A Comprehensive Understanding on Sewability of Natural Biomaterial: An Insight on Process Optimization during Leather Manufacture

by

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Abstract

Leather is three-dimensional matrix possessing unique properties which makes it more comfortable for daily use. Garments made from leathers are preferred choice owing to their multifaceted properties as compared to textiles in the colder regions. In the present study, an attempt has been made to evaluate the influence of phenolic syntan and synthetic fatliquor on the sewability and physical properties of post tanned leathers. From the experimental results, it is observed that the concentration of phenolic syntan and fatliquor influences leather sewability. Optical microscopic images of leathers also show that they are more compact and tighter with higher percentage of syntan. The study provides an insight in understanding the optimum usage of post tanning chemicals for better sewing properties without affecting the leather matrix adversely.

Introduction

Leather and leather-based products are termed as luxurious class owing to the comfort and multifaceted properties.[1] Though, several alternate materials to leather are available, till date their material matching properties to leather remains a great challenge. Leathers are the preferred choice of material for making products due to their impeccable physico-chemical properties.[2] Fabric used for clothing is basically a two-dimensional matrix and their properties can be fine-tuned during weaving process, whereas in leather, the three-dimensional fiber network of the natural properties of the animals are retained, refined and brought into the final texture of the products.

Sewability is the ability and ease with which fabric/leather components can be qualitatively and quantitatively seamed together for conversion into a product.[3] Fundamentally, in garment manufacturing, a two-dimensional structure is converted into a three-dimensional structure. Sewing needle penetration force is a measure of the damage which appears as a result of sewing process. A high penetration force means high resistance of the fabric and thus a high risk of damage.[4] Fabric through which a needle passes easily is expected to sew without difficulty.

Sewing of leather garments is a challenging task as compared to textile fabrics, since leather is a complex dense material with presence of different chemical constituents making it more demanding. Ease of needle penetration is highly required as it reduces the distortion of the matrix which otherwise would lead to the damage of material and in-turn affect the quality of final products.[5-7] Studies pertaining to optimization of post tanning process in line with sewability properties of leathers are very limited. Commonly used syntan in leather processing is phenolic based syntan owing to its interaction efficiency and filling ability due to availability of aromatic functional groups. Similarly, synthetic fatliquors are widely used in leather manufacture to achieve lubrication and softness. In the present study a preliminary work has been carried out to understand the influence of phenolic syntan and synthetic fatliquor on sewability and physical properties.

Materials and Methods

Phenolic based syntan was used in this study with 0-8% offer on the goat wet blue leathers. Synthetic fatliquor of 10% was used in all the trials followed by fixing with formic acid.

Post tanning process

Conventional chrome tanned leathers were shaved to a uniform thickness of 0.6-0.7 mm and neutralized to pH 5.0-5.5 through conventional method. After neutralization, leathers were completely washed and drained prior to retanning. Different percentage of phenolic syntan like 2, 4, 6 and 8% with 10% fatliquor were offered. Finally, leathers were fixed using formic acid and piled overnight. After 24 h, leathers were set, hooked to dry, staked and buffed. Based on the optimized syntan concentration, different percentages of fatliquor was offered (0, 4, 8, 12, 16 and 20%) and leathers were assessed for sewability, stiffness and softness.

Physical testing of leather samples

The samples for physical testing were obtained as per IULTCS methods (4 numbers). The samples have been conditioned at 26°C and 65% R.H. for 48 h (IUP 2, 2000).[8-9] Each value reported was an average of four (2 along and 2 across the backbone) measurements.

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Manuscript received October 9, 2020, accepted for publication March 2, 2021.

Stiffness measurements

Stiffness was determined according to Indian standard IS 6490 test method.[10] Samples of dimensions 25 × 120 mm were cut parallel and perpendicular directions to the backbone of the leather and subjected to Stiffness measurements. For each sample, the length of slacking part of sample (L) was measured by the constant angle method with each side up, first at one end and then at the other. The mean value of (L) was attained which is a measure of stiffness.

Determination of softness

Softness is the most important physical property to be considered when assessing the quality of fabric or leather. Softness of the specimens was measured using MSA ST300 digital softness tester as per the standard IUP 36 [11] test method. Softness was measured at five different locations for leather samples. Difference in value of softness is due to difference in material, thickness, fusing and reinforcement used. High value of compression index indicates high softness.

