SURFACE AREA GAIN OF LEATHERS DRIED UNDER DIFFERENT CONDITIONS

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Abstract

Drying is one of the most important leather production processes which is necessary to obtain usable leather form from skin and determines the fundamental structural, chemical and physical properties of the leather. Using different drying methods within the footwear upper production affect the change in surface area of the leathers as distinct from each other. Surface area gain has a great significance since the footwear upper leathers are sold depend their size of the surface area. In this research, it is determined that the surface area gain of the each footwear upper leathers which manufactured using the wet-toggle and vacuum drying methods that are different drying processes, and the area gain of the leathers are compared. As a result, it is observed that the significance changes occurred on the surface area gain of the same origin upper leathers as using the different drying methods and conditions. Especially, the wet-toggle for the drying of footwear upper leathers could be a preferable drying method owing to the better surface area gain provided by the method.

Keywords: Shoe upper leather, wet-toggle drying, vacuum drying, area gain.

1. Introduction

Different properties and fastness are expected from the finished leathers according to the utilization areas of the products. The drying process has a big contribution, besides to the chemicals used for the leather having these properties and fastness. The physical properties such as final structure, softness and elasticity are basically formed as the result of the drying process.

In addition to desired physical properties, one of the most important factors is surface area gain for the leather producer. Since the price of finished leathers is set by the surface area size. Leather production is a subject of commerce, so gaining or retaining of the leather surface area is had to handle as a very important concept. For this reason, most of the drying methods have character increasing the surface area efficiency. Therefore, investigation of the effects of different drying methods selected for leather drying and the variables of drying processes on leather surface area efficiency is one of the very important research topics. Different drying methods are used for drying of the upper leather like other leather types. Vacuum drying method is that the most favourite drying method for upper leather. In recent years, wet-toggle drying method have been widely used since it provides features such as desired softness, handle and drum milling effect and provide a high surface area gain for the leather.

The effects of hang drying, wet toggle drying and vacuum drying methods on surface area gain of upper leathers were comparatively determined in this study.

2. Material and Method

2.1. Material

In this research, eighteen sides of wet-blue leathers for upper leather production originates from Azerbaijani were used as material.

2.2. Method

Wet-blue side leathers were subjected to dyeing, retanning and fatliquoring processes with a recipe suitable for standard upper leather treatment. Then, they were setting out after being horsed-up for one night before drying.

2.2.1. Drying Process

After setting-out process, the eighteen side willows were divided into three groups for applying different drying methods. Drying methods and conditions applied to the leathers are given below.

Hang drying: The drying hanger unit with the 600 meters total length and 2 m/min speed was used. The temperature of closed drying cabin unit with 40 meters length where placed at the end of hanger unit was adjusted at 70°C.

Wet-toggle drying: The temperature of the wet-toggle drying cabin used in the study was adjusted at 60°C and drying was applied for four hours.

Vacuum drying: The temperature of the vacuum drying unit used in the study was adjusted to 50°C, and four different drying durations that are 50, 100, 200, 400 seconds were applied.

Drying process was completely terminated when the moisture level of the leathers reached 12 % for all drying trials.

Dried side willows were subjected to staking, drum milling for three hours and staking processes, respectively.

2.2.2. Area Measurement

The surface areas of wet-blue side leathers, side willows that were staked after the drying process and drum milled after the staking process and staked after the drum milling process were measured by using a surface measuring machine in order to determine the changes in the surface areas of side willows by drying and mechanical processes after drying.

3. Results and Discussion

The surface area of leathers is the main topic for leather commerce. It is strongly influenced by drying, stretching, storage conditions and any kind of heating within the dried state (Heidemann, 1993).

Generally, leather is sold-out based on surface area and maximizing of surface area yield is that the aim of leather commerce. This goal does not decrease quality of leathers (Manich et al., 2006).

