

DEVELOPMENT OF ALGINATE-CHITOSAN BASED BIOPOLYMERS FOR LEATHER RETANNING

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ABSTRACT

Hides and skins when received in tanneries have closely and firmly packed together bundles of collagen fibers, with elastin and other non-fibrous proteins aiding a dense structure formation. However, in order to enable the easy diffusion of chemicals, a series of pre-tanning operations ensure the opening up of the fiber bundles and the removal of the non-fibrous materials, resulting in a loose structure. A majority of leather consumers often demand properties, which were available on hides and skins, but lost during the pre-tanning operations. One such property is the compaction or firm packing of fiber bundles. While vegetable tanning processes provide for good fullness and firm packing of fiber bundles, the lack of strength and stability against wet heat forces the tanners to adopt chrome tanning. Chrome tanning provides for good inter and intra networking of fibers, but is unable to replenish the firmness found in the original raw material. To overcome this drawback, tanners often resort to the use of a combination of retanning agents in varying proportions. The varying character of these products results in non-uniform and poorer uptake. In this work an attempt has been made to develop syntans from biopolymers such as chitosan and alginate, which could provide fiber compaction to the leather.

INTRODUCTION

Leather processing is unique. It often calls for destruction of some of the fantastic properties inherently available in the raw material for ensuring easy diffusion of chemicals and subsequently through a series of processes attempt to restore the same. These properties vary from simpler ones such as look, handle, feel etc. to high-end smarter properties such as ability to adjust to hot and cold conditions at will. While the primary aim of tanning is to provide a desired level of hydrothermal stability, the tanning agents often end-up providing a characteristic feel to the leather. For instance soft, supple, not so full leather with better hydrothermal stability and high tensile strength and good color yield is obtained with chrome tanning. While chrome tanning leaves an empty feel in the leather, firmer fuller character, with much less hydrothermal and physical stability is obtained with vegetable tanning. In terms of wash and perspiration fastness, aldehyde tannages are applicable. If the grain needs deep correction, the choice is chrome-vegetable combination. For nubuck type leather, zirconium retanning, and for shrunken grain leather; syntan-chrome combination tanning is considered.¹

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Even though a large variety of tanning agents are available, chrome tanning continues to be the obvious first choice due to the high stability and strength it provides to the leather. The tanner is often happy to overcome the disadvantages such as an empty or non-compact feel of chrome tanned leathers through retanning with synthetic tanning agents.² Utility and fashion market often demand, in addition to shades and colors, a host of properties, which are to be met through appropriate retanning. Unfortunately, no single syntan is able to confer all the desired properties of the customer, leading to the tanner employing a number of synthetic tanning agents differing in chemical type. The process of choosing appropriate retanning agents (a combination of at least 3 to 5 proprietary products) is even more challenging when poorer quality raw materials, such as those from ill fed or under-nourished animals is employed. The magnitude of uptake of each of these individual syntans and their overall contribution to the final properties of the leather is often difficult to understand.⁴

An initial survey of the Indian leather chemical industry indicates a much desired need to develop such retanning agents, which can in combination with other proprietary products available in the market meet the needs of providing compaction to the collagen fibre bundles in the hide, especially to those of Indian origin. Such new developments need to adequately address the concerns of the customer ecobenign materials. Modern customer preferences are also towards natural materials and recycled products. This work proposes to develop retanning agents, which can provide for firm, fuller and denser fibre structure from natural products and leather wastes through appropriate grafting with polymers. The developed products would be tested against standard retanning processes or agents employed in Indian leather industry on a wet blue cow as substrate and employing different methods for the determination of compactness of leather.

MATERIALS AND METHODS

Materials

All chemicals used for leather processing were of commercial grade. Chitosan and the chemicals used for the analysis of spent liquors were sourced from SD Fine Chemicals, India. Sodium alginate was obtained from Loba Chemies Pvt. Ltd.

Preparation of Solutions of Alginate and Chitosan

Sodium alginate solution was prepared by adding 1g of sodium alginate to 100 mL water under constant stirring. The stirring was continued till a homogeneous solution of sodium alginate was obtained. Similarly, chitosan solution was prepared by adding 1 g of chitosan to 100 mL of 2% acetic acid solution under constant stirring, until a homogeneous solution of chitosan was obtained.

