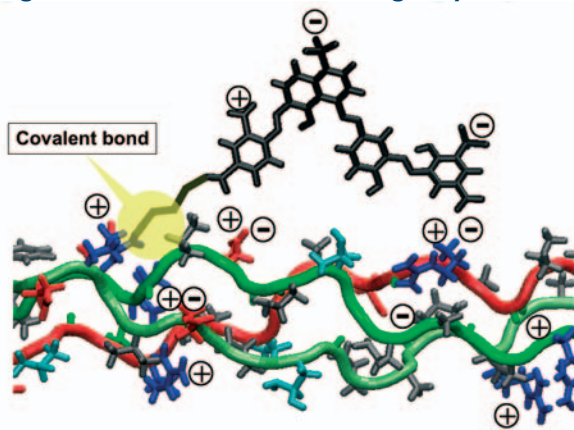


Figure 2: Model for covalent bonding of dyes





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Figure 3: Colour fastness according to ISO 15703

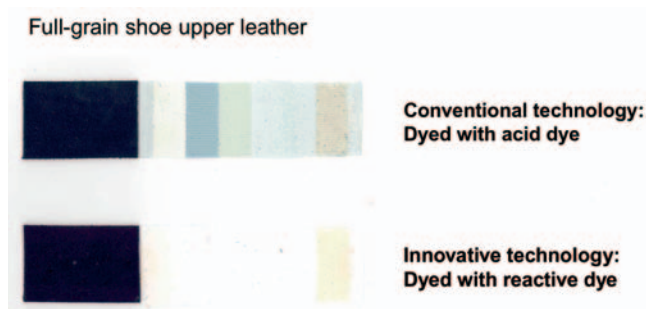


Figure 4: Colour fastness according to ISO 15702



Figure 5: Colour fastness to seawater according ISO 105 EO 2

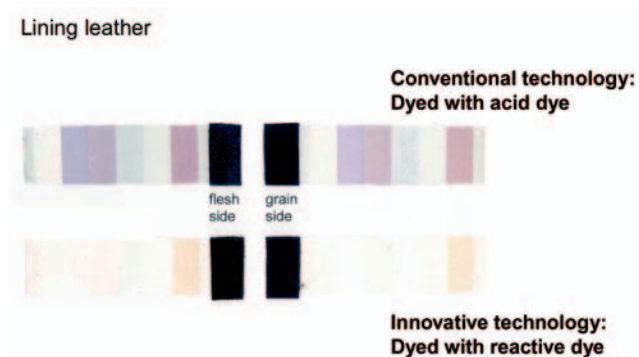


Figure 6: Colour fastness to dry-cleaning solutions according to ISO 11643



The reactive dye

The reactive dye consists of a chromophore group, which imparts colour, and a reactive anchor group, which fixes it irreversibly to the collagen. The chemical mechanisms by which the dye is fixed are similar to those that are used to fix reactive dyes to textiles. Both the chromophore group and the anchor group must be specifically designed to take into account the different structure of collagen.

The most important requirement of the dye and its performance can be summarised as:

- The reactive dye has a special anchor group that enables it to be fixed to collagen irreversibly by covalent bonding.
- It is anionic and homogeneous.
- The powder has excellent solubility and performs well in a short float and at temperatures of 35°C - 45°C.
- High build-up makes it possible to achieve deep shades, and the coverage of grain defects is excellent.
- The dye penetrates easily even through thick wet blue, and the grain layer can be dyed to deep, even shades.
- The dye has no tendency to bronze in deep shades.

The covalent fixation of the dye results in much higher wet fastness, which has the following advantages:

- Excellent perspiration fastness
- Excellent washfastness
- Excellent migration fastness
- Excellent resistance to solvents
- Improved rubfastness, i.e. no dye transfer

Fastness to washing

Washable leather is tested according to a variety of standardised methods. A distinction is made between tests that simulate dry cleaning and tests that simulate household laundering:

- ISO 15703/IUF 423: Test with sodium lauryl sulphate for 30 minutes at 30°C to simulate the effects of washing with a classic light-duty detergent.
- ISO 15702/IUF 435: Test with ECE Detergent 77 for 30 minutes at 30°C to simulate the effects of washing with a heavy-duty detergent.
- ISO 105 EO2: Colour fastness to seawater for 30 minutes at 30°C.
- ISO 11643/IUF 434: Test with tetrachloroethylene as solvent for 30 minutes at 30°C to simulate dry cleaning.

In all of these tests, the washfastness of the leather is assessed on a grey scale by measuring the discoloration of a textile fabric that is washed together with the leather. The results of colour fastness tests performed on leather dyed by the new process compared with the results obtained on conventional leather dyed with Acid Black 210 are given in *Panels 3, 4, 5 and 6*.

The differences between the old technology and this new process are quite dramatic under all washing conditions. It can also be seen whether any dye is extracted in the laboratory, by observing the colour of the wash liquor.

