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Scientific paper
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Determination of some chemical and physico – mechanical indicators of Albanian leather

This study is focused in measuring some chemical and physico- mechanical indicators like untanning, determination of humidity, pH, thickness, determination of leather side resistance along flexing, determination of tensile strength and percentage elongation in different Albanian leathers.
Leather industry is one of the most important. Leather is one of the last remaining natyral materials in our high- tech world of teflon, rubber and synthetic materials. For this reason, leather is one of the most important and usable materials in various fields. Leather processing from row skin/hide up to end product passes through several stages. In order to obtain such a versatile end product from a simple animal skin, this material has to be subjected to numerous processes, which are: preservation, soaking, liming, tanning and finishing. Each of these processes play a decisive role in giving and preserving important leather characteristics to the end product. Control of each of these processes is very important to avoid defects that can arise during these leather processing, as well as to make it more stable against of swell, decay, action of high temperatures, action of microorganisms (microbes and enzymes) etc.
We did chemical and physico-mechanical analysis according ISO standarts. Selection of tests samples is done in a random way. Evaluation of some of these indicators is done according to www.ctlleather.com/ctl_clearance_products in the absence of technical specifications .
***Key words**: leather, ISO standarts, chemical and physico-mechanical characteristics.*

1. INTRODUCTION

Leather industry has developed time before. It has had a great importance in people′s lives and has developed along with their evolution. Leather is one of the last remaining natural materials in our high-tech world of Teflon, rubber and rayon and it is also one of the most versatile. For this reason, leather is one of the most important and usable materials in various fields (such as clothing, furniture, car upholstery, etc).

Leather is a resistent and flexible material made by tanning of raw skin/hide. Leather processing from row skin/hide up to end product passes through several stages.

In order to obtain such a versatile end product from a simple animal skin, this material has to be subjected to numerous processes, which are: preservation, soaking, liming, tanning and finishing. Each of these processes play a decisive role in giving and preserving important leather characteristics to the end product. Control of each of these processes is very important to avoid defects that can arise during these leather processing, as well as to make it more stable against of swell, decay, action of high temperatures, action of microorganisms (microbes and enzymes) etc.

For these is important analysing chemical and physico – mechanical leather indicators of semi product and product of leather.

2. THE METHOD OF DETERMINATION OF SOME CHEMICAL AND PHYSICO-MECHANICAL INDICATORS OF ALBANIAN LEATHER

Experimental measurement are performed based in Albanian Standards and ISO standards. Some chemical and physico – mechanical indicators analysed were: humidity, pH, untanning, leather side resistance along flexing, thickness, determination of tensile strength and percentage elongation.

Table 1 - Tested leather samples

Denomination	Color	Average Thickness	Hardness
Crust Goat Leather	grey	large	medium
Finished Sheep Leather	green	small	low
Finished Calf Leather	black	medium	low

2.1 Determination of humidity [5]

The method is based in determination of humidity in finished leather through drying and then calculating the mass difference. In a shallow glass dryed and weighted before until it has reached a constant mass, put 2 to 5 g pieces of leather weighted in an analytical balance with an accuraty 0.0002 g. The leather pieces are dryed in thermostat in the temperature 100-105 $^{\circ}C$ until a constant mass. The

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first weighting is done after 6 hours and others after each 2 hours. Drying continue until the last two weight don't have a difference higher than 0.001 g.

$$\text{Humidity content (\%)} = (a+b-c)/b \times 100 \quad (1)$$

Which:

a – mass of shallow glass

b – mass of analyzed pieces of leather

c – mass of shallow glass together with the pieces of leather after drying until a constant mass

2.2. Determination of pH [6]

The method is based in determination of pH value and the determination of the difference figure of the diluted solution taken from leather extract. Conditioning the samples for 24 hours according the method [2] and then chopp up in small pieces according the method [4]. Place the pieces of leather in a wide-mouthed flask and add 100 ± 1ml distilled water at 20 ± 2º C. Shake well by hand for about 30 s, so that the test portion is uniformly wet. Then shake mechanically in the shaker for 6 h. Allow the extract to settle before decanting. After standardized the pH-meter with two buffer solution: one below the expected value and one above the expected value determined the pH value of the extract to the nearest 0.05 pH unit within 30 to 60s after rinsing the electrodes in the extract.

