

# A practical evaluation of dyestuffs

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*This study describes a method for evaluating commercial dyestuffs, using of a series of simple tests that can be applied to the dyestuff and on the finished leather. By means of in-house tests, this process can prove useful to tanneries in the selection of dye, that from a cost-effectiveness point of view, best suit their purposes.*

In recent years, following increases in the price of raw materials and chemicals, the competition of new markets such as China and India, and the introduction of ever stricter laws on pollution and environmental impact, it has become necessary to optimise leather manufacture. In particular this includes the cost-effectiveness and content of products used in the leather-making process.

High cost is not always synonymous with high quality, and it is as well that those working in the sector can satisfy their requirements to the full. The category of dyestuffs is one that better lends itself to such an evaluation as there are many companies operating on the market and the range of dyestuffs available is extremely broad. The following study offers professionals some simple tools for assessing the quality of dyestuffs used, thus enabling a more informed choice.

During this study, the chemical/physical characteristics and dyeing efficiency/performance of several dyes have been examined. The aim was to establish whether commercially available products from different origins possess mutually consistent requisites allowing them to be compared. In addition, whether it is possible to obtain the same chromatic effect on dyed leather when one dye is substituted for another having the same Colour Index number.

Adopting the dyeing processes traditionally carried out in the Santa Croce sull'Arno tannery area, evaluations were made of brilliance, penetration, colour uniformity and fastness to artificial light. Moreover, consistency tests were carried out using blow tests, acid/alkali reaction tests, spectrophotometric UV-Visible analyses and Thin-Layer Chromatography (TLC).

## The study

Commercial products marketed by six chemical companies operating in the Santa Croce sull'Arno tanning area were examined—within this study these companies were identified as companies A to F. Among the vast range of dyestuffs on the market, the decision was taken to test powdered dyes, as these are the most commonly used. It was also decided to consider only single colourants through their Colour Index (CI) name, with each sample designated a reference number that relates to the CI and the supply company, as shown in *Figure 1*.

## Consistency tests

Consistency tests were carried out on the powdered dye or on solutions. This was to determine whether the different products available with the same CI are similar, or if they present differences that will affect dyeing quality.

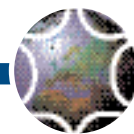
These tests are all quality-oriented. Although some can be conducted in such a way as to give quantitative information, for this type of investigation such responses were not considered necessary.

## BLOW TEST

This test is carried out directly on powdered dye and shows up any dyestuffs that may be present in addition to the principal

**Figure 1: Commercial products used in the tests**

| N° | Colour Index    | A   | B   | C   | D   | E   | F   |
|----|-----------------|-----|-----|-----|-----|-----|-----|
| 1  | Acid Orange 061 | A1  | B1  |     | D1  |     |     |
| 2  | Acid Blue 113   |     |     |     | D2  | E2  | F2  |
| 3  | Acid Blue 193   | A3  | B3  |     | D3  |     |     |
| 4  | Acid Brown 075  | A4  | B4  | C4  | D4  |     | F4  |
| 5  | Acid Brown 097  | A5  | B5  | C5  | D5  |     |     |
| 6  | Acid Brown 160  | A6  |     |     | D6  |     | F6  |
| 7  | Acid Brown 165  | A7  | B7  |     | D7  |     | F7  |
| 8  | Acid Brown 188  |     |     | C8  | D8  | E8  | F8  |
| 9  | Acid Brown 191  |     |     |     | D9  | E9  | F9  |
| 10 | Acid Brown 314  |     |     |     | D10 | E10 | F10 |
| 11 | Acid Brown 322  | A11 | B11 |     | D11 |     |     |
| 12 | Acid Yellow 194 | A12 | B12 | C12 | D12 |     |     |
| 13 | Acid Red 097    |     |     | C13 | D13 |     | F13 |
| 14 | Acid Red 119    |     |     |     | D14 | E14 | F14 |
| 15 | Acid Green 026  | A15 |     |     | D15 |     | F15 |
| 16 | Acid Green 068  | A16 | B16 |     | D16 | E16 |     |



one. These products give the leather a different nuance and can condition the behaviour of the principle dye, particularly when used in combination with other dyestuffs.