The most common problem involved in the leather drying process is shrinkage. This problem is mostly valid in leather tanned with metal ions, including chromium. Leather shrinks during drying process like other hydrophilic materials. Surface area yield decreases by shrinkage. The shrinkage of hydrophilic materials after removal of water is well-known behaviour. During water removal, voids filled with water which is reduced by the influence of the interior pressure slowly tightening. Therefore the material shrinks (Liu and Dimaio, 2000).

Although a little surface area could be gain by mechanical operations like sammying and setting out, this case could be lost in the progressive stages. More persistent surface area gain is provided by drying process which leather is stretched like toggled drying. Significantly surface area gain could be obtained by biaxial stretching of leather (Leather International, 2006).

When drying is carried out without stretching, elastic strain would be loose. Surface area decreases accordingly elasticity of leather significantly increase (Bienkiewicz, 1983).

Surface area measurement values are given in Table 1.

Table 1. Surface area measurement values of leathers (dm^2).

Drying Methods	n		Wet-Blue	Staking	Drum Milling	Drum Milling + Staking
Hang Drying	3	Min.	68,00	68,00	68,00	68,00
		Max.	100,00	101,00	101,00	103,00
		X±S.E.	86,00±9,45	87,00±9,85	87,00±9,85	88,00±10,41
Wet-Toggle Drying	3	Min.	74,00	89,00	85,00	86,00
		Max.	98,00	122,00	120,00	121,00
		X±S.E.	83,33±7,42	102,67±9,94	99,67±10,49	101,00±10,41
Vacuum Drying 50 °C 50 s	3	Min.	68,00	72,00	70,00	72,00
		Max.	100,00	103,00	103,00	104,00
		X±S.E.	85,33±9,33	87,33±8,95	86,00±9,54	87,67±9,24
Vacuum Drying 50 °C 100 s	3	Min.	81,00	82,00	81,00	83,00
		Max.	97,00	98,00	97,00	98,00
		X±S.E.	90,67±4,91	92,00±5,03	91,00±5,03	92,67±4,84
Vacuum Drying 50 °C 200 s	3	Min.	90,00	92,00	90,00	91,00
		Max.	102,00	108,00	106,00	107,00
		X±S.E.	97,33±3,71	100,67±4,67	99,00±4,73	100,33±4,81
Vacuum Drying 50 °C 400 s	3	Min.	75,00	79,00	78,00	79,00
		Max.	90,00	92,00	91,00	92,00
		X±S.E.	83,67±4,48	87,00±4,04	85,67±3,93	87,00±4,04

Surface area measurement values of leathers after staking process are higher than the surface area measurement values of wet-blue leathers in all drying methods and conditions (Table 1). It is concluded that, the surface areas of the leathers dried by using different drying methods and conditions were showed increase according to their surface area in wet-blue stage (Figure 1).

Figure 1. Percentage increase according to surface area measurements of wet-blue.

Generally, the area retention of leather increases steadily with the increase of drying period. Because, the longer drying period causes to remain less water in the leather and the lower residual water content enables higher area retention. Decreasing the initial water content to a certain level, this tendency steadily becomes reverse. With the increase of the drying period, this behaviour much more revealed. Probably, the leather is too dry and loses the elongation ability during toggled drying lead to lower area retention (Liu et al., 2002a).

After staking process, the leather usually goes to the drum milling process for increasing the softness of the leather. Drum milling is a physical softening process in which leather is tumbled in a dry drum fitted with wood dowels with atomized moisture injected into the tumbler. Desired softness can be generally obtained by carefully control of the drum speed, period and humidity inside the drum (Liu et al., 2011).

The cost of labour is low in the drum milling process and a more effective softness can be achieved than the other staking methods. There is no negative effect of drum milling on the strength of the leather, but the surface area loss is between 3-6%. Decrease of the surface area in the first four hours is highest (Toptaş, 1993).

It is seen that drum milling process applied after staking process is shown to reduce the surface area of leathers in all drying methods except hang drying method (Figure 2).