2.3. Determination of untanning [7]

This method determined the rate of untanning of leather wich are tanned before with vegetable-tanning and chrome- tanning. We determined the untanning of leather treated with acetic acid or in boiled water depending on the tanning process. All analysed samples were tanned with chrome.

2.3.1. Determination of tanning in chrome – tanned leather

Sampling location is done according the method [1] and then is measured thickness, width and length before and after treatment. Samples are put in a container with boiled water for three minutes and then they are compared with untreated samples. Chromed leather which is kept in boiled water should′t be shrink more than 1 mm and also it should′t petrify and disorted.

2.4. Determination of leather side resistance along flexing [8]

The method is based in resistance of the side of leather along flexing. Sampling location is done according the method [3]. Then bend the test sample with the sides turned out, with the section 8 times how the thicknes of samples place. The sample should be kept bended for a minute.

2.5. Determination of thickness [9]

The method is based in determination of the thickness of leather. The thickness is measured with thikness apparatus. After the samples conditioning for 24 hours in 23°C/50% do some measurement spreaded in all the surface and then calculate the average value. The results taken are expressed aproximately 0.01 mm.

2.6. Determination of tensile strength and percentage elongation

The method consists in determination of tensile strength, percentage elongation caused by a specified load and percentage elongation at break. A test piece elongated with certain speed until the force reaches a predetermined value or until the test piece breaks. Cut from the sample six test pieces in accordance with the method [3], three test pieces with the longer sides parallel to the backbone and three test pieces with the longer sides perpendicular to the backbone. Condition the test pieces in accordance with the method [3]. Measure the thickness of each test piece in accordance with the method [9].

Set the jaws of the tensile strength testing apparatus 50 mm apart each-other. Run the machine until the test piece was broken and record the highest force exerted as the breaking force, F.

After this determine: Tensile strength, T_n , in Newton per square millimetre shall be calculated using the equation:

$$T_n = \frac{F}{w \cdot t} \quad (2)$$

Where:

F – is the highest force recorded in Newtons;

w – is the mean width of the test piece in;

t – is the mean thicknessof the test piece in millimetres.

Percentage elongation caused by a specified, E_l , shall be calculated usin the equation:

$$E_I = \frac{L_1 - L_0}{L_0} \times 100 \quad (3)$$

Where:

L_1 – is the separation of the jaws or sensors at the specified load;

L_0 – is the initial separation of the jaws or sensors.

Percentage elongation at break, E_b, shall be calculated using the equation:

$$E_b = \frac{L_2 - L_0}{L_0} \times 100 \quad (4)$$

Where:
L_2 – is the separation of the jaws or sensors at break;
L_0 – is the initial separation of the jaws or sensors.

Table 2 - Test leather samples

Denomination	Color	Average thickness	hardness
Goat Leather	brown	1.05 mm	relatively high
Calf Leather	black	1.07 mm	medium
Lamb Leather	cream	0.61 mm	high

3. EXPERIMENTAL RESULTS

3.1. Determination of humidity

In the tables below are given the humidity content in percent for each parallel tested sample of the three kind of leathers and the average values of humidity. For each kind of leather are tested three parallel samples.

