LEATHER FINISHING WITH NEW PIGMENT PASTE

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Received: 28.02.2017 Accepted: 20.03.2017 https://doi.org/10.24264/lfj.17.1.9

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ABSTRACT. The paper presents obtaining and characterisation of full grain bovine shoe upper leather finished with new pigment pastes containing flax seed oil (brown colour) and poppy seed oil (yellow colour) as plasticizer instead of castor oil (reference). Nitrocellulose, polyurethane or acrylic dressing were used as final dressing. Finished leathers were characterized by physical-mechanical analysis and colorimetric method before and after aging. The leathers finished with polyurethane or acrylic final dressing had the highest resistance to light after aging under the influence of artificial light in comparison with those finished with nitrocellulose dressing. Flax and poppy seed oils used as plasticizers improved resistance to ageing of coating.
KEY WORDS: pigment paste, plasticizer, castor oil, flax seed oil, poppy seed oil

FINISAREA PIELII CU O NOUĂ PASTĂ DE PIGMENT

REZUMAT. Lucrarea prezintă obţinerea şi caracterizarea pielii bovine pentru feţe încălţăminte realizată prin finisare cu noi paste de pigmenţi cu conţinut de ulei din seminţe de in (culoare brună) şi ulei din seminţe de mac (culoare galbenă) ca plastifiant în locul uleiului de ricin (referinţă). Ca apret final s-a utilizat apret nitrocelulozic, poliuretanic şi acrilic. Pieile finite au fost caracterizate prin analize fizico-mecanice şi prin metoda colorimetrică înainte şi după îmbătrânire. Pieile finite cu apret final poliuretanic sau acrilic au prezentat cea mai mare rezistenţă la lumină după îmbătrânire sub influenţa luminii artificiale în comparaţie cu cele finite cu apret nitrocelulozic. Uleiurile din seminţe de in şi de mac utilizate ca plastifianţi au îmbunătăţit rezistenţa la îmbătrânire a stratului de acoperire.
CUVINTE CHEIE: pastă pigment, plastifiant, ulei de ricin, ulei din seminţe de in, ulei din seminţe de mac

LA FINITION DU CUIR AVEC UNE NOUVELLE PÂTE DE PIGMENT

RÉSUMÉ. Cet article présente la caractérisation et l'obtention du cuir bovin pour tiges chaussures obtenu par finissage avec une nouvelle pâte de pigment contenant de l'huile de graines de lin (couleur brune) et de l'huile de graines de pavot (couleur jaune) comme plastifiant au lieu de l'huile de ricin (comme référence). On a utilisé des apprêts nitrocellulose, polyuréthane et acrylique pour l'apprêtage final du cuir. Les cuirs ont été caractérisés par des analyses physico-mécaniques et par la méthode colorimétrique avant et après vieillissement. Les cuirs finis en utilisant de l'apprêt final polyuréthane ou acrylique ont montré la plus grande résistance à la lumière après vieillissement sous l'influence de la lumière artificielle par rapport à l'apprêt final nitrocellulose. Les huiles de graines de lin et de pavot utilisés comme plastifiants ont une résistance améliorée au vieillissement du revêtement.
MOTS CLÉS : pâte pigment, plastifiant, huile de ricin, huile de graines de lin, huile de graines de pavot

INTRODUCTION

The purpose of finishing is to improve the use properties of leather and to protect it from wetting and soiling, to level out patches and grain faults, furthermore to modify the surface properties (shade, lustre, handle, etc.).

The quality of pigment pastes used to develop finishing films impart some physical-mechanical, technological, aesthetical and ecological properties to the finished leather. Cumulated, they give value of use and commercial appearance to the manufactured products: footwear, clothing, handbags, etc. Pigments are inorganic or organic compounds constituting the colouring base of covering paints. In order to be used for leather finishing, pigments have to present some characteristics, the most important being: resistance to light, atmospheric agents and temperature, brilliant colour, great covering power, great degree of dispersion, compatibility with the other components of the finishing solution [1].