Washing leather dyed with acid dye, even with water alone, causes the solution to become slightly discoloured. But there is no discolouration if the leather is dyed using reactive technology as shown in *Panel 7*. ➤



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Figure 7: BASF method, extraction and washing with water for 30 min at 60°C

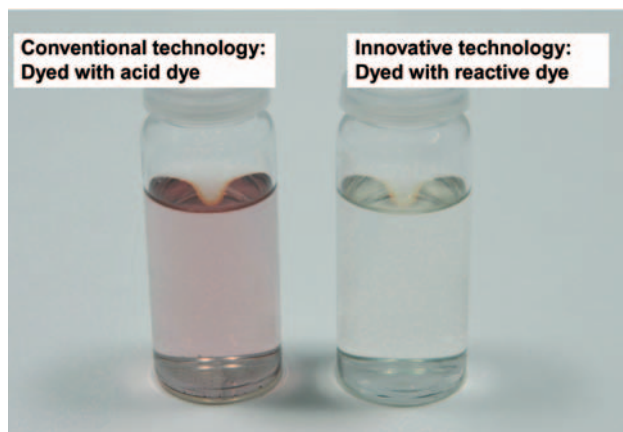


Figure 8: BASF method, extraction and washing with liquid detergent for 30 min at 60°C

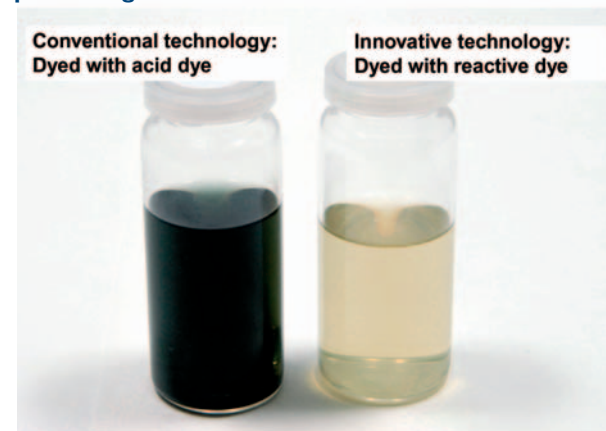
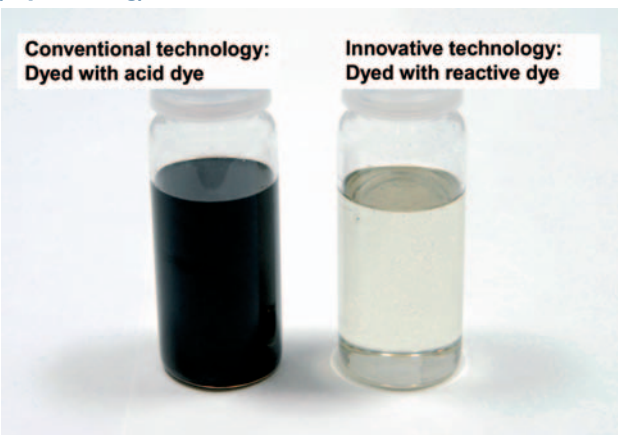


Figure 9: Extraction according to ISO 11643 (dry cleaning)



When washing with detergent solution, the wash liquor is strongly discoloured where the leather has been dyed using acid dyestuff. This is shown in *Panel 8*. This test also extracts tanning agents and fatliquors that are not tightly fixed to the leather, and this causes the slight turbidity observed with the sample dyed with reactive dye.

Similarly, the results obtained with solvents also demonstrate the excellent fixation of this reactive dye as shown in *Panel 9*:

The clarity of the washing liquor from these tests indicates that

Figure 10: Perspiration resistance according to ISO 11641

Split suede shoe upper leather



Figure 11: Resistance to migration into PVC

Migration fastness according to DIN EN ISO 15701

Full grain shoe upper leather



the dye is completely immobilised on the collagen fibres, and that the dye performs equally well on wet white and wet blue.

Fastness to perspiration and migration

Besides washfastness, the perspiration resistance of garment leather and the resistance of the dye to migration into other materials are important factors from the point of view of fashion design and comfort. This is clearly demonstrated when testing for resistance to perspiration and to migration into PVC as shown in *Panels 10* and *11*.

It can be seen from the performance of the first reactive dye Lugafast* Black AN, when compared with the classic anionic dyestuff Acid Black 210, that excellent fastness can be achieved with this new technology. New standards of wearability and serviceability are set for the garment leather sector.

A significant advantage is that fashion designers can now combine leather with other materials without the risk of the dye migrating or being transferred. An example of this is the riding breeches shown in *Panel 12*.

Figure 12: Riding breeches



**Figure 13: Gloves**

This shows that there is no change in the colour of the leather, or even in the colour of the white textile fabric after the breeches have been worn and washed repeatedly. This is an impressive indication of the high performance of this new dyeing process. Other leathers can also benefit, such as the gloves shown in *Panel 13*.

A range of reactive dyes

Preliminary results, obtained in the laboratory, demonstrate that a workable range of reactive dyes is possible, and the findings are shown in *Panel 14*.

Here, several different brown and red shades were matched

Figure 14: Brown shades wet white automotive leather - Colour fastness according to ISO 15703

with reactive dyes on wet blue and wet white, and their washfastness was assessed according to ISO 15702. It can be seen that a wide range of different shades can be matched and the same excellent standards of washfastness can be achieved as demonstrated on wet blue and even on wet white. A comprehensive range of reactive dyes for leather will soon become a reality.

Legend

*The reactive dye used in the examples 1 -13 was Lugafast Black AN, the first reactive dye designed for leather. *Lugafast is a registered trademark of BASF.*

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