The test is carried out by blowing a small quantity of powdered dye onto a sheet of filter paper measuring 10 x 20 cm, previously dampened with boiled water. When the powder comes into contact with the moisture, it dissolves and reveals the different dyes making up the mixture. It is not possible to measure the concentration of these nuanced shades, but being able to establish their presence enables a prediction of the colour-spread that might be produced by these dyes.

#### ACID/ALKALI REACTION

This test allows assessment of the reaction of a dye solution when exposed to an acid or alkali. The test is carried out by depositing one droplet of a 10% sulphuric acid solution ( $H_2SO_4$ ) and one droplet of a 10% sodium hydroxide solution (NaOH) respectively on test-strips of filter paper prepared in the same way as for the blow test.

#### UV-VISIBLE SPECTROPHOTOMETRY

Spectrophotometric analyses provide both qualitative and quantitative results. By analysing the wavelength of the peaks of maximum absorption, it is possible to identify chemical differences between various products with the same CI. It is also possible to determine the relative content of dyestuff in the different products.

In fact, spectrophotometric performance indicates the percentage obtained from the absorption value of the sample being examined in relation to the maximum absorption value found among samples with the same CI. This constitutes an index of the relative concentrations of dyestuffs in the samples under examination.

The analyses, carried out using a "UV 2100 Shimadzu" spectrophotometer, were performed on solutions of 60 mg/litre for the more tenuous colours (oranges, yellows, browns and greens) and 40 mg/litre for the more intense colours (reds and blues). These levels were used to avoid too high absorption levels in the solutions subjected to the test.

#### THIN LAYER CHROMATOGRAPHY

Silica gel was deposited on a TLC plate, then activated by heat application to force-evaporate the moisture through the pores of the silica gel. 1% solutions of the dyestuff samples (10g/litre) were deposited onto the gel using a glass-spotting capillary. The droplets of dye were then dried, and the dried slide transferred to a developing chamber.

The eluant used was a mixture of piridine, diethylamine, isoamilic alcohol and ammonia in a 33% solution. The relationships between these components were selected colour by colour, as shown in *Figure 2*.

#### The evaluation of dye performance on the leather

The evaluation of the dye's performance is dependent upon the qualitative judgement on leather that has undergone the dyeing process. The dye properties analysed are brilliance, penetration, colour uniformity, and fastness to artificial light.

**Figure 2: Composition of eluants used in TLC for the dyes tested**

| For all dyes<br>(standard eluant) |                   | Acid Blue 193 |                   | Acid Yellow 194 |                   | Acid Brown 188 |                   |
|-----------------------------------|-------------------|---------------|-------------------|-----------------|-------------------|----------------|-------------------|
| 20                                | Piridine          | 40            | Piridine          | 40              | Piridine          | 30             | Piridine          |
| 20                                | Diethylamine      | 20            | Diethylamine      | 20              | Diethylamine      | 30             | Diethylamine      |
| 40                                | Isoamilic alcohol | 40            | Isoamilic alcohol | 60              | Isoamilic alcohol | 40             | Isoamilic alcohol |
| 40                                | Ammonia           | 40            | Ammonia           | 40              | Ammonia           | 30             | Ammonia           |

The dyeing operation was carried out on crust samples measuring 15x20 cm and 1.0-1.1 mm thick. These originated from calfskins that had undergone a standard process based on the traditional chrome tanning process. Within a standardised dyeing process, 6% dyestuff was used with the float at 50°C, followed by fixation using 6% formic acid.

Brilliance and colour uniformity were evaluated by visual observation and by awarding a point between 0 and 100 to each. Penetration was evaluated by observing the colour distribution along the crust leather cross section and by awarding a point between 0 and 100. Similarly, the light fastness to artificial light evaluation was made by awarding a point between 0 and 100.

The light fastness test was carried out according to the I.U.F./402 directive. Small samples of dyed leather measuring 5x3 cm were taken, together with eight standard samples of dyed wool serving as controls. Half of each sample was exposed to a Xenon lamp operating at a temperature of 5500-6500 K for a period of 12 hours. After exposure, the colour shades of the exposed parts were compared with those of the parts that had not been exposed. The standard control samples consisted of woollen fabric dyed with the dyestuffs listed in *Figure 3*. Evaluations of the shades of dye were made using the ISO105-A03 grey scale as a reference.

