Effect of leather pyrography on the functional properties of leather garments

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Abstract:

Leather is one of the most important materials used in the manufacture of clothing. It is a durable and resilient material created by tanning rawhide and animal skins. Pyrography is a decorative technique in leather consisting of designs burned onto the surface of the grain of leather using burning tools or pyrography sets. This study will discuss the technique of burning leather called pyrography. It also displays the tools and materials used in burning leather. Finally, it discusses the functional properties that determine the performance of the leather after burning. Two types of leather (Goat Suede & Sheep Napa) were examined, which are the most used types of leather by manufacturers leather garment. Eight experimental tests were carried out to determine the functional properties of the tested leather. Compares the tested characteristics to measure the effect of pyrography technique on the functional properties studied.

Keywords:

Leather, Pyrography, functional properties, leather garment.

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Introduction:

Pyrography is a decorative technique in leather consisting of designs burned onto the surface of the grain of leather using burning tools or pyrography kits. The word pyrography comes from the Greek words “pur,” meaning fire, and “graphos,” meaning writing, which translates as “writing with fire.” The modern application of burning is more in designs and drawings than writing on leather. Leather burning is a creative technique of imprinting burnt designs on leather. It uses specific tools to create the lines, shapes, letters, and graphics of your choice and follows a meticulous procedure to produce the art in leather. Leather is a good material to burn designs on. Soft and smooth leather surface, where the tip of the burning tool sinks well on its grained side. It allows designs to be printed easily, and can also create amazing hues and shades, and the aesthetic and beautiful look of the dark brown leather will really make the design stand out.

The best leather to use for pyrography is vegetable-tanned leather. This leather is produced using natural materials such as tree bark and is not produced by chemicals, unlike chrome-tanned leather. In addition, the tanned leather allows the plants to burn beautifully on their surface. Pyrography can also be done on wood, gourd, paper, and other materials that do not deteriorate when applied with heat from a burning tool.

Tools and materials used in leather pyrography.

- **Leather:**
- The most important material we need, of course, besides the burning tool, is leather. Vegetable-tanned leather is most suitable for pyrography because they are tanned using natural materials such as dried leaves and tree bark. This leather will not release potentially harmful chemicals when burning compared to chrome-tanned leather, which uses chemicals in the tanning process such as chromium sulfate. This is why it is easier to produce and takes less time in the tanning process.
- **Leather Burning Tool:**
- The most important tool in leather pyrography is the burning kit, sometimes referred to as the searing tool. It is a portable tool with a burning tip like a pen. The heat from the burning tool is used to burn the designs onto the leather, not burning the entire leather but parts of it to create a layered design. It is electrically powered and comes with different brands and designs.
- Before purchasing a burning tool, there are a few things to consider. The first is the heating capacity of the pyrography tool. There are two types of heating, single temperature burner, and variable temperature. Single-temperature burners have a preset high temperature and often come with interchangeable copper tips. The heating property of this tool is similar to a soldering iron, in that you cannot adjust to the required temperature. It is an inexpensive alternative for beginners who are just getting started with skin thermography. The variable temperature burner can be used to work with fine print details. This tool provides a great deal of control in terms of temperature. Applicable to designs with variable thermal requirements -

required burning temperature ranges from 200 to 450°C, depending on design depth.

- **Tracing Paper or Carbon Paper**
- Carbon paper or tracing paper is what will be used to transfer the design from the paper to the leather. These materials are light and help avoid creating any unnecessary marks on the leather. The transferred design will be the guide in the burning process.

Fig. 1 pyrography tools

How to do leather pyrography.

- **Preparing the leather:**

Pyrography is performed on the dermal side of the leather. When preparing the leather, we need to wet it with water to prepare the skin to accept the burn. Apply to a smooth area, skin side up. Then spray some water on the skin using a spray bottle or sponge. Let the skin absorb the water.

