A RESEARCH ON THE USE OF ALUMINUM SULPHATE IN PARCHMENT PRODUCTION AND ITS EFFECTS ON AGEING AND COLOR

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Abstract. In this study, different proportions 2.5%, 5%, 10% of Aluminum sulfate were used as tanning agents during parchment production. The research was carried out on goat skin and also there were no usage of any tanning agents as control groups. Finished leathers have been exposed to ageing conditions. Before and after ageing color measurements on all finished leathers have been conducted with Konica Minolta CM-3600d brand spectrophotometer. The impacts of the aluminum sulfate utilized in the research on light fastness were also inspected by using an ATLAS-XENOTEST ALPHA+ test instrument. Visible whitening on the color of parchment was observeded when tanning process with aluminum sulphate was performed.

1 Introduction

Parchment is a material invented to write on it. It is a material that made by skin of certain animals such as lamb and goat. Firstly, the hair is removed from the skin by liming, then it is cleaned by washing and dried by stretching and rubbing. The importance in carrying and transcription of information made parchment a milestone in science and art history (Bayramoğlu and Yılmaz, 2018).

It is known that, citizens of Pergamum are the first community that invent parchment and used it. Also it is supported by historical documents. Moreover, it is indicated that, the name parchment is coming from Pergamum (Dağtaş, 2017; Yıldız,2003). The story of invention of parchment in Pergamum lies within outgrown Pergamum library. The Egyptians who are owners of Alexandria Library have become so jealous about Pergamum library and put a ban on sending papyrus to Pergamum. Thus, citizens of Pergamum invented parchment and developed it (Bayramoğlu and Yılmaz, 2018).

Actually, İsmail Araç is the last tanner (87 years old) who produces parchment in a traditional method. İsmail Araç trained two apprentices who become masters through Ahi-order traditional ceremony. The Ahi-order ceremony is performed according to its original style and traditionally symbolized after 107 years and attracted quite a lot of attention (Figure 1). Important endeavors of Journalist Lütfü Dağtaş and Mehmet Gönenç, mayor of Bergama, who are architects of this ceremony, can be traced on the book they published and offered as a cultural service (Dağtaş, 2017).

Figure 1. Traditional Ahi ceremony held in Bergama on 2017 (Photo: Prof. Dr. Eser Eke Bayramoğlu).

Parchment is manufactured in this research by applying aluminum sulfate to the pelts with various ratios and light-fastness is examined. Moreover, color values specimens of Parchment manufactured with different methods are measured before ageing process and after 24 hours and 96 hours of ageing processes. According to data obtained and with the use of aluminum sulfate, visible bleaching and temporal variations on light-fastness are determined.

2 Material and Method

2.1 Material

Domestic goat skin, aluminum sulfate, ammonium sulfate, CaCO3 and Na2S are used for the process.

2.2 Method

Skins, while they are treated according to Parchment treatment formula, following stages are processed after the liming:

- 1st group is washed after liming and left for drying by stretching.
- 2nd group's lime is eliminated after liming process, it is processed by acids and enzymes, pH 3 is decreased and they are tanned with 2.5% of aluminum sulfate for 12 hours and they are washed and left for drying.
- 3rd group's lime is eliminated after liming process, it is processed by acids and enzymes, pH 3 is decreased and they are tanned with 5% of aluminum sulfate for 12 hours and they are washed and left for drying.
- 4th group's lime is eliminated after liming process, it is processed by acids and enzymes, pH 3 is decreased and they are tanned with 10% of aluminum sulfate for 12 hours and they are washed and left for drying.

Dried parchments are taken from the drying bench, are scraped and their sides are cleaned. Light-fastness Test of specimens of Parchment obtained is done according to EN ISO 105-B02 method whereas Color Measurement Test is done with Konica Minolta CM-3600d model spectrophotometer (In-House Method).

2.2.1 Light-fastness Test

Light-fastness Test is done according to EN ISO 105 B02 Normal: 2002. Discoloring on leathers' colors and leathers' surfaces are observed during the time due environmental impacts. This formation is accelerated with Light-fastness Test and results are obtained.

Test samples are cut and prepared with 1 cm x 4 cm dimensions. Samples prepared are properly placed on panels. Test selected is started according to specialties, after panels are placed by an expert on the ATLAS Xenotest Alpha+ model machine. Samples are treated for 72 hours. Samples taken out from the machine are measured on grey scale and blue scale and fastness degrees are determined.

