Physico-Insight on Sewability Properties of Crust Leathers Using Melamine Syntan and Synthetic Fatliquor

by

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Abstract

Leather being a natural material finds a most prominent position in the fashion field. Leather goods, garments and products symbolize luxury and comfort. Manufacturing of leather products requires meeting the physical and chemical norms stipulated by the international agencies depending on the end products. Among the various physical properties, sewability is very important in deciding the quality of manufactured products. The present research discusses about the effect of syntan and fatliquor on leather properties. Experiments have been designed with varied concentration of melamine syntan along with 10% fatliquor. Various physical characterizations such as sewability, tensile strength, grain crack and microscopic images have been studied to elucidate the effect of syntan and fatliquor on leather properties. The experimental results show that the presence of fatliquor is a critical component to achieve better sewability properties in leather. Similar effect has been observed in the case of grain crack and tensile strength of the crust leathers. Prosaically, the experimental data have shown that the usage of fatliquor shows better sewability property.

Introduction

Leather and leather products pose a permanent place in the luxury segment.[1] Among the various products, garments, gloves and shoes are widely used in the colder regions for protection. The breathability of leather makes it a unique material of choice for making garments.[2,3] Leather processing is classified into pre-tanning, tanning, post-tanning and finishing. Pre-tanning mainly focuses on cleaning the material and preparing it for the tanning process, which gives permanent stabilization against natural deterioration. The post-tanning process aids in the functional and performance properties of the leathers.[4] Depending on the end products, the process recipe is designed.

Re-tanning, dyeing and fatliquoring are carried out during the post-tanning process. Re-tanning employs a different class of syntans to provide performance properties such as grain tightness, selective filling, adding fullness, roundness, etc., properties to the leathers.[5] Phenolic, acrylic, melamine, malic styrene-based synthetic tanning agents are used in the re-tanning. Fatliquoring is another inevitable step in leather manufacture that provides lubrication to the fibers and reduces the friction between leather fibers, resulting in the softness of the leathers. Moreover, the essential properties required for garment leathers such as drape and breathability, are greatly influenced by choice of fatliquoring.[6] However, the usage of excess fatliquoring leads to its deposition on the surface, limiting the application of the leathers for various functionalities.[5] Dyeing is carried out to provide aesthetic colors to the leather. It can be stated that re-tanning and fatliquoring have significant contributions to leather performance properties. From our earlier studies, we have reported the impact of phenolic syntan on leather sewability properties.[6] In the present study, we have attempted to understand the sewability properties of the leather by varying the melamine syntan concentrations during the post-tanning. The experimental leathers have been evaluated for their sewability, grain crack, tensile strength and microscopic images.

Materials and Methods

Post-tanning chemicals for the process were of commercial grade. Wet blue goat leather was chosen as the tanned material for further post-tanning.

Experiments were designed with fixed fatliquor concentration accompanied by varying the syntan concentrations from 0-10% to understand the leather sewability as given in Table I.

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Table I
Experimental process

Process	Percentage	Durations
Neutralization		
Water	150%	60 min
Nutrigan	0.50%	(pH 5 to 5.5)
Drain & Wash		
Retanning		
Water	100%	
Syntan Base:	Melamine Base (FB6)	
Trial 1	0%	
Trial 2	2%	
Trial 3	4%	30 min (Each Trial)
Trial 4	6%	
Trial 5	8%	
Trial 6	10%	
Fatliquoring		
Fatliquor Base:	Anionic – Synthetic	
Sintoil EN	10%	30 min (Each Trial)
Fixing		
Formic Acid	0.50%	30 min (pH 4)
Drain & Wash		

Physical testing of the sample
Physical testing samples were prepared as per IULTCS methods.[7] The samples were conditioned (IUP 2, 2000) and were evaluated for the tensile strength (IUP 6, 2000) and grain crack testing (IUP 9, 1996).[8-9]

Sewability analysis
The testing sample (Crust leather) was taken in the dimension of 30 x 350 mm. This testing was carried out using the L&M Sewability Tester machine (penetration rate- 100/min, needle number-90, Needle System-34LR).[10] Good sewability range is generally considered to be in the range from 0-10%.[11]

Optical microscopic studies
Celestron Microscope was used to examine the grain surface and cross-sectional view of the experimental and the control leathers.

Results and Discussion

Leather manufacture is a complex process due to its three-dimensional matrix system.[12] To develop a new technique or address concerns and challenges of existing technologies, a fundamental understanding of leather science is inevitable. Post tanning process of leather is a critical step during leather manufacturing to obtain required physical properties. Since, most of the products require stitching, the sewability of the leather is the main parameter among the physical properties of the leather.[13-16] This holds very much in-line for garment and leather goods. In our earlier study, understanding the impact of phenolic syntan on leather has been reported.[6] Continuing with that, an insight on melamine syntan on sewability property has been studied. It is well known that leather's physical properties are not limited to individual performance chemicals. A combination of post tanning chemicals would contribute to the required properties concerning the leather product.