The formulations of pigment pastes for leather finishing usually contain castor oil as plasticizer. Castor oil is a vegetable oil obtained by pressing the seeds of the castor oil plant (*Ricinus communis*) [2]. It is a triglyceride in which approximately 90 percent of fatty acid chains are ricinoleates. Oleate and linoleates are the other significant components.

The castor seed contains ricin, a toxic protein. Heating during the oil extraction process denatures and deactivates the protein. However, harvesting castor beans may not be without risk [3]. Allergenic compounds found on the plant

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surface can cause permanent nerve damage, making the harvest of castor beans a human health risk. India, Brazil, and China are the major crop producers, and the workers suffer harmful side effects from working with these plants [4]. These health issues, in addition to concerns about the toxic by-product (ricin) from castor oil production, have encouraged the quest for alternative sources for hydroxy fatty acids [5, 6].

In order to increase health and environmental protection alternative materials with low toxicity are used to develop a finishing auxiliary – pigment paste [11-15].

Flax and poppy seed oils were reported to increase the films' resistance to yellowing over time [7, 8].

Linseed oil, also known as flaxseed oil, is a colourless to yellowish oil obtained from the dried, ripened seeds of the flax plant (*Linum usitatissimum*). The oil is obtained by pressing, sometimes followed by solvent extraction. Linseed oil is a drying oil, meaning it can polymerize into a solid form. Due to its polymer-forming properties, linseed oil can be used on its own or blended with combinations of other oils, resins or solvents as an impregnator, drying oil finish or varnish in wood finishing, as a pigment binder in oil paints, as a plasticizer and hardener in putty, and in the manufacture of linoleum.

Linseed oil is a triglyceride, like other fats. Linseed oil is distinctive for its unusually large amount of α-linolenic acid, which has a distinctive reaction with oxygen in air [9].

Linseed oil is a common carrier used in oil paint. It can also be used as a painting medium, making oil paints more fluid, transparent and glossy. It is available in varieties such as cold pressed, alkali refined, sun bleached, sun thickened, and polymerised (stand oil).

Poppy seed oil is a drying oil. In oil painting, it is a popular oil for binding pigment, thinning paint, and varnishing finished paintings. Some users consider "sun-thickened" poppy seed oil to be the best painting medium [10]. While poppy seed oil does not cause as much yellowish tinting of paints as linseed oil, it dries slower and is less durable than linseed oil because the fat responsible for the yellowing also provides durability [10].

The paper presents obtaining and characterization of full grain bovine shoe upper leather finished with new pigment pastes [11-13] containing flax seed oil (brown colour) and poppy seed oil (yellow colour) as plasticizer instead of castor oil (reference). Nitrocellulose, polyurethane or acrylic dressing were used as final dressing. Finished leathers were characterized by physical-mechanical analysis and colorimetric method before and after aging.

EXPERIMENTAL

Materials

The chrome tanned bovine leathers, finished and crust for shoe upper: 1.2-1.4 mm thickness; brown; obtained in the facilities of INCDTP – Division Leather and Footwear Research Institute Bucharest, Romania.

Auxiliary materials for leather finishing from TFL Company, Germany.

Roda wax Mono: dry substance 36.87%; pH (10% solution) 4.2; Ford cup viscosity Φ4, 12; kinematic viscosity 8.97 cSt; density 0.957 g/cm^3.

Roda-cryl 87: dry substance 34.50%; pH (10% solution) 6.0; Ford cup viscosity Φ4, 14; density 1.025 g/cm^3.

Roda-pure 302, polyurethane binder for ground coat: dry substance 30.87%; pH (10% solution) 7.5; Ford cup viscosity Φ4, 15; density 1.076 g/cm^3.

Roda-pure 5011, polyurethane binder: dry substance 40%; pH (10% solution) 5.5; Ford cup viscosity Φ4 7; density 1.053 g/cm^3.

Roda lac 93, dry substance 15%.

Roda pur 5011, dry substance – 41%, pH – 6.5.

Other auxiliary materials for leather finishing.

Medacril EFP34, acrylic binder, ICPAO Mediaş, Romania, dry substance 39%, pH (10% solution) 5.5, Ford cup viscosity Φ4 12, kinematic viscosity, cSt 7, density 1.033 g/cm^3.