Evaluation of sewability

The L&M Sewability Tester was used to test fabric sewability.[12] This equipment simulates a sewing machine by penetrating the fabric with an unthreaded needle, at a rate of 100 penetrations per min and measures the penetration force exerted by a sewing needle on the fabric. 34 LR needle system has been used with needle number 90 and reverse twist pointing system. The dimension of leather used was 30-40 x 350 mm. Leather sewability corresponds to the number of points that exceed the threshold previously set related to the overall tested points and expressed as a percentage. The sewability was considered good if the sewability values range between 0 and 10%.[13]

Evaluation of organoleptic properties

Crust leathers have been assessed for grain smoothness, fullness and general appearance by tactile evaluation. Three experienced tanners rated the leathers on a scale of 0-10 points for each functional property.

Optical microscopic studies

Grain surface and cross-sections of the control and experimental leathers were studied using Magnus Stereo Zoom Microscope with Trinocular Body micro imaging facility.

Results and Discussion

The selection and choice of post tanning chemicals influences the aesthetic and functional properties of post tanned leathers.

The present study explores the effect of phenolic syntan and synthetic fatliquor in imparting physical strength characteristics to post tanned leathers. Chrome tanned goat leathers have been used as the raw material and retanned with different percentage offer of phenolic based syntan and 10% synthetic fatliquor for all the trials (control and experimental) as given in Table I.

Table I

Post tanning process

Process/chemicals	%	Duration (min)	Remarks
		Washing	
Water	100	10	Drained
		Neutralization	
Water	150		
Sodium formate	1.0	10	
Sodium bicarbonate	1.0	3x15+45	pH – 5.0 - 5.5, Drained.
		Washing	
Water	200	15	Drained
		Retanning and Fat liquoring	
Water	100		
Phenolic syntan	0-8	60	
Synthetic fatliquor	10.0	30	Mixed in hot water
Formic acid	1.5	4x10+20	Exhaustion was checked. Drained.
Washing	100	15	Drained. Crust leathers were set twice, hooked to dry, conditioned, and staked.