Preparation of Various Alginate-chitosan Complexes

Alginate-chitosan complexes were prepared by mixing the solutions of alginate and chitosan in 1:1 proportions. The complex thus formed was stirred for a period of 15 minutes, after completion of stirring; the product was adjusted to different pH conditions with sodium bicarbonate. Products A, B and C were obtained by adjusting the product pH to 9, 6 and 3, respectively. The experiments were performed at 25°C. Alginate-chitosan complex adjusted to pH 9 (Product A), was subsequently added with 0.2 gms. of poly acrylic acid (mol. wt. 2100) and the complex stirred for 30 minutes. Urea of 20, 50 and 100 mg (per gram of alginate) were added to the complex to obtain products D, E and F, respectively and the pH of the final products adjusted to 9.0 using sodium bicarbonate.

Determination of Solid Content

A known quantity of product was weighed in an empty dish and dried at 103°C -105°C for 1 hr as per the standard procedure.⁵ Total solids of the products were calculated from the dried weight.

Thermal Analysis of the Developed Products

The samples were fused in a differential scanning calorimetric cell of a Seiko Model SSC 5200 220C (DSC) differential scanning calorimeter. The temperature was calibrated effectively using indium as standard. The heating rate was maintained constant at 6°C/min. The denaturation temperature T_D (°C) of the products was measured under N_2 atmosphere.

FTIR Spectral Studies of the Developed Products

The FTIR (Fourier Transform Infrared) spectra of Products were obtained using KBr disc technique. The products were ground in mortar for 5 mins after drying it for a period of 2 hrs at 80°C. Dilution and homogenisation to 0.01% (W/W) with KBr (Spectroscopic grade) were carried out with additional grinding. The disc was pressed in a hydraulic KBr press. The Transmission FTIR spectrum was then recorded using Perkin – Elmer Spectrum RX IFT – IR system between 400 and 4000 cm^{-1} .

Preparation of Leathers

The wet blue cow hides of Indian origin were chosen as raw material for the manufacture of upper leathers. Wet blue cow sides were sammed and shaved to a uniform thickness of 1.1-1.2 mm and corresponding shaved weight was noted. The chemicals were offered based on the shaved weight. Post tanning process followed for control leathers is given in Table I. The experiments were carried out in a stainless steel drum with 15 rpm.

Physico-chemical Evaluation of the Leather

Samples for various physical tests from experimental and control crust leathers were obtained as per IUP method.⁵ Specimens were conditioned at 80±4°F and 65±2% R.H. over a period of 48 hrs. Physical properties such as tensile strength, % elongation at break, were examined as per the standard procedures.⁶ Tear strength was examined as per the standard procedure.⁷ Measurement of distension and strength of grain by the ball burst test were examined as per the standard procedure.⁸

TABLE I
Process Recipe for Manufacture of Upper Leather
from Wet Blue of Thickness 1.1-1.2 mm (Control).

Process/chemicals	% (based on shaved weight)	Duration (minutes)	Remarks
Washing			
Water	100	10	Drained
Neutralization			
Water	150		
Phenol acrylic copolymer Syntan	5	40	
Neutralizing syntan	2	3x15+45	Check for pH 5.0 -5.2, Drained.
Washing			
Water	200	15	Drained
Water	100	15	Drained
Retanning, Dyeing and Fat liquoring			
Water	50		
Acrylic resin	3		
Synthetic fatliquor	1	30	
Phenolic replacement syntan	8		
Melamin condensate	4		
Wattle-GS powder	4		
Dye	2	90	Check penetration
Water	100	20	
Carbohydrate and protein based filling syntan	2.5	20	
Sulphited synthetic fatliquor	6		
Vegetable semi synthetic fatliquor	1	60	
Sulphited fish oil	1		
Wattle- GS powder	1.5	30	
Formic acid	2	3x10+30	

The exhaustion of the bath was checked. Drained. The leathers were set twice, Hook dried, conditioned and staked.