2.2.2. Ageing Test – Color Change Test

Manufactured Leathers – Light-fastness Test: ıt is done according to International Standard ISO 17228 ULTCS/IUF 412, concerning Ageing Test and Color Change Test.

Samples of 15 x 15 dimensions are cut from all leather samples for this test. Ageing Test is done in three different ways. These standards are respectively the following: the first one is solely ageing with heat, the second one is ageing with heat and humidity and the third one is ageing with heat

and humidity cycles on different degrees. In this standard, extended general purpose ageing method, 96 hours, 50°C and 90% humidity is applied.

Colors of samples are measured before starting the ageing test with Konica Minolta CM-3600d model spheroidal spectrophotometer. Measurements are processed according to CIE Lab color system. Second Minolta color measurement is done after having applied first standard of ageing test and impacts of ageing are observed. Leather samples are again exposed to ageing process and color is again measured on Minolta. Increase on "L" value indicates an augmentation of brightness and whiteness whereas a decrease on "L" value indicates a diminution of brightness and whiteness. Color measurements are done on different points of 4 different leather samples and mean value of values measured are considered. Only "L" values elaborated, for dyestuff is not used in the research.

2.2.3. Statistical Analyses

Data obtained from color measurement done after the Ageing Test is analyzed with Wilcoxon Signed Ranks Test and Kruskal Wallis Test. Statistical difference before and after the Ageing Test is considered. Besides, color changes observed on the leather with application in different rates of aluminum sulfate to the leather is analyzed with Kruskal Wallis Test.

3 Results and Discussion

Whereas a visible whiteness occurs on leathers tanned with aluminum sulfate, a slight decrease is determined when light-fastness is considered. This difference is not observed among groups which include aluminum sulfate. Results of both grey scale and blue scale are coherent among them (Table 1).

Table 1. Light fastness results of the parchments.

	Groups	**Grey scale**	**Blue scale**
0 % Aluminum sulfate	Control 1	4	2/1
	Control 2	4	2/1
	Control 3	5	1
2.5 % Aluminum sulfate	4. Parchment	4	2
	5. Parchment	3	3/2
	6. Parchment	4/5	2/1
5 % Aluminum sulfate	7.Parchment	4/5	3/2
	8. Parchment	4/5	2
	9. Parchment	3/4	4
10 % Aluminum sulfate	10 .Parchment	3/4	4
	11. Parchment	5	4
	12.Parchment	4/5	4/3

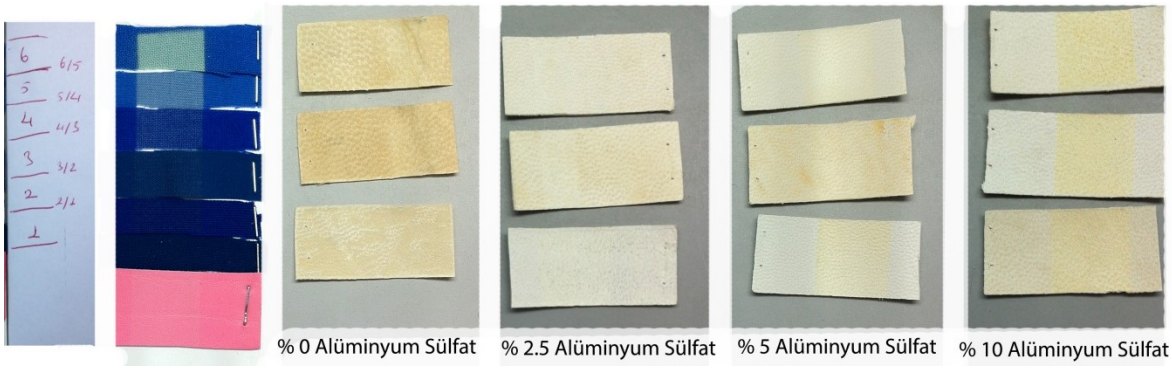


Figure 3. Comparison on blue scale of Light-Fastness Test results.