Wax-AGE 7, Feeling agent, INCDTP – Division ICPI, Buharest, Romania: dry substance 18.96, pH (10% solution) 7.3, Ford cup viscosity Φ4 27 s, kinematic viscosity, cSt 10.48, density 0.975 g/cm^3.

Methods

Chemical characteristics of bovine shoe upper leather were determined according to the following standards: SR EN ISO 4684:2006; Leather - Chemical tests - Determination of volatile matter; EN ISO 4048: 2008 - Determination of matter soluble in dichloromethane and free fatty acid content; SR EN ISO 5398:2008 - Leather - Determination of chromic oxide content; Part 1: Quantification by

titration; SR EN ISO 11640:2013 - Leather. Tests for colour fastness. Colour fastness to cycles of to-and-fro rubbing; SR EN ISO 5402:2003 - Leather - Physical and mechanical tests - Determination of flex resistance by flexometer method (ISO 5402:2002).

Colorimetric measurements of leather finishing were performed using a MINOLTA spectrophotometer (CM 2002), with light impulses from a xenon lamp with 0.8 cm aperture. Light reflection is focused on a silicon photo diode with wavelengths between 400 and 700 nm (10 nm steps) and L*a*b* values (chromatic coordinates: brightness, red/green and yellow/blue). In the CIE L*a*b* space used in colorimetric analysis by reflection, the tint (represented by fundamental colours – red, green, yellow and blue), brightness or clarity (represented by the chromatic stimulus varying from black to white) and saturation (purity of colour) are expressed according to three coordinates: L*, a* and b*. On the X axis, a* parameter has values between red (a* > 0) and green (a* < 0) stimuli, on the Y axis, b* parameter varies between yellow (b* > 0) and blue (b* < 0) stimuli, and L* parameter, on polar Z axis, represents brightness (grey axis), varying between white and black.

Obtaining and Characterization of Pigment Pastes

Brown and yellow pigment pastes were obtained as described in [11-13]. The formulations are presented in Table 1. The reference sample for brown colour was considered the PPR1 formulation and for yellow colour, PPG1, for which castor oil was used as plasticizer. For the formulations PPR2 and PPG2, flax seed oil was used as plasticizer and for formulations PPR3 and PPG3, poppy seed oil was used as plasticizer.

New pigment pastes were characterized by physical-chemical analyses. Physical-chemical characteristics are presented in Table 2.

Physical-chemical characteristics of new pigment pastes are similar, no much differences were observed.

Obtaining of Finished Bovine Shoe Upper Leather

The framework technology for dry finishing of bovine leather into natural grain box assortments (brown and yellow), is presented in Table 3.

RESULTS AND DISCUSSION

Characterization of Finished Shoe Upper Leathers

The finished shoe upper leathers were characterized by physical-mechanical tests and results are presented in Tables 5-7.

Physical-mechanical characteristics of thermally aged samples (IT1 and IT2) are generally inferior compared to those of not aged leathers (NA) and depend on temperature of the treatment and type of final dressing.

Table 1: The composition of new pigment paste formulations

Formulation/ Components	PPR 1 reference castor oil	PPR 2 flax seed oil	PPR 3 poppy seed oil	PPG 1 reference castor oil	PPG 2 flax seed oil	PPG 3 poppy seed oil
Red iron oxide, (%)	30	30	30	-	-	-
Yellow oxide, (%)	-	-	-	30	30	30
Polyacrylic binder, %	40	40	40	40	40	40
Ethoxylated lauric alcohol, %	10	10	10	10	10	10
Castor oil, %	10	-	-	10	-	-
Flax oil, %	-	10	-	-	10	-
Poppy seed oil, %	-	-	10	-	-	10
Wax emulsion, %	3	3	3	3	3	3
Water, %	7	7	7	7	7	7

Table 2: Physical-chemical characteristics of new pigment pastes

Sample/ Characteristics	PPR 1 reference	PPR 2	PPR 3	PPG 1 reference	PPG 2	PPG 3
Dry substance, %	43.83	43.23	44.45	47.14	47.33	48.10
pH solution 10%	6.9	7.2	7.3	6.8	7.0	7.1
Ash, %	56.45	56.67	56.94	57.19	57.38	58.21

Characterisation of Finished Leathers by Colorimetric Method

Finished leathers were tested according to the CIE LAB system; chromatic characteristics of leather are measured and presented in Table 8.