Table 3 - Humidity content for crust goat leather

Crust Goat Leather				
Nr of samples	a (g)	b (g)	c (g)	Humidity %
Sample I	39,128	2,945	41,592	16,3
Sample II	38,128	2,945	40,605	15,9
Sample III	38,847	2,924	41,304	15,9
				Aver = 16,03

Table 4 - Humidity content for finished sheep leather

Finished Sheep Leather				
Nr of samples	a (g)	b (g)	c (g)	Humidity%
Sample I	47,928	2,713	50,266	13,8
Sample II	43,167	2,395	44,226	14
Sample III	47,429	2,591	49,650	14,2
				Aver = 14

Table 5 - Humidity content for finished calf leather

Finished Calf Leather				
Nr of samples	a (g)	b (g)	c (g)	Humidity %
Sample I	38,474	2,673	40,705	16,5
Sample II	38,299	3,825	41,522	15,7
Sample III	39,059	2,809	41,401	16,6
				Aver = 16,26

3.2. Determination of pH

In the table below are given the pH values for each parallel samples of the three kind of tested leather. In the table are also given the average value of pH for three kinds of leathers and the limit value [13].

Table 6 - pH values measured with pH-meter

Leather	Nr of samples	pH values	Average	Limit values [13]
Crust Goat leather	Sample 1	4,9	4,73	≥3.5
	Sample 2	4,64		
	Sample 3	4,66		
Finished sheep leather	Sample 1	4,24	4,28	≥3.5
	Sample 2	4,24		
	Sample 3	4,38		
Finished calf leather	Sample 1	5,7	5.62	≥3.5
	Sample 2	5,5		
	Sample 3	5,66		

3.3. Determination of untanning

In two tables below are given the measured value of three parameters (thickness, length and width) which change after the treatment. The values are measured before and after treatment for two parallel samples for each kind of leather.

Table 7 - Determination of thickness of leather samples

Determination of untanning in chrome tanned leather				
Kind of leather	**Thickness before treatment**		**Thickness after treatment**	
	Sample a (mm)	**Sample b (mm)**	**Sample a (mm)**	**Sample b (mm)**
Crust Goat leather	1,3	1,2	1,3	1,2
Finished sheep leather	0,9	0,9	1,1	1,1
Finished calf leather	1,1	1,1	3	2,6

Table 8 - Determination of length and width of leather samples

Determination of untanning in chrome tanned leather								
Kind of leather	**Length before treatment**		**Length after treatment**		**Width before treatment**		**Width after treatment**	
	Sample a (mm)	**Sample b (mm)**	**Sample a (mm)**	**Sample b (mm)**	**Sample a (mm)**	**Sample b (mm)**	**Sample a (mm)**	**Sample b (mm)**
Crust Goat leather	202	200	198	199	4	4	4	4
Finished sheep leather	199	198	195	193,3	4,3	4,1	4,2	4
Finished calf leather	200	199	131	146	3,9	4	2,4	2,3

3.4. Determination of leather side resistance along flexing

Visual changes that happens in three kind of leather after flexing of the side are shown in a summary table.

Table 9 - Visual changes of the leather side after flexing.

Kind of leather	**Visual changes of the leather surface**
Crust Goat leather	We observed only the creation of some light lines or creases. We don't have split signs which means that we have a strong and resistable leather.
Finished sheep leather	We observed the creation of less visible lines which are created because of this leather was very thin and soft. We don't have split signs or cracking which means that we have strong and resistable leather.
Finished calf leather	We observed the creation of some lights that are less emphasized compared with two other tested leather. This is because of the hardness of leather compared with two others, but even in this leather we don't have split signs or cracking so it is a strong and resistable leather.

3.5. Determination of thickness

In the table below are given the thickness value measured for five parallel samples of each tested leather

Table 9 - Thickness measurement of tested leather

Leather thickness (mm)		
Crust Goat leather	**Finished sheep leather**	**Finished calf leather**
1,5	1,1	1,1
1,4	1.0	1,1
1,1	1.0	1,2
1,6	0,90	1,1
1,1	0,80	1,1
Aver = 1,34	Aver = 0.96	Aver = 1,1

3.6. Determination of tensile strength and percentage elongation.

Below are given final graphs of tensile strength and percentage elongation for each direction of the cutted test pieces, parallel to the backbone and perpendicular to the bacbone. For each direction of the tested leather we tested three parallel test pieces.