Smooth the leather side with a wood burnisher. Move it over the skin with sufficient pressure on all sides of the skin. You can also use anything smooth on the surface but avoid using things that might scratch the skin. Smoothing the leather causes the water to be deeply absorbed, ensuring easy transfer of designs through the buffing tool. You can add more water when the skin starts to get dry. Continue the process until the leather is smooth in all directions, then allow it to dry. Drying can take a few hours or even overnight, so we should be patient with this process.

- **Transferring of design pattern on Leather**

Using carbon paper or tracing paper, transfer the design to leather. Use a pen to outline your design. Remember don't press too hard, as this can make the design embossed. We just need an outline for the pyrography tool we're using.

Do not use masking tape to attach the pattern to the leather.

It may leave a mark because the skin is sensitive to a surface reaction after it has been polished and applied with water. Alternatively, you can use paper tape if you feel the need. Paper strips usually leave a few marks on the leather that can be wiped off by applying a small amount of water and buffing.

Fig.2 Leather pyrography

- **The pyrography process:**

To begin with, burn the leather on a low controlled heat, so we can start with a low temperature and then ramp it up as needed for pyrography. When changing temperatures try it out on a piece of scrap leather first so the design won't spoil if we use too much heat. Follow the outline to create burnt imprints on the skin.

When burning the same spot several times, allow the part to cool before reapplying the heat so that the leather does not lose its cohesion due to the high temperature. Furthermore, leather is prone to tearing when applied to excessive heat, so we must be careful when dealing with delicate and intricate designs.

The exposure of the skin of the leather to the burning tool determines the outcome of the project. If we work with high heat, we must make small and slow strokes on the leather and try not to rework it, as this could tear the leather. For lighter tones, use a small amount of heat and just enough pressure so that the surface of the leather is not compromised.

Fig. 3 Back of vest with pyrography owl

Experimental work

Leather specifications

the pyrography technique was implemented on two types of natural leather that are most used in the manufacture of leather clothing Because it is readily available and due to its suitable thickness and weight compared to other types of leathers. The following table 1 illustrates the tested leathers specifications.

Table 1, Leather specifications

Leather type	Thickness (mm)	Weight (gm/m^2)
Goat Suede	10.9	$375 \pm 5\%$
Sheep Napa	11.2	$460 \pm 5\%$

Experimental tests

A few tests determine functional properties of leathers before and after pyrography. All tests were done in conditioned atmosphere of 20ºC ± 2 and 65% ± 2 RH. Extensibility and Tensile strength obtained using tensile tester according to BS (2576).

. Abrasion test was conducted, by means of Martindale BS (5690) for several cycles, 150 cycles, mass loss was achieved before and after abrasion process.

Stiffness test obtained using Shirley stiffness tester according to ASTM (D 1388). The air permeability test was carried out by using an electronic air permeability tester according to ISO (9237).

Angle of crease recovery, for both length and width directions, has been measured based on Paramount crease recovery tester according to BS (11313), this test was done for aesthetic appeal of leather apparel.

A wettability test was carried out according to AATCC (test method 79-1986). At last, a heat loss test was carried out according to ISO (11092-1993).

Results and Discussion

1- Tensile strength test

Tensile strength is the ability of the leather to withstand a longitudinal pulling force. Sheep Napa has a lower tensile strength than Goat Suede as shown in Table 1. This is because Sheep Napa consists of micelles while Goat Suede consists of bundles of fibers which makes it more durable.

Table 2 Tensile strength test results

Leather type	Goat Suede	Sheep Napa
Before pyrography	35.6	26.1
After pyrography	29.3	21.3