The finished leathers were artificially aged according to ISO 17228:2015 [17].

The following abbreviations were used: IT1 – leather aged at temperature of 50°C for 7 days; IT2 – leather aged at temperature of 70°C for 7 days; IL – leather aged in artificial light (Xenon lamp) for 7 days; IUV - leather aged in UV light for 7 days.

The colour difference parameters of the tested and reference leather samples are expressed by the following equations:

$$\Delta a^* = a^*_P - a^*_R \quad (1)$$

$$\Delta L^* = L^*_P - L^*_R \quad (2)$$

Based on these equations, the following parameters can be calculated:

- chromatic shifting, through the relation:

$$\Delta E^* = [\Delta a^{*2} + \Delta b^{*2} + \Delta L^{*2}]^{1/2} \quad (3)$$

- saturation or purity difference, using the relation:

$$\Delta C^* = [a^{*2}_P + b^{*2}_P]^{1/2} - [b^{*2}_R + L^{*2}_R]^{1/2} \quad (4)$$

- tint difference, through the relation:

$$\Delta H^* = [\Delta E^{*2} - \Delta L^{*2} - \Delta C^{*2}]^{1/2} \quad (5)$$

Variation of colorimetric parameters for aged finished leathers are shown in Tables 9 and 10.

The first group of samples was finished using reddish brown pastes (CL 1-CL 9) containing castor oil (CL 1, CL 4 and CL 7), flax oil (CL 2, CL 5 and CL 8) or poppy seed oil (CL 3, CL 6 and CL 9) as plasticizers and nitrocellulose (CL 1-CL 3), acrylic (CL 4-CL 6) or polyurethane (CL 7-CL 9) dressing.

After irradiation and thermal treatment, samples CL 7 and CL 8 have positive values for brightness ($\Delta L^*>0$), i.e. they have lighter (brighter) colours than sample CL 9 that has a negative value for brightness ($\Delta L^*<0$), indicating the positive influence of poppy seed oil on the colour.

Table 3: Finishing technology for bovine shoe upper leather

Operation	Composition of dispersion/Method of application
Application of dispersion I (basecoat)	100 g/L pigment paste PPR1/PPR2/PPR3/PPG1/PPG2/PPG3 30 g/L aqueous wax emulsion (Roda wax Mono) 300 g/L aqueous acrylic dispersion (Roda-cryl 87) 70 g/L water Application by spraying (2 passes dispersion I)
Intermediate pressing	In hydraulic press with the mirror or fog plate, parameters: - temperature 50-60°C; pressure 50-100 atm
Application of dispersion I	By spraying (2-3 passes dispersion I)
Application of final dressing (fixing)	Final dressing (3 variants) with the composition presented in Table 4. Application of the final dressing by spraying (2 passes)
Final ironing	In hydraulic press with the mirror plate, parameters: - temperature 70-80°C; pressure 50-100 atm

Table 4: Variants for final dressing of leather finishing

Variant / Components	FN (nitrocellulose)	FA (acrylic)	FP (polyurethane)
Roda lac 93, g/L (nitrocellulose)	700	-	-
Medacril EFP34, g/L (acrylic)	-	700	-
Roda pur 5011, g/L (polyurethane)	-	-	700
Wax emulsion AGE 7, g/L	20	20	20
Water, g/L	280	280	280

Samples CL 4-CL 9 aged by IL and IUV methods have ΔL^* parameters lower than CL 1-CL 3, indicating the positive influence of acrylic and polyurethane dressing on fastness to light of leathers compared to the nitrocellulose dressing.

