

## ***PHYSICAL-MECHANICAL TEST LABORATORY***



### **ANALYSIS OF THE IMAGE IN THE EVALUATION OF THE QUALITY OF HAIR DYES AND OF SHAMPOOS FOR DYED HAIR**

## 1 - ABSTRACT

This informative document describes the possible uses of a scanner for the evaluation of the quality of hair dyes, of shampoos for dyed hair, of products both for professional and for domestic use destined to increase the colouring duration.

## 2 – INTRODUCTION

To verify the quality of hair dyes, of the shampoos for dyed hair and of the professional products or for domestic use destined to increase the colouring duration, it is very important to evaluate the covering capacity, the colouring duration and the tone of the hair after the colouring.

These evaluations can be carried out:

- by comparison with a competitor product and/or with a market leader product;
- on the same product taken in different times to verify the qualitative constancy of the production lots;
- on the same product at 0 (zero) time and after the performance of accelerated ageing test (shelf life).

The hair dye and other possible correlated treatments are applied on locks of natural hair, of different colours or on white locks of hair given by specialized institutes.

They can be evaluated only after the application of the products and after being submitted to different treatments such as:

- exposure to sun light using a simulator;
- repeated washings;
- immersion in seawater;
- washings in coloured washings;
- colour fastness to acid and alkaline perspiration;
- colour fastness to ironing (with straightener).

## 3 – TEST MODALITIES

Depending on the required test, the application of the hair dye or of other products to be evaluated can be the only applied treatment, before proceeding with the evaluations, or it is possible to carry out additional treatments to verify different kinds of claim. The dyed hair can be submitted to:

- repeated cycles of washings with normal shampoos and/or with special shampoos for dyed hair: the use of normal shampoos allow to evaluate the resistance of the hair dye, whereas the use of shampoo for dyed hair by comparison with a competitor, or with a leader or with a normal shampoo allow to evaluate the efficacy of this kind of products.
- exposure to sun light by the use of a simulator with xenon lamps: this test can be carried out at different temperatures according to the requirements of the costumer: 20°C for not adding to the effect of the sun rays the one of the temperature, 40°C to simulate, in addition to the light exposure, the summer temperature. Also the humidity can be regulated according to the requirements of the costumer, from 25% to 95% UR.
- Immersion in seawater and in chlorinated water (of swimming pool). To prepare the necessary solutions to perform these tests are used normative references (UNI EN ISO 105 E02 – colour fastness to seawater and UNI EN ISO 105 E03 – colour fastness to chlorinated water) normally they are used in the textile sector. In this way, it is possible to evaluate the resistance of the hair dyes in the bathing season during which, besides the

seawater exposure, the hair are often washed with showers in the beaches, which water is strongly added with chlorine.

- Colour fastness to acid and alkaline perspiration. To prepare the necessary solution to perform this test, it is used a normative reference (UNI EN ISO 105 E04 – colour fastness to acid and alkaline perspiration) that is usually used in the textile sector.
- Colour fastness to ironing (with hair straightener). With this test it is evaluated the resistance and the stability of the colouring of the hair after the ironing of the hair with hair straightener at 200°C (except in case of different indications by the costumer).

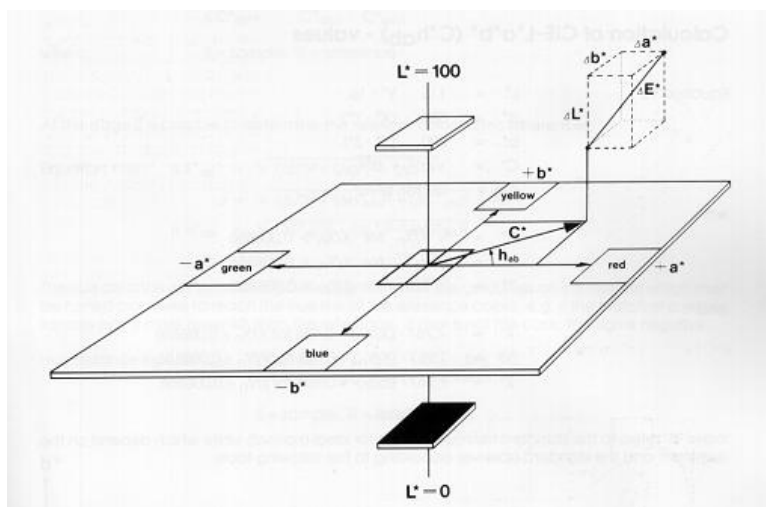
After the preparation of the samples, it is necessary to measure the colour. On the locks of the hair it is impossible to use a spectrophotometer, that it is not able to measure the colour on the samples with irregular surfaces or heterogeneous colorings. The use of a scanner allows to work on this kind of samples that are photographed in a lightning controlled environment. The imagine at high resolution, visualized on a calibrated monitor, allows to obtain a high quality of reproducibility and definition of the colors on the locks of hair, that have irregular form, shadings and different tones.