Assessment of Softness Through

Digital Leather Softness Tester

The softness of the leathers was measured using a MSA ST 300 digital leather softness tester supplied by MSA Engineering Systems Limited as per standard procedure.⁹ The method permits measurement of softness of leather without defacing the hide. The measurements were performed using a 35 mm ring at $20 \pm 2^\circ\text{C}$ and with a relative humidity of $65 \pm 2\%$ with thickness of leather being 1.2mm. Higher value indicates higher softness. Measurements were carried out on 5 locations within the sampling area and reported as average.

Reflectance and Color Measurements

The principle involves measuring the amount of light reflected from the surface of opaque specimen at wavelengths throughout the visible spectrum as a fraction of that reflected by a white standard identically illuminated. It is known as the reflectance factor. The white standard used should be an absolute one i.e., it should be a perfect reflecting diffuser whose reflectance at every wavelength is 100%. The control and experimental crust leathers made in this study were subjected to reflectance measurements using an Ocean optics UV 2000 spectrophotometer employing an OOIrrad software instrument. Color measurement parameters *viz.*, L, a, b, h and C were recorded using a Lambda 35 instrument for control and experimental crust leathers¹⁰; where 'a' represents red and green axis and 'b' represents yellow and blue axis; 'h' represents hue and 'C' represents chromaticity.

Hand Evaluation

Experimental and control crust leathers were assessed for fullness, roundness, softness, grain smoothness, grain tightness (break) and general appearance by hand evaluation methods. The leathers were rated on a scale of 0–10 points for each functional property by experienced tanners, where higher points indicate better properties.

Scanning Electron Microscopy Analysis

Samples from control and experimental tanned leathers were cut from the official sampling position⁶ from the crust leather. Samples were cut into specimens and coated with gold using an Edwards E306 sputter coater. A Leica Cambridge stereoscan 440 scanning electron microscope was used for the analysis. The grain as well as cross-section was examined under the microscope at varying magnifications.

Evaluation of Extent of Compaction by Comparing the Physical Property of the Belly and Butt

The physical property of the butt and belly are carried out as per standard procedure.⁶⁻⁸ The result of both is correlated for the evaluation of the compactness.

Weight Ratio

The circular samples were taken from different portion i.e., neck, belly, tail, shank and flank. A sample was taken in a butt portion such that its mass should be greater than the other portion and named it as tight portion. Then the tight portion was X_n and other portion i.e., neck, tail, belly, shank and flank as X_1, X_2, X_3, X_4 and X_5 . To calculate the weight ratio X_1, X_2, X_3, X_4 and X_5 are divided by X_n . The weight ratios of the leathers were used to evaluate the compaction.

Apparent Density

Apparent density is the ratio of apparent mass by apparent volume. Here the weight of the sample was taken as mass and the volume of sample was calculated from the radius of the sample and thickness of the sample. By comparing the values, the extent of compaction was measured.

Analysis of Wastewater

Total volume of wastewater generated was determined. Chemical oxygen demand (COD) and total solids (TS) were determined as per standard procedures.¹¹

RESULTS AND DISCUSSION

Synthesis of Alginate-chitosan Complexes

A polyelectrolyte complex (PEC) is formed by the association of two or more polymers based on their electrostatic force. For example, a polycation interacts with a polyanion through a proton transfer, resulting in the formation of PEC. Preparation of PEC's using chitosan and a counter pair of polyanion, like an alginate composed of (1-4)-linked β -D-mannuronic acid and α -L-guluronic acid units is reported as an effective technique for preparing separating membranes and microcapsules.^{12,13} White precipitates in the chitosan/alginate solutions indicated the formation of a PEC. Solutions of alginate (1%) and chitosan (1%) were mixed in proportion of 1:1, in a magnetic stirrer for a period of 30 min at room temperature. A stable product was formed having a pH of 4.5 and solid content of 16%. The pH has a strong influence on polyelectrolyte functional groups. Three PEC's were prepared at pH 9, 6 and 3 and are termed as product 'A', 'B', and 'C', respectively. The FT-IR spectra of the prepared products are presented in Fig. 1a-c.