ΔE^* colour difference is higher for leather sample CL 1 than for samples CL 2 and CL 3 aged using IT1 and IUV methods. Sample CL 4 has a higher colour difference than CL 5 and CL 6 aged

Table 5: Physical-mechanical characteristics of shoe upper leathers finished with new pigment pastes and nitrocellulose dressing

Sample/ Characteristic	MI	CL 1	CL 2	CL 3	CL 10	CL 11	CL 12
Nitrocellulose dressing							
Flex resistance, number	NA*	200.000	200.000	200.000	200.000	200.000	200.000
	IT1**	180.000	180.000	180.000	180.000	180.000	180.000
	IT2***	170.000	160.000	160.000	160.000	160.000	160.000
Colour fastness to cycles of to-and-fro rubbing, 1-5	NA*	5/4 4/3	5/4 4/3	5/4 4/3	5/4 4/3	5/4 4/3	5/4 4/3-4
	IT1**	5/4 4/3	5/4 4/3	5/4-5 4/3	5/4 4/3	5/4 4/3	5/4-5 4/3-4
	IT2***	5/3 4/3	5/4 4/3	5/4 4/3	5/3-4 4/2-3	5/3-4 4/2-3	5/4 4/3

NA* - not aged;
IT1**- leather aged at temperature of 50°C for 7 days;
IT2*** – leather aged at temperature of 70°C for 7 days

Table 6: Physical-mechanical characteristics of shoe upper leathers finished with new pigment pastes and polyacrylic dressing

Sample/ Characteristic	MI	CL 4	CL 5	CL 6	CL 13	CL 14	CL 15
Polyacrylic dressing							
Flex resistance, number	NA*	200.000	200.000	210.000	200.000	200.000	210.000
	IT1**	180.000	180.000	190.000	180.000	180.000	190.000
	IT2***	170.000	170.000	80.000	170.000	170.000	180.000
Colour fastness to cycles of to-and-fro rubbing, 1-5	NA*	5/4 4/3	5/4 4/3	5/4-5 4/3	5/4 4/3	5/4 4/3	5/4 4/4
	IT1**	5/4 4/3	5/4 4/3-4	5/4-5 4/3-4	5/4 4/3	5/4 4/3-4	5/4-5 4/4
	IT2***	5/3-4 4/2-3	5/3-4 4/3	5/4 4/3	5/3-4 4/2-3	5/3-4 4/3	5/4 4/3-4

NA* - not aged;
IT1**- leather aged at temperature of 50°C for 7 days;
IT2*** – leather aged at temperature of 70°C for 7 days

using IUV method; likewise, CL 7 has a ΔE^* value higher than CL 8 and CL 9 similarly aged.

The second group of samples was finished using ochre yellow pigment pastes (CL 10-CL 18) containing the same plasticizers: castor oil (samples CL 10, CL 13 and CL 16), flax oil (samples CL 11, CL 14 and CL 17) or poppy seed oil (samples CL 12, CL 15 and CL 18) and nitrocellulose (samples CL 10-CL 12), acrylic (samples CL 13-CL 15) or polyurethane (samples CL 16-CL 18) dressing. Samples CL 16-CL 18 aged using IT1 and IT2 methods have negative values for brightness ($\Delta L^*<0$), therefore are darker than CL 13-CL 15, with positive values, except for sample CL 14, with $\Delta L^*<0$, aged using IT2 method.

Samples CL 10-CL 13 have positive values for brightness, i.e. become brighter than the thermally aged ones in series II.

Therefore, leathers finished with acrylic and polyurethane dressing are more resistant to ageing than those finished with nitrocellulose dressing. Samples CL 13-CL 18 aged using IL and IUV methods have lower values of ΔL^* parameter compared to C 10-C 12 and are darker, which indicates a positive influence of the acrylic and polyurethane dressing on fastness to light of leathers finished compared to nitrocellulose dressing.

The lower values of ΔL^* also indicate the positive influence of plasticizer poppy seed oil used on resistance to ageing.