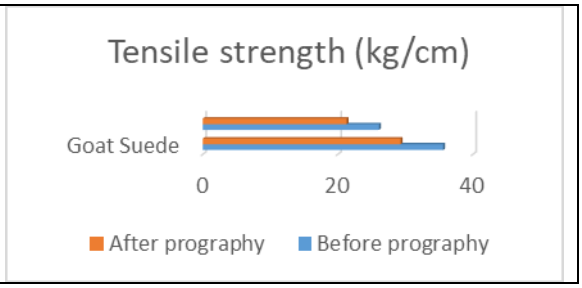
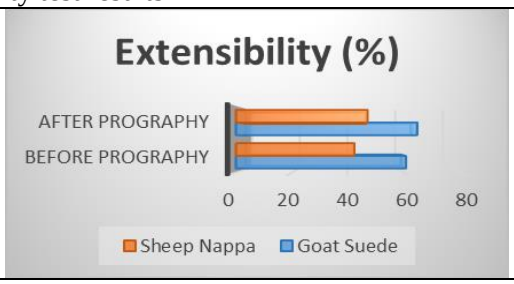


Table (2) clarifies that there is a little decrease in the Tensile strength of the two types of leather after pyrography compared to the result before pyrography. This is due to the burning process, which reduces the thickness and durability of the leather.

2- Extensibility test

Table 3 Extensibility test results

Leather type	Goat Suede	Sheep Napa
Before pyrography	61	42.5
After pyrography	65	47.2



It's clear from table3 that there is an increase in the Extensibility for the two types of leather after pyrography. This is due to the burning process, which reduces the thickness and increases the elasticity of leather.

tend to retain their original dimensions during use. Extensibility is the ability of a material to stretch when subjected to mechanical forces. All types of leather stretches more in width than length. Sheep Napa is less flexible than Goat leather.

1- Abrasion resistance test

Abrasion resistance is the ability of a material to withstand the frictional force applied to its

surface. Table 4 shows that Sheep Napa is more abrasion resistant than Goat Suede (Sheep Napa has a smaller difference in mass loss than Goat Suede). This can be attributed to the Sheep Napa having a smooth, silky surface and high wear resistance.

On the other hand, the velvet-like surface of Goat Suede with a slight nap of short protein fibers that are less abrasion resistant.

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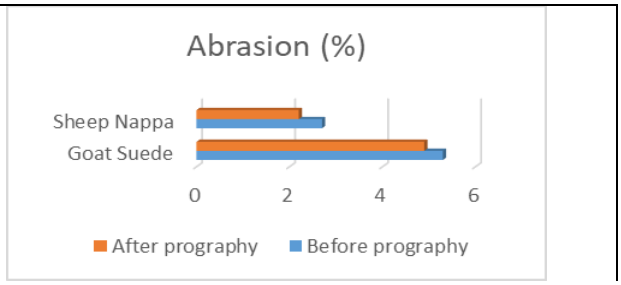
Table 4 Abrasion resistance test results

Leather type	Goat Suede	Sheep Napa
Before pyrography	5.3	2.7
After pyrography	4.9	2.2



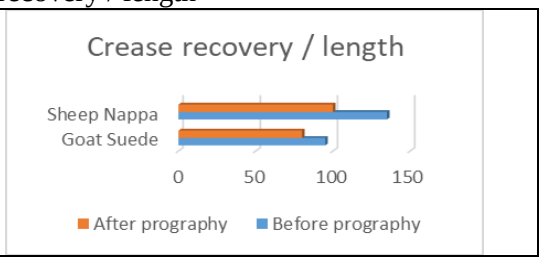
As shown in Table 4, Abrasion resistance test result was 5.3% in Goat Suede before pyrography, but it decreases to 4.9 % after pyrography. And the same in Sheep Napa, it decreases from 2.7% to 2.2%.

Bending elasticity is the most important in the creasing phenomenon. Wrinkles appear when a material is deformed in this way, and it is the ability of a material to restore its original shape after being wrinkled.

3- Crease recovery test

Table 5 Crease recovery / length

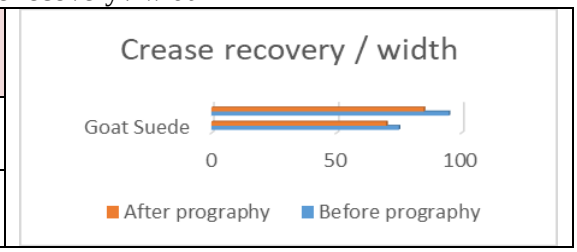
Leather type	Goat Suede	Sheep Napa
Before pyrography	95	135
After pyrography	80	100



As shown in Table 5&6, the wrinkle recovery in the width direction is lower than in the length direction. Sheep Napa has a lower wrinkle recovery than Goat Suede which affects the aesthetic appearance of the garment.