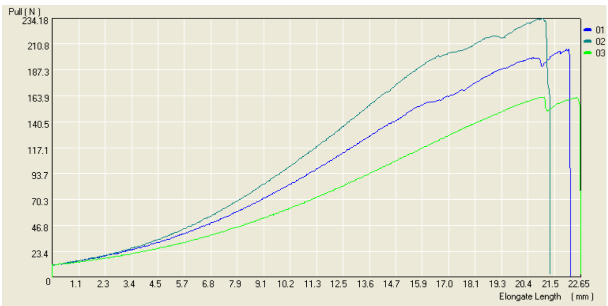

Figure 1.

In figure 1 is given the graph of tensile strength and percentage elongation for parallel direction with the backbone of the goat leather, while in figure 2 is given the graph of tensile strength and percentage elongation for perpendicular direction of the back-bone for goat leather.

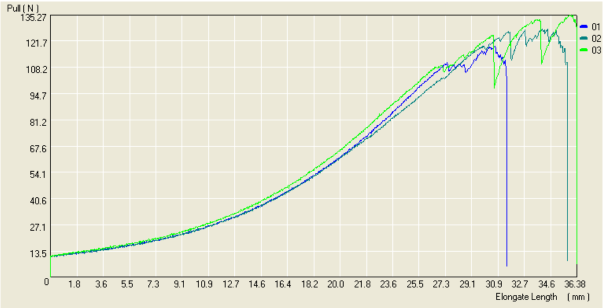

Figure 2.

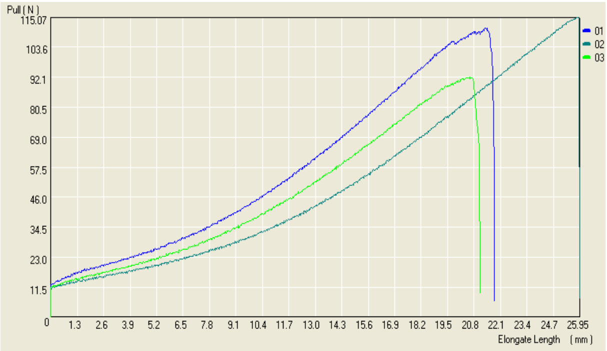

Figure 3.

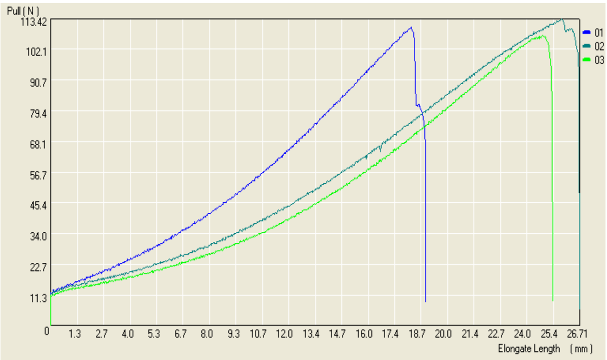

Figure 4.

In figure 3 is given the graph of tensile strength and percentage elongation for parallel direction with the backbone of the calf leather, while in figure 4 is given the graph of tensile strength and percentage elongation for perpendicular direction of the back-bone for calf leather.

In figure 5 is given the graph of tensile strength and percentage elongation for parallel direction with the backbone of the lamb leather, while in figure 6 is given the graph of tensile strength and percentage elongation for perpendicular direction of the back-bone for lamb leather.

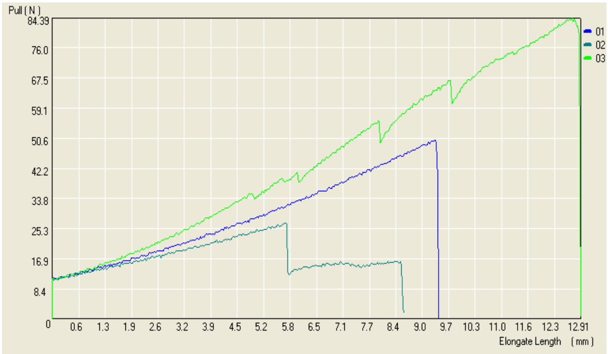

Figure 5.