Nevertheless, understanding the influence of specific chemicals on leather properties would aid in developing the optimized process. In the present study, melamine syntan has been chosen to understand its impact on physical strength characteristics of the leathers. Melamine syntan belongs to the family of resin syntan, which is for its selective filling property during the post tanning process.[17] Leather being key material, the natural skin/hide characteristics significantly vary from region to region on the same material. To achieve the uniform filling characteristics, melamine syntan is the preferred choice of chemical. Therefore, melamine syntan would play significant role in achieving the specific physical property of leather.

To understand the influence of fatliquor on the leather, Experiments were carried out with 10% fatliquor (Table I). It can be observed from trials 5 and 6 that leathers with 8 and 10% melamine syntan and 10% fatliquor are found to exhibit better sewability. This study is in-line with our earlier studies with phenolic syntan.[6]

Table II
Sewability Measurements

Sample Description	Standard Threshold	Sewability (High)
TRIAL 1 – (10% Fatliquor; 0% Syntan)	500	78
TRIAL 2 – (10% Fatliquor; 2% Syntan)	525	81
TRIAL 3 – (10% Fatliquor; 4% Syntan)	475	15
TRIAL 4 – (10% Fatliquor; 6% Syntan)	500	41
TRIAL 5 – (10% Fatliquor; 8% Syntan)	550	4
TRIAL 6 – (10% Fatliquor; 10% Syntan)	500	5

Strength characteristics

Properties of grain crack strength of experimental leathers are given in Table III. It can be ascertained that leathers treated with the fatliquor and higher concentrations of syntan showed better grain strength properties.

The tensile strength of experiment leathers are given in Table IV, respectively. An increase in syntan concentration has also increased the tensile strength to certain extent with the combination of fatliquor. Thus, it is evident that retanning and fatliquoring processes influences the tensile strength of the leathers.

Morphological evaluation

Grain surface and cross-sectional view of the experimental leathers are visualized using an optical microscope.

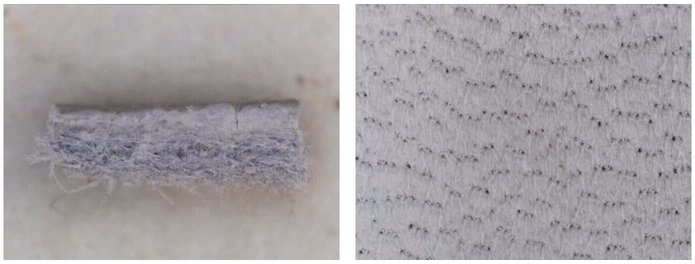
Table III
Lastometer - Grain Crack

Sample Description	Measurement	Value
TRIAL 1	Load at Grain Crack (Kg)	39.8
(10% Fatliquor; 0% Syntan)	Distention at Grain Crack (mm)	9.8
TRIAL 2	Load at Grain Crack (Kg)	38.4
(10% Fatliquor; 2% Syntan)	Distention at Grain Crack (mm)	9.9
TRIAL 3	Load at Grain Crack (Kg)	37.5
(10% Fatliquor; 4% Syntan)	Distention at Grain Crack (mm)	10.1
TRIAL 4	Load at Grain Crack (Kg)	50.2
(10% Fatliquor; 6% Syntan)	Distention at Grain Crack (mm)	10.8
TRIAL 5	Load at Grain Crack (Kg)	42.6
(10% Fatliquor; 8% Syntan)	Distention at Grain Crack (mm)	9.8
TRIAL 6	Load at Grain Crack (Kg)	41.5
(10% Fatliquor; 10% Syntan)	Distention at Grain Crack (mm)	9.5

Table IV
Tensile Strength and Elongation Measurements

Sample Description	Direction	Tensile Strength [MPa]	Elongation at Break %
TRIAL 1	1	26	67.7
(10% Fatliquor; 0% Syntan)	2	44	41.5
TRIAL 2	1	18	57.3
(10% Fatliquor; 2% Syntan)	2	29	46.8
TRIAL 3	1	18.8	69.8
(10% Fatliquor; 4% Syntan)	2	33.6	42.2
TRIAL 4	1	29	70.3
(10% Fatliquor; 6% Syntan)	2	33.1	46.5
TRIAL 5	1	25.5	54.8
(10% Fatliquor; 8% Syntan)	2	25.7	36.8
TRIAL 6	1	28.2	70.5
(10% Fatliquor; 10% Syntan)	2	29.3	36.7

(a) (0% Syntan) Cross Section and Grain Surface



(b) (2% Syntan) Cross Section and Grain Surface

(c) (4% Syntan) Cross Section and Grain Surface

(d) (6% Syntan) Cross Section and Grain Surface

(e) (8% Syntan) Cross Section and Grain Surface

(f) (10% Syntan) Cross Section and Grain Surface

Figure 1. Optical images of leathers with 10% of fatliquor (cross section and grain surface)

Conclusion

The present study summarizes the effect of melamine syntan and synthetic fatliquor on the sewability properties of the leather. Post tanning processes have been designed to understand the impact of melamine syntan on leather with the offer of fatliquor. The leathers have been characterized for their physical strength properties such as sewability, tensile strength, grain crack and morphological evaluation. The present study confirms that melamine syntan is in accordance with the phenolic syntan sewability behavior reported earlier by our research group.[6] The results provide insight on the sewability property of melamine syntan leathers which provides a better understanding in formulating the process recipe for goods and garment leather manufacture.

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