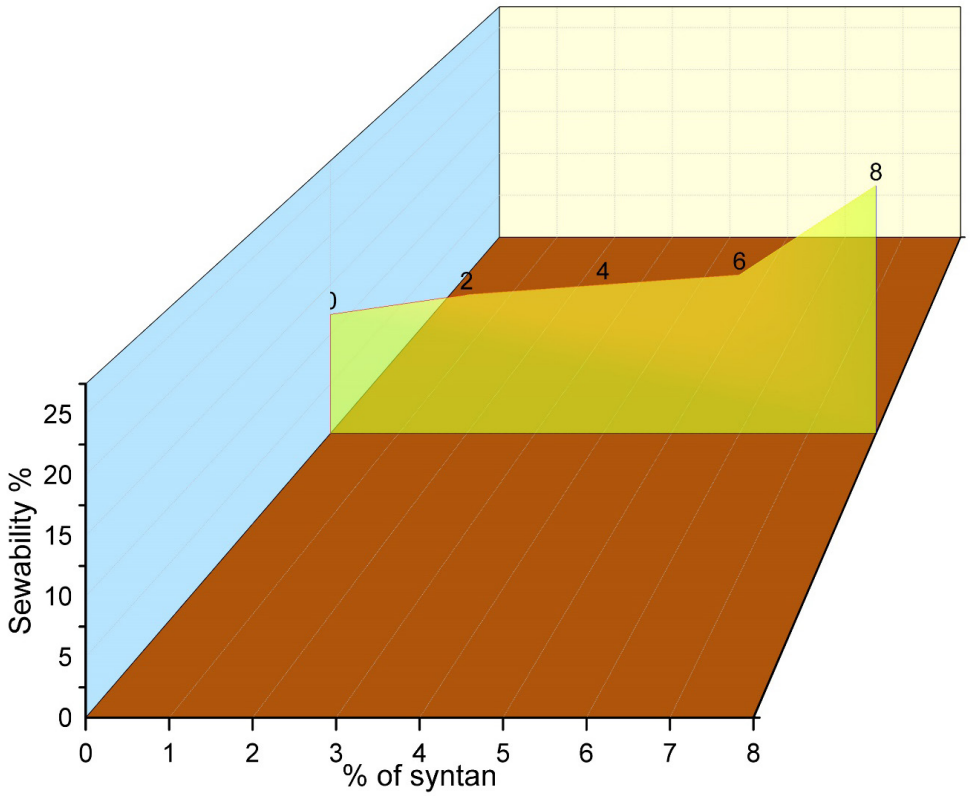


Figure 1. Sewability property of phenolic retanned leathers

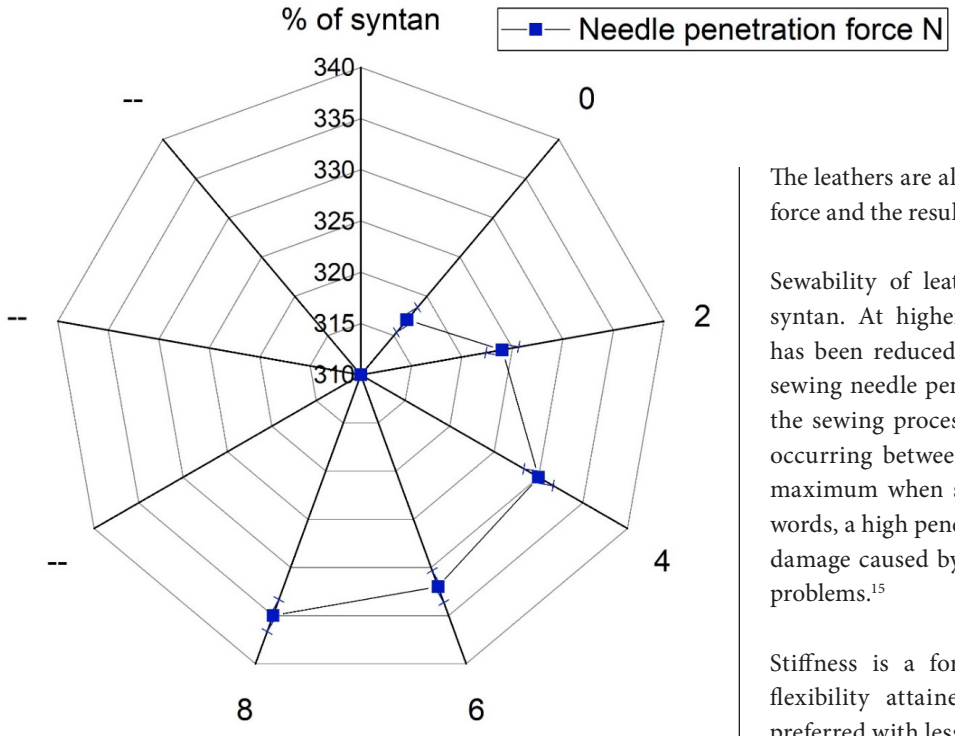


Figure 2. Needle penetration force of phenolic retanned leathers

The leathers are also assessed for sewability and needle penetration force and the results are shown in Figure 1 and 2.

Sewability of leathers is influenced with the offer of phenolic syntan. At higher concentration of phenolic syntan, sewability has been reduced which might be due to the filling nature. The sewing needle penetration force is also a significant parameter in the sewing process.[14] The penetration force is due to the friction occurring between fibers and sewing needle and is found to be maximum when sewing needle penetrates the material. In other words, a high penetration force causes a high risk of damage. Seam damage caused by needle penetration can cause severe sewability problems.[15]

Stiffness is a foremost property that defines the measure of flexibility attained by the leathers.[16-17] Garment leathers are preferred with less stiffness to achieve better drape characteristics. The stiffness properties of phenolic retanned leathers are shown in Figure 3.