The transformation of a part of the imagine in fastness and colorimetric values CIE allows to point out, without ambiguity, the fingerprint of the colour.

The possible applications of the scanner, which can be used both singly and in combination according to the characteristics of the samples, are the following:

- DIFFERENCES OF THE COLOUR - This function is used to evaluate the difference of colour between two samples and allows to compare single point of colour inside the imagine of a specific sample.
- DECOMPOSITION OF THE COLOUR - This function is used to evaluate the quality of reproducibility of the examined sample, decomposing the colour of a selected area to determine the variations.

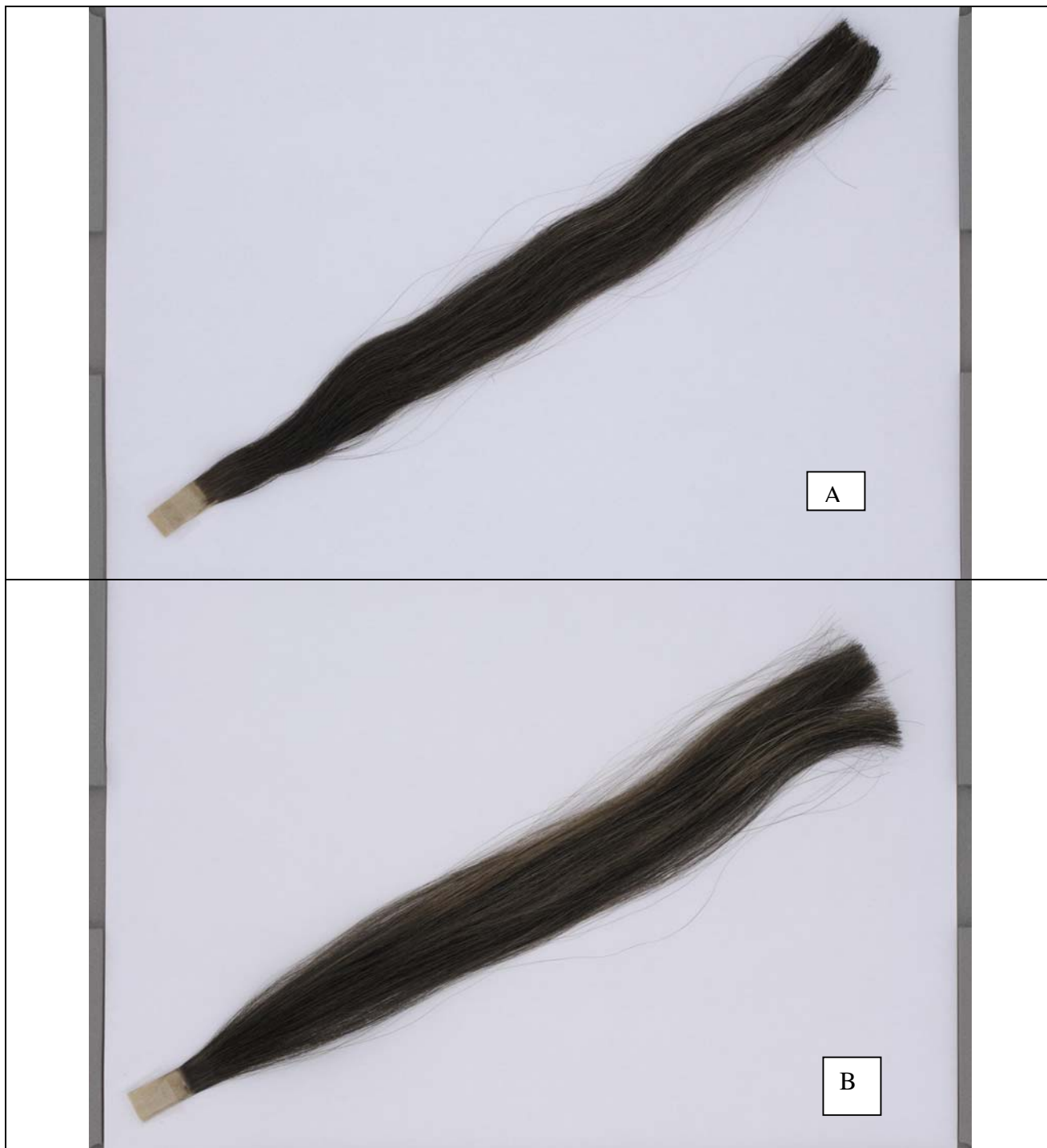


The imagine above reproduced shows visually the meaning of the colour components.