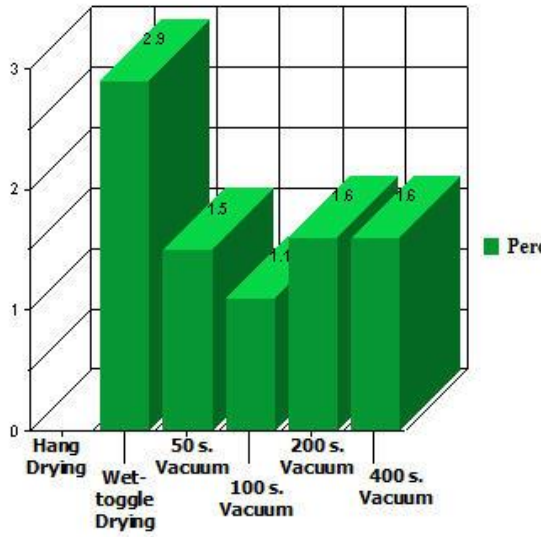

Figure 2. Percentage decrease of the surface area after drum milling.

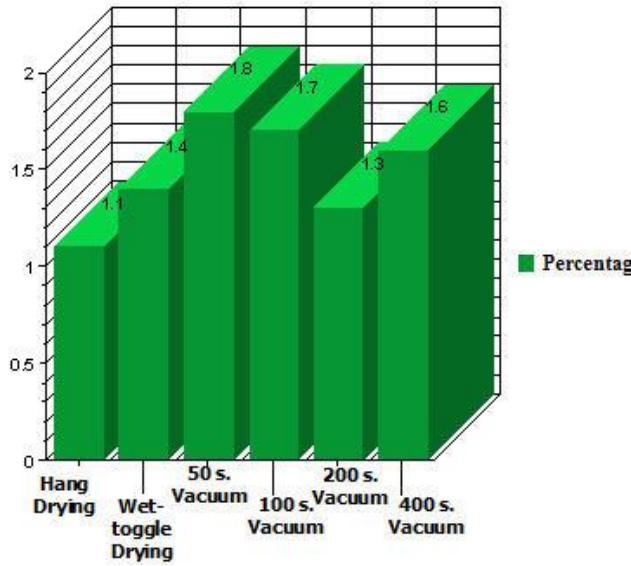

Figure 3. Percentage increase of the surface area after staking process applied after drum milling.

Liu et al. (2011) investigated that the effects of conditioning, staking and drum milling processes on the retention of surface area gained by toggling process. The results indicated that toggling has markedly effect on surface area retention, conditioning and staking have a little effect on area retention, whereas the drum milling significantly decreased the surface area.

It is observed that the tendency of decreasing on surface area after drum milling is also higher in the drying methods which provide higher surface area gain after staking process. Despite this decrease, it is also seen that the surface areas after drum milling in all the drying methods are higher than the surface areas of wet-blue leathers.

According to the measurement values of the leathers after drum milling, the surface areas of the leathers were increased after the staking process (Figure 3).

It is commonly known that the drying process often causes the leather fibers to stick together. Mechanical action from staking is necessary to break the weak adhesion within the fiber structure, thereby promoting fiber mobility (Liu et al., 2002b).

4. Conclusion

Surface area of the leathers has been increased in all drying methods compared to the wet-blue status. The maximum surface area gain was observed in the leathers that are subjected to wet-toggle drying method. This was followed by vacuum drying processes. The leathers that were subjected to the hang drying have been minimum surface area gain. The longest period vacuum drying process achieved maximum surface area gain. The drum milling process hasn't caused any changes in the surface area of hang dried leathers, but has caused decrease in the surface area of leather in all other drying processes. Maximum reduction in the surface area was observed in the leathers dried by the wet-toggle drying method. It is understood that the surface area reduction after drum milling is also higher in the drying methods which provide high surface area efficiency.

Adding staking after drum milling provided surface area gain of the leathers for all drying methods. It is determined that staking process clearly helps to increase surface area yield of the leathers.

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