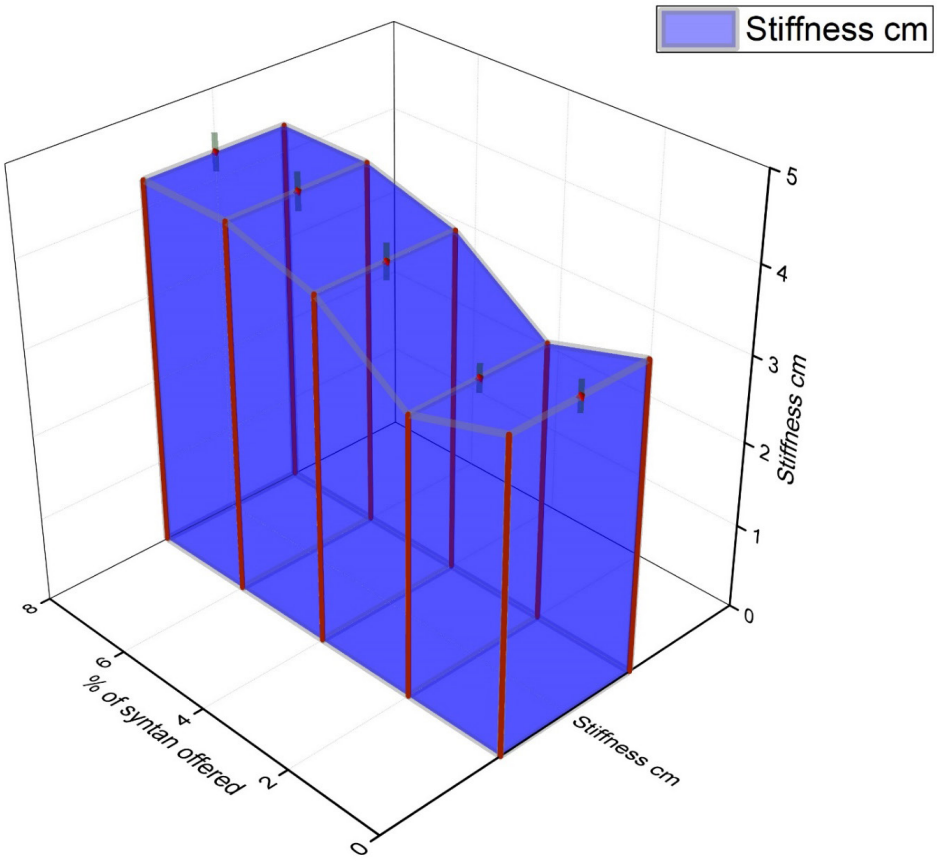


Figure 3. Stiffness measurements of phenolic retanned leathers

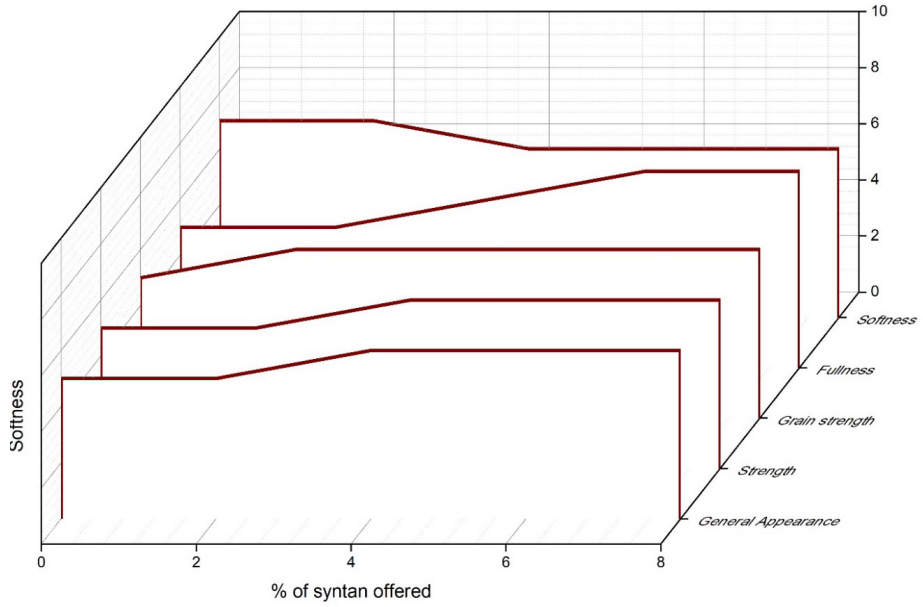


Figure 4. Organoleptic properties of leathers

Table II

Physical characteristics of different fatliquor offered leathers

Sample (Fatliquor offered)	Sewability %	Stiffness cm	Softness
Control	0	3.85	3.70
4%	0	3.5	4.15
8%	4	3.6	4.10
12%	4	3.7	4.02
16%	6	3.9	3.90
20%	34	3.7	3.50

Concentration of syntan- 6%

From the results, it can be observed that with an increase in the offer of phenolic syntan there is an influence on leather stiffness.[18] Retanned leathers were also assessed for their organoleptic properties and the results are shown in Figure. 4.

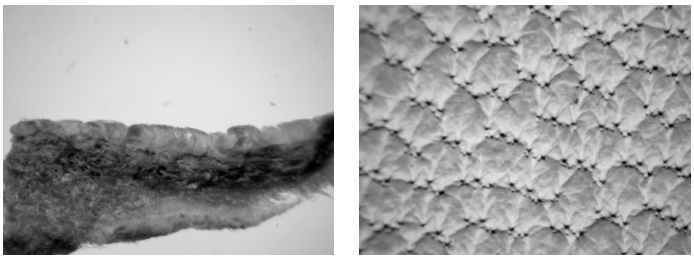
From the hand evaluation results, it can be inferred that with an increase in phenolic syntan offer, leathers were found to be full and more compact. The surface characteristic and cross-section of retanned leathers were examined using magnus stereo zoom microscope and shown in Figure 5.