A peak at around 1420 cm^{-1} can be seen for all complexes. Intensity of this peak increases from Product C (pH 3) to Product B (pH 6) and decreases a little for Product A (pH 9). This peak is attributed to the amino (NH_3^+) groups of chitosan interacting with the carboxyl ($-\text{COO}^-$) groups of alginate. A strong peak at 1750 cm^{-1} is seen in Product C (pH 3). This peak is explained by non-ionization of ($-\text{COOH}$) groups of alginate at low pH values. The peak seen for all complexes at 1560 cm^{-1} explains unreacted ($-\text{NH}_2$) groups of chitosan.

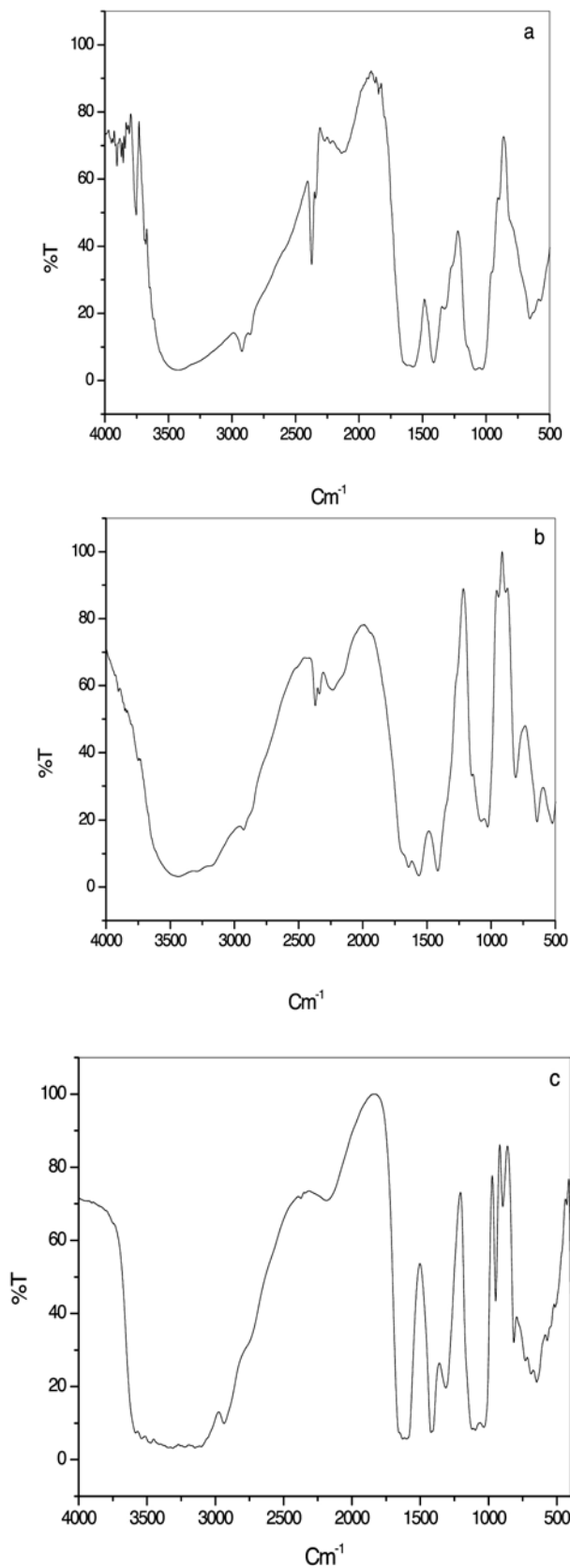


Figure 1. FTIR spectra of a) Product A b) Product B and c) Product C.

A thermogravimetric analysis performed on the Product A (Fig. 2) revealed that with increasing temperature the weight of sample decreases rapidly up to 150°C, slowly in the 150–200°C range. The loss of weight is mainly attributed to the loss of free and bound water. Beyond 200°C the compound appears to be stable up to 1000°C and above this temperature significant weight loss is noticed, which could be due to thermal degradation of the compound.