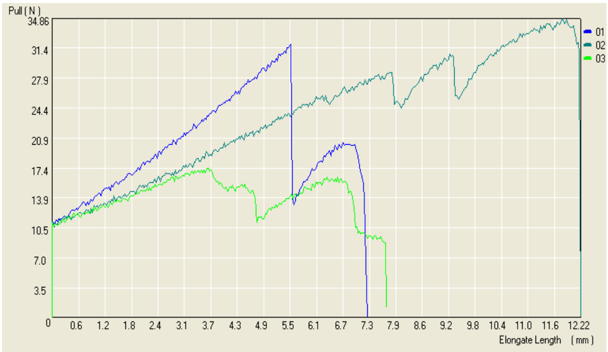

Figure 6.

In tables below are given the measured values of Maximal Force (N), Elongation in percent (%), The Mean Tensile strength (N/mm^2) and the limit values for two direction of each leather.

Table 10 - The Mean Tensile strength, T_n in N/mm^2 according to parallel direction to the backbone of the three leathers.

	Parallel direction to the backbone of the leather				
Leather	**Max Force (N)**	**Elongation (%)**	**Limit values for Elongation (%) [13]**	**T_n (N/mm^2)**	**Limit values T_n (N/mm^2) [13]**
Goat Leather	234.18	44.30	40 – 70	22.3	≥ 12
Calf Leather	115.07	51.72	40 – 70	10.7	≥ 12
Lamb Leather	84.39	25.38	40 – 70	13.8	≥ 12

Table 11 - The Mean Tensile strength, T_n in N/mm^2 according to perpendicular direction to the backbone of the three leathers.

	Perpendicular direction to the backbone of the leather				
Leather	**Max Force (N)**	**Elongation (%)**	**Limit values for Elongation (%) [13]**	**T_n (N/mm^2)**	**Limit values T_n (N/mm^2) [13]**
Goat Leather	135.27	71.76	40 – 70	12.9	≥ 12
Calf Leather	113.42	51.54	40 – 70	10.6	≥ 12
Lamb Leather	34.86	23.58	40 – 70	5.7	≥ 12

Determining the percentage elongation caused by a specific load, is chosen a different force for each leather because of the samples have different tensile strength as a result of the variation of the thickness of leather samples.

Table 12 - The mean percentage elongation at a specified load, E_l

Percentage elongation caused by a specific load, E_l			
Cutting Direction	**50 N**	**45 N**	**17 N**
	Goat Leather	**Calf Leather**	**Lamb Leather**
Parallel to the backbone of the leather	E_{lmes} = 15.02 %	E_{lmes} = 21.89 %	E_{lmes} = 4.33 %
Perpendicular to the backbone of the leather	E_{lmes} = 35.73 %	E_{lmes} = 21.73 %	E_{lmes} = 5.13 %
The mean percentage elongation in both direction	E_{lmes} = 25.37 %	E_{lmes} = 21.81 %	E_{lmes} = 4.73 %

Table 13 - The mean percentage elongation at break, E_b

Percentage elopngation at break (E_b).			
Cutting Direction	**Goat Leather**	**Calf Leather**	**Lamb Leather**
Parallel to the backbone of the leather	E_{bmes} = 44.14 %	E_{bmes} = 45.84 %	E_{bmes} = 20.63 %
Perpendicular to the backbone of the leather	E_{bmes}= 69.07 %	E_{bmes} = 47.32 %	E_{bmes} = 18.15 %
The mean percentage elongation at break in both direction	E_{bmes}= 56.60 %	E_{bmes} = 46.58 %	E_{bmes} = 19.39 %

4. CONCLUSIONS AND DISSCUSION OF THE RESULTS

In this study, we have realised the determination of humidity, pH, untanning, thickness, leather side resistance along flexing, tensile strength and percentage elongation of leather conform Albanian standard and International standards.

Comparing the results obtained of humidity content, we observed that sheep leather has the lower percentage of humidity than the other analyzed leathers. The values of percentage humidity for goat leather and calf leather are approximately the same.