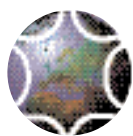
**Figure 3: Standard samples of reference for the artificial light fastness test**

| Standard | Color Index Designation         |
|----------|---------------------------------|
| 1        | C.I. Acid blue 104              |
| 2        | C.I. Acid blue 109              |
| 3        | C.I. Acid blue 83               |
| 4        | C.I. Acid blue 121              |
| 5        | C.I. Acid blue 47               |
| 6        | C.I. Acid blue 23               |
| 7        | C.I. Vat blue 5 in soluble form |
| 8        | C.I. Vat blue 8 in soluble form |

The evaluation of the overall dyeing quality was made by considering the following parameters: spectrophotometric performance, brilliance, penetration, colour uniformity, fastness to artificial light and. Once each parameter was associated to a point between 0 and 100, these points were then adjusted or

**Figure 4: Weighting attributed to each parameter analysed for determining the overall dye performance capacity evaluation**

|           | Spectrophotometric performance | Brilliance | Penetration | Colour uniformity | Light fastness |
|-----------|--------------------------------|------------|-------------|-------------------|----------------|
| Weighting | 0.24                           | 0.19       | 0.14        | 0.24              | 0.19           |

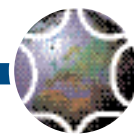


Figures 5a and 5b: Summary of test results

|                                | CI 1 - Acid Orange 61 |                 |                 | CI 2 - Acid Blue 113    |                        |                       | CI 3 - Acid Blue 193 |                 |                 | CI 4 - Acid Brown 75 |                    |                       |                              |                         |
|--------------------------------|-----------------------|-----------------|-----------------|-------------------------|------------------------|-----------------------|----------------------|-----------------|-----------------|----------------------|--------------------|-----------------------|------------------------------|-------------------------|
|                                | A1                    | B1              | D1              | D2                      | E2                     | F2                    | A3                   | B3              | D3              | A4                   | B4                 | C4                    | D4                           | F4                      |
| Reaction to acid               | brown - crimson       | brown - crimson | brown - crimson | dark blue flame violet  | dark blue flame violet | dark blue flame green | no change            | no change       | no change       | greenish yellow      | greenish yellow    | clear greenish yellow | pale yellow                  | greeny yellow           |
| Reaction to alkali             | no change             | no change       | no change       | slightly pinkish violet | no change              | no change             | no change            | no change       | no change       | dark bluish brown    | dark brown magenta | dark brown magenta    | medium intensity red magenta | almost black dark brown |
| Blow test                      | single dyestuff       | single dyestuff | single dyestuff | single dyestuff         | single dyestuff        | single dyestuff       | single dyestuff      | single dyestuff | single dyestuff | single dyestuff      | single dyestuff    | single dyestuff       | single dyestuff              | single dyestuff         |
| UV-Vis. analysis               |                       |                 |                 |                         |                        |                       |                      |                 |                 |                      |                    |                       |                              |                         |
| λ (nm)                         | 438.5                 | 442             | 443             | 540.50                  | 539.50                 | 566.50                | 577.50               | 573.00          | 577.00          | 427.50               | 433.50             | 427.50                | 434.00                       | 427.00                  |
| Absorbency                     | 0.6191                | 0.4021          | 1.2004          | 0.6189                  | 0.7878                 | 0.7549                | 0.5977               | 0.4278          | 0.5837          | 1.1724               | 1.2558             | 1.0648                | 1.2816                       | 0.8408                  |
| Spectrophotometric performance | 51.57                 | 33.50           | 100.00          | 78.56                   | 100.00                 | 95.82                 | 100.00               | 71.57           | 97.66           | 91.48                | 97.99              | 83.08                 | 100.00                       | 65.61                   |
| Brilliance                     | 100                   | 70              | 100             | 90                      | 90                     | 100                   | 90                   | 80              | 100             | 100                  | 80                 | 100                   | 100                          | 80                      |
| Penetration                    | 100                   | 100             | 100             | 100                     | 100                    | 100                   | 100                  | 100             | 100             | 100                  | 100                | 100                   | 100                          | 100                     |
| Colour uniformity              | 100                   | 100             | 100             | 100                     | 100                    | 100                   | 100                  | 100             | 100             | 100                  | 100                | 100                   | 100                          | 100                     |
| Lightfastness                  | 90                    | 80              | 90              | 90                      | 90                     | 90                    | 100                  | 100             | 100             | 100                  | 100                | 100                   | 100                          | 100                     |
| Total points♦                  | 86                    | 75              | 98              | 91                      | 96                     | 97                    | 98                   | 89              | 99              | 98                   | 96                 | 96                    | 100                          | 88                      |