Three products developed have been used for the retanning of cow wet blue of Indian origin. The process followed for control and experiment is shown in Table I and II. The variation in tensile strength, tongue tear strength, the load and distension at grain crack, as well as softness for the leathers processed using products A, B and C is as presented in Table III. Adequate tensile strength is very important in manufacture of upper leather. The cutting direction had a varying effect depending on the retanning agent used. The load at grain crack was highest for Product A, followed by product C and product B. This effect could be attributed to the greater surface fixation that accompanies with the elevated pH conditions. Product B (pH 6) reduces the distension of grain crack in the ball burst test marginally, when compared to Product A and Product C. The resistance to fracture was highest when Product A was employed, followed by Product B and C, respectively.

Apparent density is an important factor controlling the softness of the leather. It has been shown earlier that apparent density can directly be related to assessment of compaction of fiber weave. Lower apparent density results in softer leathers. This is attributed to the larger unfilled spaces between individual fiber bundles.¹⁴ A marginal difference in softness was observed as the retanning process varied, with Product B offering a slightly higher softness than Product A and C. Thus it can be concluded that Product A offered a higher filling of the interfibrillar spaces than Product B and C. Subsequent experiments were carried out with Product A, as it showed better characteristics.

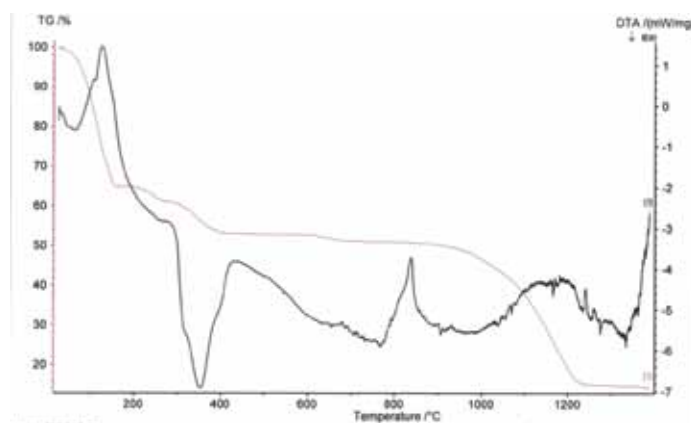


Figure 2. Thermogravimetric spectrum of product A.

TABLE II
Process Recipe for Manufacture of Upper Leather from
Wet Blue of Thickness 1.1-1.2 mm (Experimental).

Process/chemicals	% (based on shaved weight)	Duration (minutes)	Remarks
Washing			
Water	100	10	Drained
Neutralization			
Water	150		
Phenol acrylic co polymer syntan	5	40	
Neutralization syntan	2	3x15+45	Check for pH 5.0 -5.2, Drained.
Washing			
Water	200	15	Drained
Water	100	15	Drained
Retanning, Dyeing and Fat liquoring			
Water	50		
Acrylic resin	3		
Synthetic fatliquor	1	30	
Phenolic replacement syntan	8		
Melamine condensate resin	4		
Wattle- GS powder	4		
Dye	2	90	Check penetration
Water	100	20	
Product A*, B, C, D, E or F	2.5	20	
Sulphited synthetic fatliquor	6		
Vegetable base semi synthetic fatliquor	1		
Sulphited fish oil	1	60	
Wattle- GS powder	1.5	30	
Formic acid	2	3x10+30	

The exhaustion of the bath was checked. Drained. The leathers were set twice, hook dried, conditioned and staked.

* A is varied at 2.4, 3.2, 4.0, and 4.8%

Role of Percentage Offer of Product on the Physical Properties Of The Leathers

A pronounced increase in the tensile strength of the leather is observed as the offer of product A varied from 2.4 to 4.8% as shown in Table IV. The resistance to fracture, as measured by the tear strength is observed to be constant over the range of concentrations investigated. There is an increase in the grain crack strength up to an offer of 3.2%. Further increase in concentration of the product to 4.8%, decreased the grain crack strength. This could be attributed to the overloading of grain by the product. Softness seems to be unaltered by the concentration of product offered.