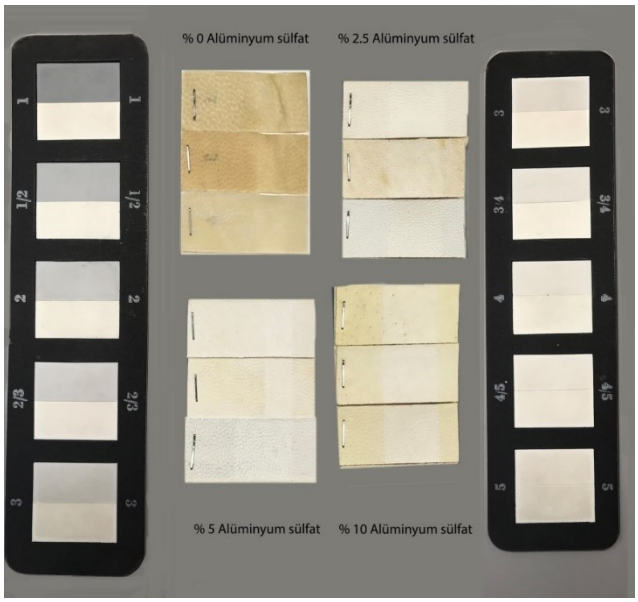


Figure 4. Comparison on grey scale of Light-fastness Test results.

3.1. Ageing Test – Color Change Test Results

Table 2. Color Change Test Results by Minolta.

	Groups	**First Measurement**	**Second Measurement** (after the first ageing: 50°C, 90% humidity, 24 hours)	**Third Measurement** (after the second ageing: 50°C, 90% humidity, 96 hours)
0 % Aluminum sulfate	Control 1	72,35	70,37	70,70
	Control 2	70,47	68,97	69,22
	Control 3	78,95	77,36	77,56
2.5 % Aluminum sulfate	4. Parchment	91,36	90,90	90,36
	5. Parchment	90,07	89,39	89,48
	6. Parchment	92,01	91,8	91,55

5 % Aluminum sulfate	7.Parchment	92,89	92,58	92,16
	8. Parchment	89,62	88,62	88,46
	9. Parchment	91,68	91,33	91,01
10 % Aluminum sulfate	10 .Parchment	92,31	91,83	91,81
	11. Parchment	92,74	92,50	93,37
	12.Parchment	85,53	88,03	88,37

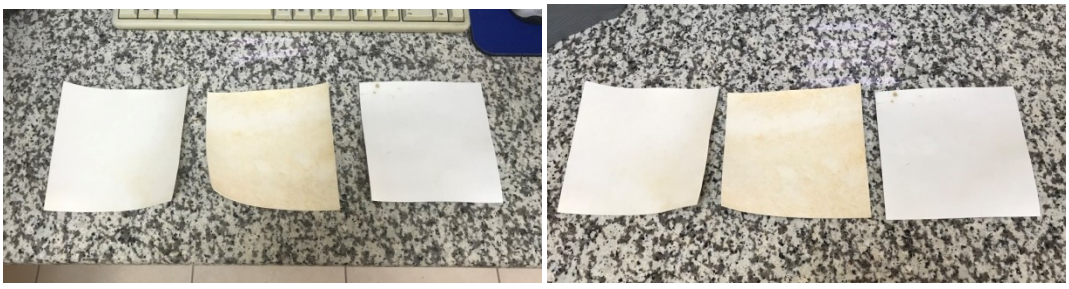
State of specimens of Parchment before and after ageing is observed on figures.

First ageing * Second ageing**

Figure 5. Control 0% Aluminum sulfate.

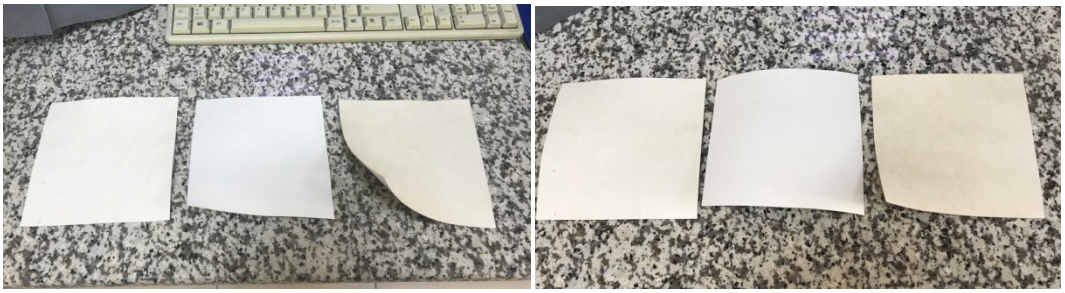
First ageing * Second ageing**

Figure 6. 2.5 % Aluminum sulfate.