|                                                  | C.I. 5 - Acid Brown 97 |                      |                    |                             |                  | C.I. 6 - Acid Brown 160 |                  |                             | C.I. 7 - Acid Brown 165     |                             |                             | C.I. 8 - Acid Brown 188 |                          |                          |                          |
|--------------------------------------------------|------------------------|----------------------|--------------------|-----------------------------|------------------|-------------------------|------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------|--------------------------|--------------------------|--------------------------|
|                                                  | A5                     | B5                   | C5                 | D5                          | A6               | D6                      | F6               | A7                          | B7                          | D7                          | F7                          | C8                      | D8                       | E8                       | F8                       |
| Reaction to acid                                 | loss of yellow shade   | loss of yellow shade | slight yellowing   | slight yellowing            | no change        | yellow orange           | yellow orange    | no change                   | no change                   | no change                   | no change                   | no change               | weakening of yellow tone | weakening of yellow tone | weakening of yellow tone |
| Reaction to alkali                               | red violet             | red violet           | intense red violet | red violet medium intensity | no change        | no change               | no change        | brown veering towards green | brown veering towards green | brown veering towards green | brown veering towards green | bordeaux                | scarlet                  | red brown                | red brown                |
| Blow test                                        | Single dyestuff        | Single dyestuff      | Single dyestuff    | Single dyestuff             | Single dyestuff  | Single dyestuff         | Single dyestuff  | Single dyestuff             | Single dyestuff             | Single dyestuff             | Single dyestuff             | Single dyestuff         | Single dyestuff          | Single dyestuff          | Single dyestuff          |
| UV-Vis. analysis<br>$\lambda$ (nm)<br>Absorbency | 430.00<br>1.4449       | 431.00<br>1.3830     | 437.00<br>1.0589   | 437.00<br>1.3793            | 452.50<br>0.6454 | 452.00<br>0.7460        | 447.50<br>0.4784 | 399.50<br>0.7139            | 411.00<br>0.7960            | 399.50<br>0.9888            | 399.50<br>0.4991            | 389.00<br>1.2221        | 426.00<br>1.5372         | 429.50<br>1.1147         | 430.50<br>0.6677         |
| Spectrophotometric performance                   | 100.00                 | 95.72                | 73.29              | 95.46                       | 86.51            | 100.00                  | 64.13            | 72.20                       | 80.50                       | 100.00                      | 50.48                       | 79.50                   | 100.00                   | 72.51                    | 43.44                    |
| Brilliance                                       | 100                    | 100                  | 100                | 100                         | 100              | 80                      | 80               | 80                          | 80                          | 100                         | 80                          | 80                      | 100                      | 90                       | 90                       |
| Penetration                                      | 100                    | 100                  | 100                | 100                         | 100              | 100                     | 100              | 100                         | 100                         | 100                         | 100                         | 100                     | 100                      | 100                      | 100                      |
| Colour uniformity                                | 100                    | 100                  | 100                | 100                         | 100              | 100                     | 100              | 100                         | 100                         | 100                         | 100                         | 50                      | 100                      | 100                      | 100                      |
| Lightfastness                                    | 80                     | 90                   | 90                 | 80                          | 100              | 90                      | 90               | 100                         | 100                         | 100                         | 90                          | 90                      | 80                       | 80                       | 70                       |
| Total points♦                                    | 96                     | 97                   | 92                 | 95                          | 97               | 94                      | 86               | 90                          | 92                          | 100                         | 82                          | 89                      | 96                       | 88                       | 79                       |

♦ Total points is the sum of the weighed values attributed to Spectrophotometric performance, brilliance, penetration, colour uniformity and lightfastness.