The pH- values obtained for three kind of leather compared with limit values from www. ctlleather. com/ctl_clearance_products, are within certain norms.

In determination of untanning we observed that:

- *Crust Goat leather*. After the tratment we observed that: we haven't any change of the thickness, small changes of the length and width of the test sample. We have very small shrinks, hardening of leather and small distorted of the sides. So according to the specification of the standard the leather have a good tanning.
- *Finished sheep leather.* After the treatment the thickness of the sample have changed only 0.1 mm but again the value are within the limit values of change. Diferences in length and width of test sample before and after the treatment vary from 2-3 mm. We observed big shrinkage of test sample, creases of the outer side and little hardening. According to the specification of the standard this leather have a relatively good taning.

- *Finished calf leather.*The thickness of the leather after the treatment has changed with 2 mm so has pass the limit value of the thickness change. The difference in length and in width before and after the treatment is huge. In this case have distorted, hardening and big shrinks of the test samples. So we haven't a good tanning of this leather.
- For three kind of leather tested we observed that: the best tanned leather was the goat leather, while the calf leather hadn't a good tanning.

From the results obtained in determination of thickness we notice that the goat leather crust is the thicker, while finished sheep leather is the thinner.

From the obtained results of the tensile strength and percentage elongation we notice that the goat leather has higher percentage elongation at break, than ranked the calf leather and the lamb leather the last.

Comparing the measured values of elongation and the mean tensile strength with the limit values [13] conclude: For parallel direction to the backbone elongation values 44.30% is within the limit values, while for perpendicullar direction elongation values 71.76% exceed the limit values. Regarding the calf leather both measured values of elongation 51.72% and 51.54% are within the limit values. The elongation values for lamb 25.38%. and 23.58% are lower than the limit values.

Comparing the mean tensile strength values according to both direction of leather cutting, results that goat leather has higher tensile strength, the second is ranked calf leather and the leather with the lower tensile strength is lamb leather. We also notice that the mean values of tensile strength for goat leather of both cutting direction compared with limit values [13] fullfill the demand set ≥ 12 N, while for the calf leather the values are lower than the limit values that's because of the big thickness of this leathers. The lamb leather tensile strength values for parallel direction are ≥ 12 N, while for perpendicullar direction the value is lower than the limit value.

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IZVOD

ODREĐIVANJE NEKIH HEMIJSKIH I FIZIČKO-MEHANIČKIH KARAKTERISTIKA KOŽE

Ovaj rad se fokusira na merenju nekih hemijskih i fiziko-mehaničkih pokazatelja kao što su određivanje vlažnosti, pH, debljina, određivanje otpora opuštanja kože, određivanje zatezne čvrstoće i procenta istezanja u različitim vrstama albanske kože. Industrija kože je jedna od veoma važnih. Koža je jedna od preostalih prirodnih materijala u svetu teflona, gume i sintetičkih materijala. Iz tih razloga, koža je jedna od najvažnijih i upotrebljavanih materijala u raznim oblastima. Prilikom obrade kože prolazi se kroz nekoliko faza. Da bi se dobio praktičan proizvod polazeći od životinjske kože, ovaj materijal mora da bude podvrgnut brojnim procesima, koji su: čuvanje, potapanje, liming, štavljanje i dorada. Svaki od ovih procesa igra odlučujuću ulogu u davanju i očuvanju važnih karakteristika kože do krajnjeg proizvoda. Kontrola svakog od ovih procesa je veoma važna kako bi se izbegli nedostaci koji mogu nastati tokom ovih obrada kože, kao i da bi se stabilizovalo dejstvo visokih temperatura, mikroorganizama, itd. Urađena su hemijska i fizičko-mehanička ispitivanja prema ISO standarima. Izbor uzorka je vršen po slučajnom tipu. Procena nekih od ovih indikatora vršena je prema tehničkoj specifikaciji.

Key words: *koža, ISO standardi, hemijska i fizičko-mehaničke karakterstike.*

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