Table 6 Crease recovery / width

Leather type	Goat Suede	Sheep Napa
Before pyrography	75	95
After pyrography	70	85



Crease recovery of the tested samples are indicated in t\table 5&6, it can be noticed that the Sheep Napa provided the highest Crease recovery before pyrography compared to the Goat Suede.

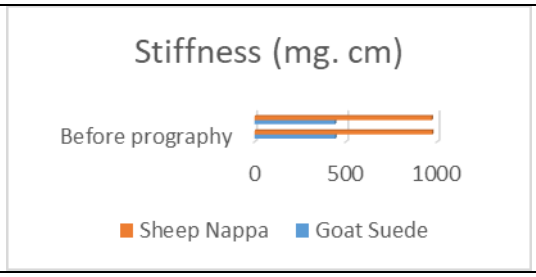
4- Stiffness test

Stiffness is the Hardness of the leather, and it is defined as the ability of a material to resist deformation under stress. In general,

materials with lower elongation tend to be stiffer than those with greater elongation.

Table 7 Stiffness test result

Leather type	Goat Suede	Sheep Napa
Before pyrography	442	973
After pyrography	440	970



As shown in table 7 it is clear that Sheep **Napa is much stiffer than** G**oat Suede.** The greater the material stiffness, the less likely the material is to drape. The pyrography affects the two types of leather, so Stiffness decreases a little after burning.

5- Air permeability test results

Air permeability is the condition in which air passes through the leather. It determines factors such as breathability and wind resistance. To avoid condensation of sweat in clothes, breathable leather is required. It also affects the coolness or warmth of the leather garment.

Table 8 Air permeability test results

Leather type	Goat Suede	Sheep Napa
Before pyrography	1.01	0
After pyrography	1.6	0.3

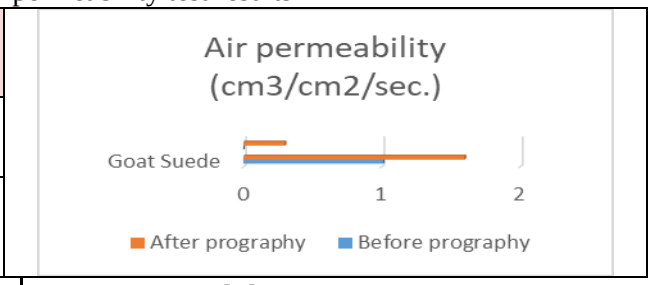


Table 8 shows that Goat Suede is air permeable while Sheep Napa is extremely windproof due to its very compact micelles. It's obvious, that the Air permeability values of the leather samples increased after pyrography when compared with the values before pyrography. This is favored as it gives sufficient comfort while wearing leather garments.

6- Wettability test

Wettability shows how the skin allows perspiration to evaporate while at the same time preventing water droplets from passing through.it is a surface property that determines how quickly a liquid can seep through a material, reach, and adhere to a substrate. The inner side of the animal hides, or skin has a higher wetting capacity than its outer side.

Table 9 Wettability test results (face)

Leather type	Goat Suede	Sheep Napa
Before pyrography	23	64
After pyrography	26	68