Table 7: Physical-mechanical characteristics of shoe upper leathers finished with new pigment pastes and polyurethane dressing

Sample/ Characteristic	MI	CL 7	CL 8	CL 9	CL 16	CL 17	CL 18
Polyurethane dressing							
Flex resistance, number	NA*	250.000	250.000	250.000	250.000	250.000	250.000
	IT1**	250.000	250.000	250.000	240.000	240.000	240.000
	IT2***	240.000	250.000	250.000	240.000	240.000	240.000
Colour fastness to cycles of to-and-fro rubbing, 1-5	NA*	5/4 4/3	5/4 4/3-4	5/4-5 4/3-4	5/4 4/3-4	5/5 4/4	5/5 4/5
	IT1**	5/4 4/4	5/4 4/4	5/5 5/5	5/4 4/4	5/4 4/4	5/5 4/5
	IT2***	5/4 4/3	5/4 4/4	5/5 5/5	5/4 4/4	5/4 4/4	5/5 4/5

NA* - not aged;
IT1**- leather aged at temperature of 50°C for 7 days;
IT2*** – leather aged at temperature of 70°C for 7 days

Table 8: Colorimetric parameters for finished shoe upper leathers

Sample code	Technological variant	CIE L*	CIE a*	CIE b*	CIE C*	CIE H*
Brown shoe upper leather						
CL 1	PPR1- FN (castor oil/ Nitrocellulose)	42.35	22.51	23.69	32.68	46.46
CL 2	PPR2- FN (flax oil/ Nitrocellulose)	42.64	22.58	23.96	32.92	46.70
CL 3	PPR3- FN (poppy seed oil/ Nitrocellulose)	42.39	21.80	22.70	22.70	46.16
CL 4	PPR1- FA (castor oil/acrylic)	42.58	23.09	24.46	33.63	46.65
CL 5	PPR2- FA (flax oil/acrylic)	43.09	23.33	24.99	34.19	46.96
CL 6	PPR3- FA (poppy seed oil/ acrylic)	42.76	22.81	23.87	33.02	46.3
CL 7	PPR1- FP (castor oil/ polyurethane)	41.86	21.31	23.44	31.68	47.72
CL 8	PPR2- FP (flax oil/ polyurethane)	42.17	21.43	23.57	31.85	47.72
CL 9	PPR3- FP (poppy seed oil/ polyurethane)	42.7	21.43	23.33	31.68	47.42
Yellow shoe upper leather						
CL 10	PPG1- FN (castor oil/ Nitrocellulose)	35.23	21.40	13.79	25.46	32.80
CL 11	PPG2- FN (flax oil/ Nitrocellulose)	35.33	22.01	14.31	26.25	33.04
CL 12	PPG3- FN (poppy seed oil/ Nitrocellulose)	35.64	21.45	13.71	25.45	32.59
CL 13	PPG1- FA (castor oil/acrylic)	34.71	21.93	14.01	26.03	32.56
CL 14	PPG2- FA (flax oil/acrylic)	34.59	22.84	14.72	27.17	32.80
CL 15	PPG3- FA (poppy seed oil/ acrylic)	35.26	21.53	13.65	25.49	32.38
CL 16	PPG1- FP (castor oil/ polyurethane)	34.36	21.23	13.56	25.19	32.56
CL 17	PPG2- FP (flax oil/ polyurethane)	34.42	21.79	14.00	25.90	32.73
CL 18	PPG3- FP (poppy seed oil/ polyurethane)	34.74	20.86	13.34	24.76	32.59