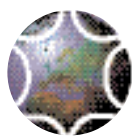
Figures 5c and 5d: Summary of test results

|                                | CI 9 – Acid Brown 191        |                             |                  |  | CI 10 – Acid Brown 314 |                        |                        |  | CI 11 – Acid Brown 322 |                     |                     | CI 12 – Acid Yellow 194 |                 |                 |                 |
|--------------------------------|------------------------------|-----------------------------|------------------|--|------------------------|------------------------|------------------------|--|------------------------|---------------------|---------------------|-------------------------|-----------------|-----------------|-----------------|
|                                | D9                           | E9                          | F9               |  | D10                    | E10                    | F10                    |  | A11                    | B11                 | D11                 | A12                     | B12             | C12             | D12             |
| Reaction to acid               | very slight olive green ring | no change                   | no change        |  | no change              | no change              | no change              |  | intense olive green    | intense olive green | intense olive green | no change               | no change       | no change       | no change       |
| Reaction to alkali             | grey with violet nuances     | grey with slight green vein | dark grey violet |  | tending towards orange | tending towards orange | tending towards orange |  | pink bordeaux          | dark pink           | pink bordeaux       | no change               | no change       | no change       | no change       |
| Blow test                      | Single dyestuff              | Single dyestuff             | Single dyestuff  |  | Single dyestuff        | Single dyestuff        | Single dyestuff        |  | Single dyestuff        | Single dyestuff     | Single dyestuff     | Single dyestuff         | Single dyestuff | Single dyestuff | Single dyestuff |
| UV-Vis. analysis               |                              |                             |                  |  |                        |                        |                        |  |                        |                     |                     |                         |                 |                 |                 |
| λ (nm)                         | 425.00                       | 412.50                      | 421.00           |  | 406.50                 | 411.00                 | 410.00                 |  | 443.50                 | 436.50              | 444.00              | 445.50                  | 446.00          | 446.00          | 445.50          |
| Absorbency                     | 1.3746                       | 1.2629                      | 0.6266           |  | 1.2037                 | 0.8227                 | 0.7352                 |  | 1.0946                 | 1.0370              | 1.0970              | 1.1083                  | 0.8575          | 0.9143          | 1.2562          |
| Spectrophotometric performance | 100.00                       | 91.87                       | 45.58            |  | 100.00                 | 68.35                  | 61.08                  |  | 99.78                  | 94.53               | 100.00              | 88.23                   | 68.26           | 72.78           | 100.00          |
| Brilliance                     | 100                          | 70                          | 90               |  | 100                    | 90                     | 70                     |  | 100                    | 100                 | 100                 | 100                     | 100             | 100             | 100             |
| Penetration                    | 90                           | 100                         | 70               |  | 80                     | 90                     | 100                    |  | 90                     | 90                  | 90                  | 100                     | 100             | 100             | 100             |
| Colour uniformity              | 100                          | 100                         | 100              |  | 100                    | 100                    | 100                    |  | 100                    | 100                 | 100                 | 100                     | 100             | 100             | 100             |
| Lightfastness                  | 100                          | 100                         | 100              |  | 80                     | 80                     | 80                     |  | 80                     | 90                  | 90                  | 90                      | 80              | 80              | 80              |
| Total points♦                  | 99                           | 93                          | 81               |  | 93                     | 85                     | 81                     |  | 95                     | 95                  | 97                  | 95                      | 89              | 90              | 96              |