## 4 – EXAMPLE

The images below reproduced show three locks of hair that are usually used to perform the tests on this kind of products. In particular, the blond locks are coloured with a brown hair dye (A) and then a series it was subjected to 15 consecutive washings with shampoo and a product to fix the hair dye (B), the other only with the shampoo (C).

The following tables show as the equipment can describe the color variations.





These tables show the data related to  $\Delta L$  e al  $\Delta E$ .

T0 VS T15 BROWN HAIR DYE,BLOND HAIR FIX

DL	DE
1.08	1.93

T0 VS T15 BROWN HAIR DYE,BLOND HAIR FIX

DL	DE
7.1	5,65

$\Delta L$  indicates how much the sample is bleached or darkened. The equipment calculates the  $\Delta L$  subtracting the result obtained by the treated sample to those of the reference sample. As a consequence, a  $\Delta L$  higher than zero demonstrates that the sample is bleached after the treatment. In particular the  $\Delta L$  is very smaller in the lock treated with the fix product than those not treated.

$\Delta E$  indicates the difference of colour of the sample before and after the treatment. This parameter is obtained by the coordinates  $L^*$ ,  $a^*$  and  $b$  and for convention it is considered that if it is superior to 2, the difference of colour is visible to human eye. In this case, it is possible to note a  $\Delta E$  equal to 1.93 in the lock treated with the fix product, and equal to 7.1 in the non-treated lock. The modification of the colour is minimum in the first case, and very accentuated in the second case.

The following tables mention the values of the colour related to the decomposition of the colour in 5 components.

### CLUST T0 BROWN DYE BLOND HAIR

Standard Table				
Name	L*	a*	b*	Percentage
Index0 D65/10	6,75	1,77	-0,8	12,6%'
Index1 D65/10	15,03	0,9	0,9	25,3%'
Index2 D65/10	23,03	0,29	1	16,2%'
Index3 D65/10	18,45	-1,53	9,31	31,3%'
Index4 D65/10	12,64	1,15	0,63	14,7%'
AVERAGE	<b>15,2</b>	<b>0,5</b>	<b>2,2</b>	

### CLUST T15 BROWN DYE BLOND HAIR WITH FIX PRODUCT

Standard Table				
Name	L*	a*	b*	Percentage
Index0 D65/10	13,46	1,01	0,39	24,6%'
Index1 D65/10	15,87	0,7	0,54	23,9%'
Index2 D65/10	20,17	-1,32	0,71	27,5%'
Index3 D65/10	24,06	0,41	8,76	12,3%'
Index4 D65/10	9,91	2,94	0,09	11,8%'
AVERAGE	<b>16,7</b>	<b>0,7</b>	<b>2,1</b>	

### CLUST T15 BROWN DYE BLOND HAIR WITHOUT FIX PRODUCT

Standard Table				
Name	L*	a*	b*	Percentage
Index0 D65/10	12,61	10,59	9,44	19,4%'
Index1 D65/10	18,45	7,31	17,55	29,4%'
Index2 D65/10	21,47	4,16	7,21	23,8%'
Index3 D65/10	32,29	2,71	7,37	7,6%'
Index4 D65/10	26,76	7,71	9,67	19,7%'
AVERAGE	<b>22,3</b>	<b>6,5</b>	<b>10,2</b>	

In these tables the colour was decomposed in 5 components. For each of these components, are reported the % (percentage) and the values of L\*, a\* and b. Examining the middle values, it is possible to see that the component a\* (that indicates the colour change towards the red), is clearly increased in the locks washed without the fix product, whereas it is steady in those washed with the fix product. Also the component b\*, which in case it is bigger than 0 (zero) indicates a colour change towards yellow, modifies itself in the locks washed without the fix product and remains steady in the others. At last L\* shows a strong increase in the locks washed without the fix product and a light increase in those washed with the fix product. These data show that the hair washed with the fix product also after 15 washings has an hair dye similar to T0, whereas the hair washed without fix product bleached significantly and the dye assumes red component leaving glimpse the original hair dye (blond) as demonstrated the clear increase of the component b\*. In all the sample it is possible to evaluate the different percentages of the shadings that compose the dye.

## 5 – BIBLIOGRAPHY

- UNI EN ISO 105 E02-1998 - Textiles – Test of colour fastness-Colour fastness to seawater
- UNI EN ISO 105 E03-1998 - Textiles – Test of colour fastness - Colour fastness to chlorinated water (water of swimming pool)
- UNI EN ISO 105 E04-2009 - Textiles - Test of colour fastness - Colour fastness to perspiration.