



Migration of colour into water-based finishes

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For the tannery supplying the automotive and upholstery markets, an important characteristic of the dyed leather is the stability of the colour when exposed to various extremes of temperature and humidity. This applies not only to the dyed crust leather but especially to the leathers with a finishing coat, as found in the car interior. Typically the automotive finishing coat systems are water-based formulations, containing some high boiling point solvents as solubilising and flow agents. More recently these formulations have been changed to eliminate solubilising and flow agents such as N-methyl-2-pyrrolidone (NMP) to comply with REACH requirements. Now low volatile glycol-type chemicals have been introduced as the solubilising agent.

The slow evaporation of these solubilising agents in combination with exposure to high temperature and humidity provides a matrix where some non-polar components can become mobile within the finishing coat. Under such extreme conditions this migration process can show up as a change in colour of the water-based finish. As with all changes in colour, the dye is the automatically considered the most likely source of this migration. Practice has shown that the dye alone is normally fixed in the leather, but under the influence of non-polar components found in fatliquors and finishing formulations, small amounts of non-polar components in the dye can be transported to the surface.

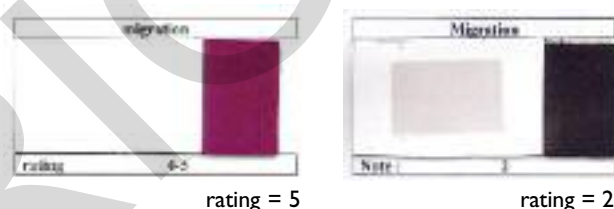
Many of the dyes traditionally used in automotive leathers are being re-evaluated in a search for those that do not show migration into water-based finishing coats. Several test procedures have been developed, some using reasonable temperature and humidity profiles. However, others with extreme conditions have been proposed but they can occupy equipment for weeks. Basically there needs to be a correlation between the test and the real exposure conditions experienced by most automotive interiors. Two of the commonly used systems for determining colour migration in dyed crust leathers are presented along with some explanation of the colour migration using a selected dye.

Migration of colour into PVC

Traditionally one determines the tendency for migration of a colour component in dyed leather by measuring the fastness to migration into PVC as indicated in *Panel 1*.

This technique is an International Standard, EN ISO 15701, and was developed for shoe leathers where dyed leathers and white soles were in contact. Today this simple test has a wider

Panel 1: Colour migration into PVC, according to EN ISO 15701.



Panel 2: Leather dyeings with 4 different samples of C.I. Acid Brown 75.



full chrome retanned upholstery
shoe upper shoe upper leather



use as the first selection criteria when looking for non-migrating dyes.

Leather dyes are normally fixed in the leather; nevertheless some components of the dyes migrate. An example of these phenomena is where leather is dyed with various samples of C.I. Acid Brown 75, a widely used brown azo dye based on resorcinol.

Four different commercial samples with this Colour Index number were dyed on different types of leather. The variation in colour of the leathers using these different C.I. Acid Brown 75 samples is shown in *Panel 2*.

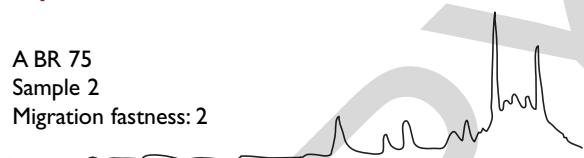
The reason for the colour difference comes from variations in the dye manufacturing process. This dye is not just a single chemical dye structure but is a mix of several coloured dye components. From the migration results, some of the dye components are non-polar and migrate into similar non-polar substrates such as PVC. However, the polar dye components do not migrate into substrates like PVC.

Interestingly, one finds that the fuller, nicer brown colours are those with the additional components, but with a poorer migration into PVC. By contrast, the manufacturing process optimised to minimise the non-polar dye components, results in a less saturated, redder colour. Since for C.I. Acid Brown 75 these non-polar products migrating into the PVC are typically yellowish in colour, this colour variation can be explained.

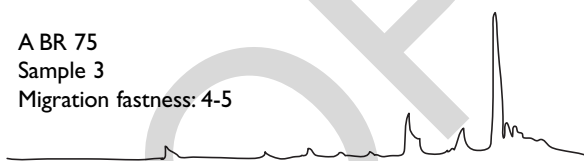
One can ask why a dye with the same Colour Index has such different colours and migration properties. If we run the HPLC chromatogram, it clearly shows the components in the dye composition, and this is given in *Panel 3*:

Panel 3: HPLC chromatograms of 2 different samples of C.I. Acid Brown 75.

A BR 75
Sample 2
Migration fastness: 2



A BR 75
Sample 3
Migration fastness: 4-5



This shows that the additional components formed during the reaction process of sample 2 as shown in the HPLC chromatogram do have an influence on the leather colour and the migration fastness of the colour.

Other polymers, for example TPU, are often today used in footwear and commonly it is requested that these polymers be used to check the colour migration. But very often suitable test materials for these polymers are unavailable and PVC is one of the most easily definable polymers to manufacture for such a test. Between the different polymers the results have the same trend, so PVC remains a suitable substrate for this migration test.

Migration of colour into the finishing coat

An additional colour migration technique used more often in recent years is the propensity of the dye to migrate into the finishing coat. This is often referred to as the MIF (migration

into finish) test, but at present there is no International Standard for this test procedure. The MIF test determines the tendency of a colour to migrate when a water-based finishing coat system is applied to crust leathers. The leather is dyed and dried, and then a light grey pigmented finishing coat system is applied on the dyed crust.

Part of the coated leather is exposed to a set of tropical conditions as listed in EN ISO 17228; for example, at 90% relative humidity and 70°C for 16 hours. The resultant colour change, if any, is compared with the original unexposed piece and the colour difference evaluated using the grey scale. Some coloured leathers show a considerable discolouration of the finishing coat as shown in *Panel 4*. This gives a warning that these dyes are not suitable for the automotive and upholstery markets.

Panel 4: Results of a test for colour migration into a finishing coat (grey scale ratings at bottom).



Since practically every tannery uses a different wet-end process and finishing formulation, such a simple screening test can never reproduce all the conditions used commercially. This places the responsibility with the tannery to make the final check using their specific application and finishing process.

Conclusions

The determination of the propensity for colour migration is an important screening test for checking coloured leathers for automotive and upholstery markets. The non-polar components in dyes can be transported into the finishing coat by other similar components, for example from fatliquors and finishing formulations.

The traditional test for colour migration into PVC provides a suitable pre-screening procedure for selecting non-migrating dyes. After this a further test using a finishing coating procedure similar to that used commercially can be made. After applying a finishing coat to the leather, it is subjected to tropical extremes of temperature and humidity and the change in colour evaluated. In recent years this type of colour migration testing at ever more extreme conditions has become increasingly important for those tanneries producing leathers for automotive and upholstery markets. 🌐