|                                | CI 13 – Acid Red 97               |                                   |                                 |  | CI 14 – Acid Red 119 |                 |                 |  | CI 15 – Acid Green 26  |                        |                             | CI 16 – Acid Green 68                    |                                          |                                          |                                          |
|--------------------------------|-----------------------------------|-----------------------------------|---------------------------------|--|----------------------|-----------------|-----------------|--|------------------------|------------------------|-----------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|
|                                | C13                               | D13                               | F13                             |  | D14                  | E14             | F14             |  | A15                    | D15                    | F15                         | A16                                      | B16                                      | D16                                      | E16                                      |
| Reaction to acid               | slight darkening towards bordeaux | slight darkening towards bordeaux | no change                       |  | no change            | no change       | no change       |  | no change              | no change              | no change                   | greenish pink                            | slight darkening pinkish green           | slight darkening reddish green           | greenish pink                            |
| Reaction to alkali             | amaranth with slight green ring   | amaranth with slight brown ring   | amaranth with slight brown ring |  | no change            | no change       | no change       |  | slight yellowish tinge | slight yellowish tinge | very slight yellowish tinge | definite darkening towards greenish blue | definite darkening towards greenish blue | definite darkening towards greenish blue | definite darkening towards greenish blue |
| Blow test                      | Single dyestuff                   | Single dyestuff                   | Single dyestuff                 |  | Single dyestuff      | Single dyestuff | Single dyestuff |  | Single dyestuff        | Single dyestuff        | Single dyestuff             | Single dyestuff                          | Single dyestuff                          | Single dyestuff                          | Single dyestuff                          |
| UV-Vis. analysis               |                                   |                                   |                                 |  |                      |                 |                 |  |                        |                        |                             |                                          |                                          |                                          |                                          |
| λ (nm)                         | 496.00                            | 497.50                            | 497.00                          |  | 526.00               | 525.50          | 524.00          |  | 666.00                 | 666.50                 | 666.00                      | 602.00                                   | 603.50                                   | 605.00                                   | 604.00                                   |
| Absorbency                     | 1.4588                            | 1.9308                            | 1.2316                          |  | 0.9067               | 0.9630          | 0.7793          |  | 0.8820                 | 0.7604                 | 0.3488                      | 1.0769                                   | 0.6962                                   | 0.9262                                   | 1.1787                                   |
| Spectrophotometric performance | 75.55                             | 100.00                            | 63.79                           |  | 94.15                | 100.00          | 80.92           |  | 100.00                 | 86.21                  | 39.55                       | 91.36                                    | 59.07                                    | 78.58                                    | 100.00                                   |
| Brilliance                     | 100                               | 100                               | 100                             |  | 100                  | 100             | 100             |  | 100                    | 100                    | 80                          | 100                                      | 100                                      | 100                                      | 100                                      |
| Penetration                    | 100                               | 80                                | 100                             |  | 100                  | 90              | 100             |  | 100                    | 100                    | 90                          | 100                                      | 100                                      | 100                                      | 100                                      |
| Colour uniformity              | 100                               | 100                               | 100                             |  | 100                  | 100             | 100             |  | 100                    | 100                    | 100                         | 100                                      | 100                                      | 100                                      | 100                                      |
| Lightfastness                  | 90                                | 90                                | 90                              |  | 80                   | 90              | 90              |  | 80                     | 90                     | 80                          | 60                                       | 60                                       | 50                                       | 50                                       |
| Total points♦                  | 92                                | 95                                | 89                              |  | 95                   | 97              | 94              |  | 96                     | 95                     | 76                          | 90                                       | 83                                       | 85                                       | 91                                       |

♦ Total points is the sum of the weighed values attributed to Spectrophotometric performance, brilliance, penetration, colour uniformity and lightfastness.



weighed according to an index for each parameter, these weighing being shown in *Figure 4*.

The final results were calculated as the sum of the weighted points as attributed to each parameter. These are termed “Total Points” and shown in *Figures 5a, 5b, 5c and 5d*.

### Findings from the evaluations

The findings from the evaluations are set out in *Figures 5a, 5b, 5c and 5d*.

#### BLOW TEST

All of these dyes were shown to be single dyestuffs.

#### ACID/ALKALI REACTION, UV-VISIBLE SPECTROPHOTOMETRY & CHROMATOGRAPHY

The acid/alkali reactions and the UV-Visible Spectrophotometry showed differences in the chemical compositions of commercial products having the same CI. Within the framework of the CI, variations in acid/alkali reactions and peaks of absorption were observed for CIs 2, 5, 7 and 8.

In CIs 7 and 8, the dye's performance capacity seems to depend more heavily on spectrophotometric performance rather than on the chemical nature of the dye. For example, for CI 7 (*Acid brown 165*), the chemical difference between the sample B7 and the others does not cause obvious variations in brilliance, penetration and uniformity of colour. The dye's performance capacity is, therefore, influenced more by the difference in concentration than from differences in chemical structure.