Role of Combining Natural and Synthetic Polyanions and Urea in PEC Formation

Poly (acrylic acid) (PAA) has been chosen as a synthetic polyanion. A chitosan-PAA polyelectrolyte is expected to penetrate into tighter areas like butt, leaving the chitosan-Alg polyelectrolyte to penetrate into the looser areas like belly. When alginate is compounded with urea, the spreading and diffusion of alginate into the leather matrix can be controlled. In this work, the role of urea in enabling a better penetration of the chitosan-Alg polyelectrolyte into the looser areas is being evaluated. Product A complexed with PAA in

TABLE III
Comparison of Physical Properties of Leathers Retanned with Product A, B and C.

Samples	Tensile strength (kg/cm ²)	Tongue tear (kg/cm)	Load at grain crack (kg)	Distension at grain crack (mm)	Softness
Product A	275±5	74±2	51±3	12±1	-3.2
Product B	244±3	60±2	30±1	10±2	-3.8
Product C	273±3	40±2	40±1	12±1	-3.0

TABLE IV
Comparison of Physical Properties of Leathers Retanned with Increased Offer of Product A.

Product A (%)	Tensile strength (kg/cm ²)	Tongue tear (kg/cm)	Load at grain crack (kg)	Distension at grain crack (mm)	Softness
2.4	236±2	71±2	40±2	13±2	-3.3
3.2	305±8	70±3	52±5	12±2	-3.8
4.0	275±3	74±3	51±2	12±1	-3.2
4.8	338±7	67±2	37±3	10±2	-3.1

TABLE V
Comparison of Physical Properties of Leathers Retanned with Product D, E, and F.

Samples	Tensile strength (kg/cm ²)	Tongue tear (kg/cm)	Load at grain crack (kg)	Distension at grain crack (mm)	Softness
Product D	250±1	59±2	47±2	10±2	-5.0
Product E	260±3	59±2	50±2	12±2	-5.2
Product F	296±2	63±2	48±3	12±1	-4.2

combination with urea concentration of 20, 50, and 100 mg (per grams of alginate), referred to as product D, E, and F were prepared. Retanning process as described in Table II has been followed to process the leathers with these products. The physical properties of the leather tanned with Products D, E and F is presented in Table V. As expected at higher urea offer, the tensile strength and tongue tear resistance was improved. The lower distension at grain crack could be attributed to a better filling of the corium-grain junction. The lower softness with Product F could be attributed to a better filling of the interfibrillar portions. This is further substantiated from the apparent density values, which followed the order.

Comparison of Leather Characteristics Between Products A, F and Control

Experimental process as provided in Table II has been employed for comparing the characteristics incorporated by

products A and F as against control process employing commercial syntan, specifically aimed at selective filling of looser ends. Left-right comparison method was adopted. The physical properties of the leathers have been compared both at the butt and the belly region of the sides. The sample specimens have been cut exactly at similar positions on the left and right sides of the hide. The results are presented in Table VI. It can be clearly seen that the Product F is better when compared to the control process, in its ability to confer strength to the butt and belly regions in comparison to similar regions of the control leather. The weight ratios and apparent density of different regions of the leather (sides) made from Product A, Product F and commercial syntan are presented in Table VII. It is seen from the table that the weight ratio of belly region is lower as compared to other regions in both control and experimental trials. However, leathers made from Product A exhibited similar characteristics as compared to

TABLE VI
Comparison of Physical Properties of Leathers Retanned with Product A and F as Against Control.

Samples	Tensile strength (kg/cm ²)		Tongue tear (kg/cm)		Load at grain crack (kg)		Distension at grain crack (mm)		Softness
	Butt	Belly	Butt	Belly	Butt	Belly	Butt	Belly	
Product A	275±5	200±2	75±2	70±3	52±2	48±4	10	10.5	-4.7
Product F	296±5	210±3	65±5	58±3	48±1	42±2	11.4	11.9	-4.1
Control	280±4	200±2	62±3	70±2	46±5	43±3	10.2	11.1	-4.7

TABLE VII
Weight Ratio and Apparent Density of Leathers Retanned with Product A and F as Against Control