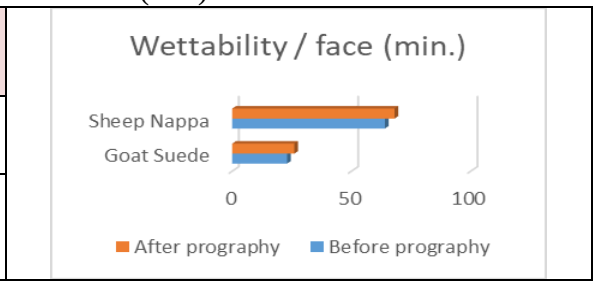
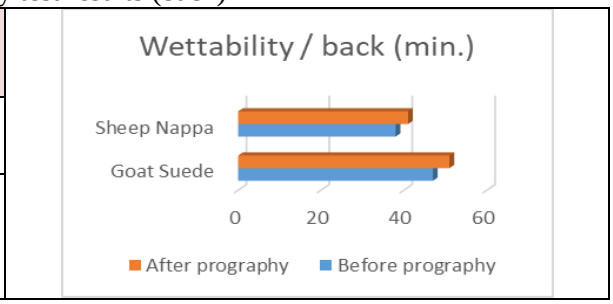


Table 10 Wettability test results (back)

Leather type	Goat Suede	Sheep Napa
Before pyrography	47	38
After pyrography	51	41



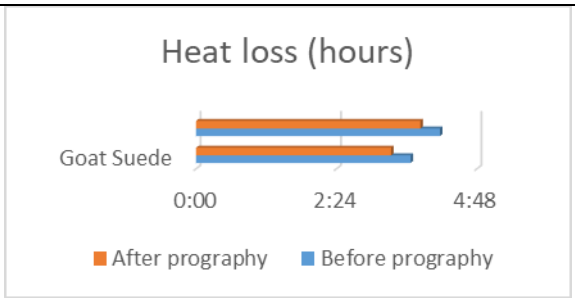
The inner side of **Goat Suede** is used as the face of apparel due to its better aesthetic appearance than its outer side. While **Sheep Napa** preferred to be used on the outer side which is soft and smooth, due to its good aesthetic appearance. However, **Goat Suede** is more wettability than **Sheep Napa** as shown in table 9&10.

7- Heat loss test results

The breathable material allows additional heat loss by evaporating moisture through the layers of clothing. If the layers of clothing are impermeable, moisture is absorbed between the skin and the clothing and heat builds up in the body. Therefore, moisture and heat accumulate, which causes discomfort.

Table 11 Heat loss test results

Leather type	Goat Suede	Sheep Napa
Before pyrography	3:40	4:10
After pyrography	3:20	3:50



As shown in Table 11, Napa Sheep lose heat slower than Goat Suede which have low compressed **micelles** and it is clear from the results that Heat loss becomes better after pyrography. It takes 3:40 hours before pyrography, but it takes less time to lose heat.

Conclusion

In this research, the pyrography technique was implemented on two types of natural leather that are most used in the manufacture of leather clothing Because it is readily available and due to its suitable thickness and weight compared to other types of leather such as cows and buffaloes which are comparatively thicker and heavier, so it is preferred in shoes and bags. Several tests were conducted to verify the effect of the pyrography technique on the functional properties of the leather. A decrease was observed in the tests of Tensile strength, abrasion resistance, Crease recovery and Stiffness, due to the decrease in the thickness and weight of the leather because of the burning application. On the contrary, it turned out that there was an increase and improvement in the Extensibility, Air permeability and Heat loss test result, which confirms that the burning technique on the skin affects the aesthetic and functional properties of leather clothing.

References

1. http://www.fibre2fashion.com/industry-article/4/344/leather-apparel-the-in-thing2.asp, date 2/12/2007
2. Doris Schubert, Leather Processing Industry, Berlin - 28 July 1998
3. N.M. Hafez, Effect of Leather Types on Apparel Functional Properties, 2018.
4. Eman Rafat, Study of different methods of cleaning and care of leather clothing, International Design Journal, Volume 10, Issue 1,2020.
5. Eman Rafat, studying aesthetic and functional properties of leather and its application in apparel industry, Master thesis, faculty of applied arts,2008.
6. Leather Pyrography Art Journal Project and Free Pattern, Lora S Irish, http://artdesignsstudio.com
7. The Art of Leather Burning, Step-by-Step pyrography, Lien Reta,2020.