The same thing can be observed for CI 8 (*Acid Brown 188*) where the dye C8 presents a different chemical structure from the corresponding products. This is shown both in the chromatography test and in the UV-Visible spectrophotometric analysis, given as *Figure 6*.

Nevertheless brilliance, penetration and uniformity appear comparable. Shade differences are, therefore, influenced strongly by spectrophotometric performance.

On the other hand, with reference to CIs 2 and 5, the dye's performance capacity seems to depend more heavily on the chemical nature of the dye. In this situation the UV-Visible spectrums of the samples with CI 2 (*Acid Blue 113*) presents a transfer of the absorption peak of dye F2 towards longer wavelengths, compared to other dyes. Moreover, the chromatographic analysis, shown in *Figure 7*, confirmed the different chemical composition of dye F2.

This different chemical nature also influences F2's different reaction to acid when compared with that of other dyes bearing the same CI. This improves the brilliance of the dyed leather to the point where, notwithstanding a lower spectrophotometric performance, the quality of dye F2 proves to be manifestly superior.

For the other CIs, the dyes tested turned out to be very similar chemically as shown in *Figure 8*, only presenting differences in concentration.

It is interesting to note that, even with the same chemical composition, enhanced spectrophotometric performance does not necessarily correspond to a higher dye performance capacity, as in the case of CIs 3 and 6.

### Judgements on a cost/performance basis

Commercial dyes classified under the same CI can have different chemical compositions and may be marketed with different concentrations of active substances. Accordingly, one or

**Figure 6: UV-Vis. spectrophotometric and TLC analysis of Acid Brown 188 commercial products**



**Figure 7: UV-Vis. spectrophotometric and TLC analysis of Acid Blue 113 commercial products**

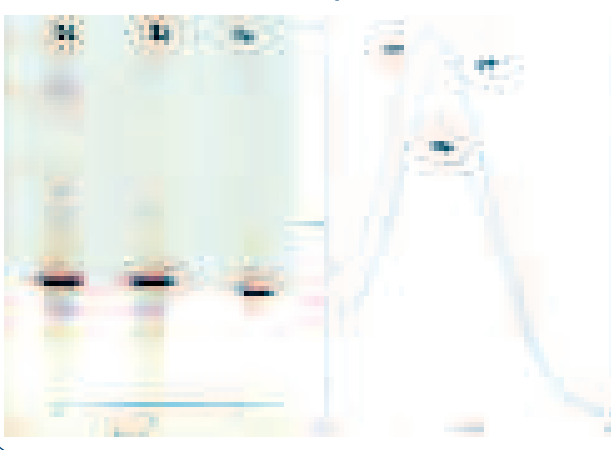
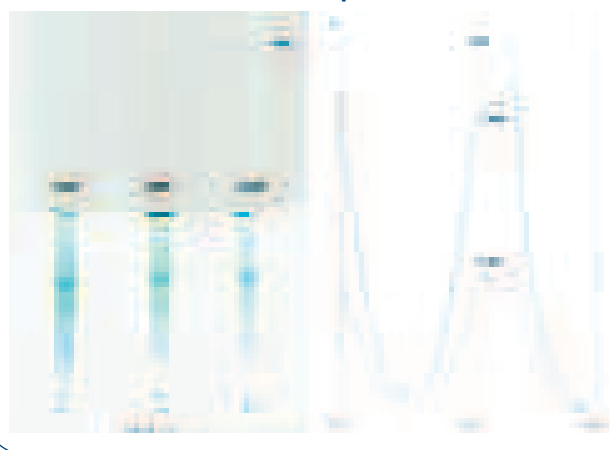


**Figure 8: UV-Vis. spectrophotometric and TLC analysis of Acid Green 26 commercial products**



the other can prevail, determining the overall dye performance capacity.

This series of simple tests described can be applied in-house to dyestuffs—and leathers dyed using those dyestuffs—showing that it is possible to form judgements on the commercial product under examination. Informed choices are therefore possible between commercial dyes of different origins but having the same CI, on a cost/performance basis.