Table 9: Variation of colorimetric parameters for aged brown finished leathers

Sample code	Aged Method	ΔL*	Δa*	Δb*	ΔE*
CL 1	IT1	0.30	0.52	0.39	0.72
	IT2	0.32	0.35	0.46	0.66
	IL	0.31	-0.45	-0.73	0.91
	IUV	0.86	-0.09	0.15	0.88
CL 2	IT1	0.13	0.25	0.29	0.40
	IT2	0.26	-0.05	0.07	0.27
	IL	0.61	-0.41	-0.06	0.74
	IUV	0.29	-0.20	-0.02	0.31
CL 3	IT1	-0.29	-0.01	-0.06	0.30
	IT2	-0.29	-0.35	-0.45	0.64
	IL	-0.36	-0.83	-0.89	1.27
	IUV	-0.05	-0.20	0.02	0.21
CL 4	IT1	0.24	0.11	0.38	0.46
	IT2	0.36	-0.18	0.21	0.45
	IL	-0.15	-0.29	-0.39	0.51
	IUV	1.08	0.37	1.03	1.54
CL 5	IT1	-0.20	0.08	-0.10	0.24
	IT2	-0.12	0.20	0.07	0.24
	IL	-0.09	0.13	0.07	0.17
	IUV	0.02	-0.09	-0.2	0.22
CL 6	IT1	-0.10	0.23	0.88	0.92
	IT2	0.44	-0.19	0.76	0.90
	IL	-0.14	-0.43	-0.17	0.48
	IUV	0.18	0.05	-0.49	0.54
CL 7	IT1	0.65	0.53	0.75	1.13
	IT2	0.74	0.37	0.94	1.25
	IL	0.26	-0.25	-0.36	0.51
	IUV	0.38	-0.07	0.24	1.18
CL 8	IT1	-0.01	0.14	0.08	0.16
	IT2	0.08	0.17	0.26	0.32
	IL	0.41	0.28	0.53	0.73
	IUV	1.15	0.24	0.40	0.45
CL 9	IT1	-0.21	0.06	-0.20	0.30
	IT2	-0.19	-0.09	0.08	0.22
	IL	0.29	0.39	0.62	0.79
	IUV	0.10	-0.02	0.25	0.27

Table 10: Variation of colorimetric parameters for aged yellow finished leathers

Sample code	Aged Method	ΔL*	Δa*	Δb*	ΔE*
CL 10	IT1	0.5	0.4	0.3	0.41
	IT2	0.2	-0.5	-0.83	1.05
	IL	0.7	0.2	-0.2	0.70
	IUV	0.8	0.4	0.36	0.94
CL 11	IT1	0.9	-0.8	-0.46	0.61
	IT2	0.9	-0.3	-0.01	0.30
	IL	0.8	0.1	-0.19	0.61
	IUV	0.8	0.4	-0.31	0.50
CL 12	IT1	0.2	-0.2	-0.01	0.22
	IT2	0.6	-0.1	-0.26	0.32
	IL	0.9	0.7	0.74	1.24
	IUV	0.9	0.7	-0.19	0.72
CL 13	IT1	0.5	-0.09	0.11	0.21
	IT2	0.03	-0.07	-0.1	0.13
	IL	0.44	-0.27	-0.39	0.65
	IUV	0.58	0	-0.15	0.60
CL 14	IT1	0.09	0.07	-0.03	0.12
	IT2	-0.06	-0.55	-0.83	1.00
	IL	0.44	-0.31	-0.51	0.74
	IUV	0.63	-0.42	-0.73	1.05
CL 15	IT1	0.13	-0.08	-0.24	0.28
	IT2	0.13	-0.35	-0.48	0.61
	IL	0.61	0.32	-0.07	0.69
	IUV	0.27	0.23	-0.12	0.37
CL 16	IT1	-0.08	-0.09	-0.05	0.13
	IT2	-0.12	0.38	0.31	0.50
	IL	0.43	-0.22	-0.48	0.68
	IUV	0.39	0.47	0.3	0.57
CL 17	IT1	-0.29	-0.35	-0.66	0.80
	IT2	-0.32	0.42	1.09	1.21
	IL	0.27	-0.08	-0.23	0.36
	IUV	0.24	0.37	0.29	0.53
CL 18	IT1	-0.51	0.8	1.07	1.43
	IT2	-0.73	0.62	1.33	1.64
	IL	0.11	-0.5	-0.51	0.72
	IUV	0.08	-0.35	-0.56	0.67

CONCLUSIONS

The leathers finished with polyurethane or acrylic final dressing had the highest resistance to light after aging under the influence of artificial light in comparison with those finished with nitrocellulose dressing.

Flax and poppy seed oils used as plasticizers improved resistance to ageing of coating.

Acknowledgements

This work was supported by Ministry of Research and Innovation in the framework of Nucleu Program INOVA-TEX-PEL 2016-2017, project code PN 16 34 02 06, contract 26N/2016.

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