From the grain and cross section images, it can be seen that there is no coarse grain characteristics and it is smooth. The experimental studies reckon that phenolic syntan has a vital role in influencing the sewability and physical properties of leathers. Leather processed without offer of fatliquor is treated as control for fatliquor optimization studies.

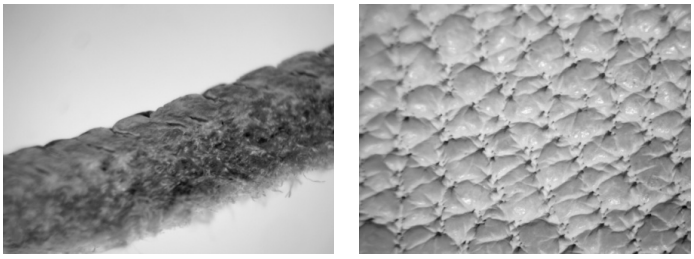
Sewability, stiffness and softness values of control and experimental leathers are given in Table II. It can be observed that synthetic fatliquor significantly influenced the sewability of leathers. Interestingly, the study provides fundamental insight on the relationship between fatliquor and sewability.[19-24]

Conclusions

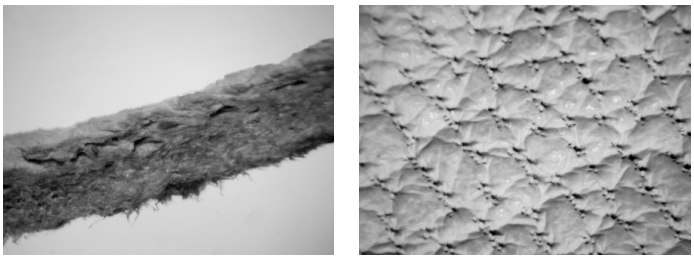
An insight of emulating the various garment leather properties and its intercalation between them had been studied to coherently emphasize the role of phenolic syntan and synthetic fatliquor. Though, there is a huge variation in phenolic syntans available in the market, nevertheless, a holistic understanding of specific syntan and fatliquor on sewability properties has been presented in this research work. Selective properties like sewability and needle penetration force, has been studied with different concentrations



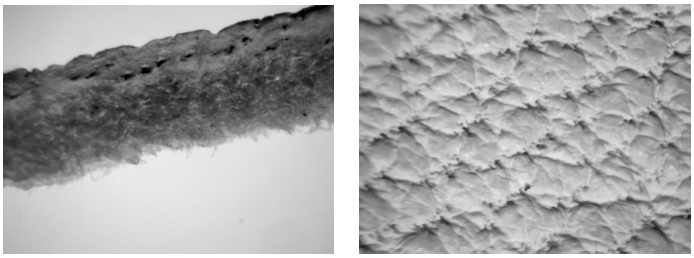
(a) Control- Cross section and Grain surface



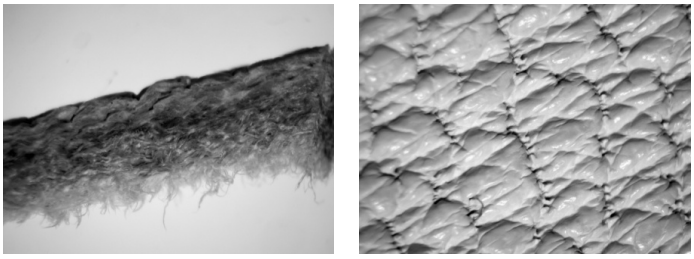
(b) 2%- Cross section and Grain surface



(c) 4%- Cross section and Grain surface



(d) 6%- Cross section and Grain surface



(e) 8%- Cross section and Grain surface

Figure 5. Optical images of leathers (cross section and grain surface)

of phenolic syntan and fatliquor. Garment properties such as sewability, stiffness and softness parameters have been influenced based on the offer of concentration. This study might surmise that selection and offer of chemicals plays a significantly influences on the leather sewability for making products. However, future studies on the synchronizing effect of post tanning chemicals needs to be evaluated.

Conflict of Interest

The authors declare that they have no conflict of interest.

Acknowledgements

Authors acknowledge the financial support from CLRI under MLP. Authors also thank CATERS for testing facilities.

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