First ageing * Second ageing**

Figure 7. 5 % Aluminum sulfate.



First Ageing* Second ageing**

Figure 8. 10 % Aluminum sulfate.

*** First ageing:** Second Measurement (after the first ageing: 50°C, 90% humidity, 24 hours)
****Second ageing:** Third Measurement (after the second ageing: 50°C, 90% humidity, 96 hours)

Discoloration on leather surface, color changes and deterioration on physical forms occurred after the Ageing test (Figure 5,6,7,8)

Statistically significant difference among values read before ageing and after the first ageing is determined ($p<0.05$); however, no statistical difference is found between the second ageing and the first ageing ($P>0.05$). Besides, whereas there exists a significant difference ($p<0.05$) between the Kruskal Wallis Test and the Control Group, in other words parchments which do not include aluminum sulfate and leathers tanned with aluminum sulfate, no significant difference is determined among groups concerning leathers tanned with different rates of Aluminum sulfate ($P>0,05$).

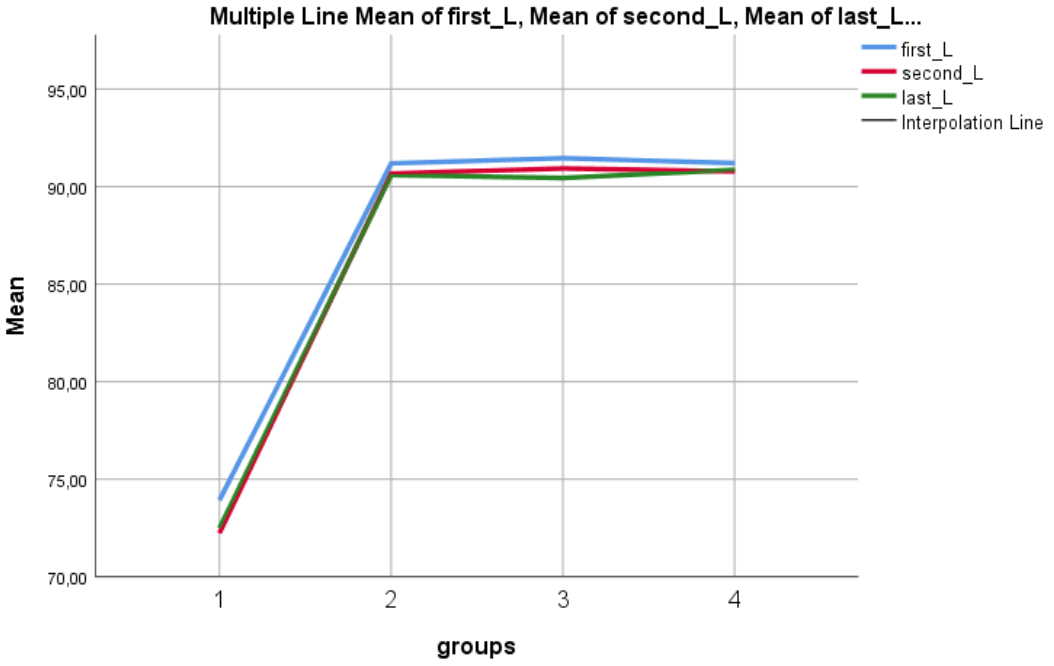


Figure 9. Statistical diagram graph of the color changing before and after ageing.

4 Conclusion

Discoloration and color changes with close rates occurred on all leather groups; however, whereas physical deformation is much more in the control group, we have observed that is lesser on leather samples treated with Aluminum sulfate. Close results are obtained on physical tests applied on leathers tanned in different groups, in terms of leathers treated with 2.5%, 5% and 10% rates. To conclude, we can say that a physical difference occurred between the control group and parchments tanned with Aluminum sulfate but the use in different rates of aluminum sulfate did not generate quite a difference in itself. Significant bleach on the parchment is determined with the use of aluminum sulfate.

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