Samples	Product A		Product F		Control	
	Weight ratio	Apparent Density (gm/mm ³)	Weight ratio	Apparent Density (gm/mm ³)	Weight ratio	Apparent Density (gm/mm ³)
Neck	0.94	0.042	0.95	0.048	0.92	0.042
Tail	0.96	0.046	0.95	0.052	0.96	0.049
Belly	0.70	0.042	0.67	0.039	0.77	0.041
Shank	0.89	0.042	0.64	0.044	0.95	0.047
Flank	0.93	0.044	0.81	0.044	0.85	0.045

control leathers. The weight ratios are lower in belly and shank regions for leathers made from product F. The distribution of weight ratio in all the regions is good for the leathers made from Control and Product A. This indicates that Product A is filling up the looser areas thus enabling uniform distribution of the product in the leather to provide the required compaction. However, the apparent density values for all the leather at different regions seems to be equal, except for belly region, where the apparent density is slightly lower. The lower apparent density of the leather means that they may be expected to have larger spaces between individual fiber bundles.

SEM Analysis

The grain surface and cross section from the butt portion and belly portion of the leathers from control and experimental (Product A and F) have been analyzed using Scanning Electron Microscopy (SEM). Grain surface of all samples obtained seems to be clean and appears to be similar (Figures not shown). SEM images of the cross section of all samples obtained from butt and belly portions are provided in Fig. 3 and 4, respectively. The sample from product F shows a compact and regular fiber structure. This could be due to the filling nature of the product. The product A and control samples shows lower compaction of fibre structure compared to product F. The orientation of the fiber structure in the belly region for samples treated with product 'A', 'F' and control are

comparable (Fig. 4). However, the product F provides more compaction compared to the other samples. This is in agreement with the above observation.

Hand Evaluation of Leathers

The hand evaluation data for the crust leathers made from Product A, F and control is given in Table VIII. It is observed from the table that the overall rating of leathers made from Product A and Product F are comparable to that of control. Although the leather made from Product A are more fuller and softer, the grain tightness needs to be improved. However, the grain tightness is better in the case of leathers made from Product F. Color measurement results are presented in Table IX. The color values obtained were similar and also the colors are comparable to the naked eye.

A comparison of the physical properties obtained for the butt region as against the belly region of the same cow side reveals interesting results. The differential figures are presented in Table X. The change in tensile strength, tongue tear, grain crack resistance and distension at grain crack were lowest with Product A when compared with Product F. This is possible as the Product F, which contained an alginate and polyacrylic acid in combination with chitosan can penetrate into both butt and belly regions, while Product A, which contains only alginate in combination with chitosan can penetrate into the

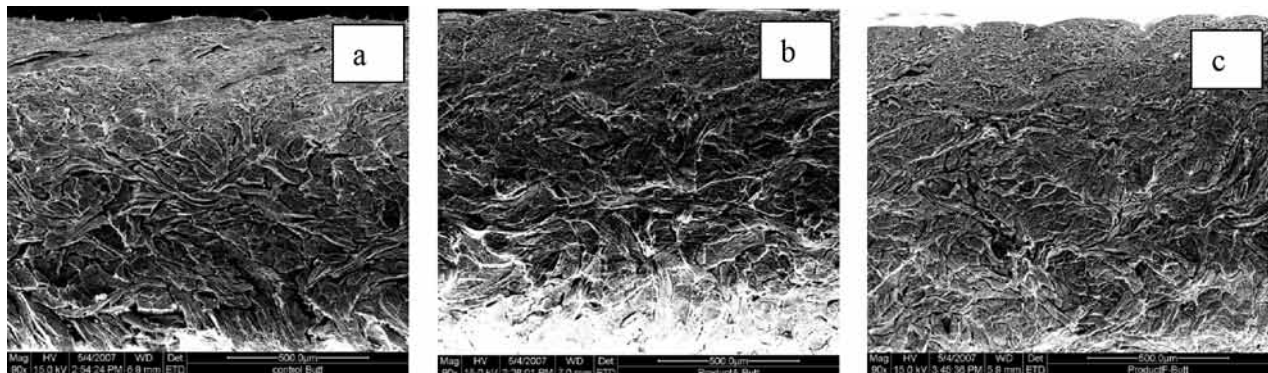


Figure 3. Scanning electron micrographs of cross section of the butt portion of the samples a) Control b) Product A c) Product F.

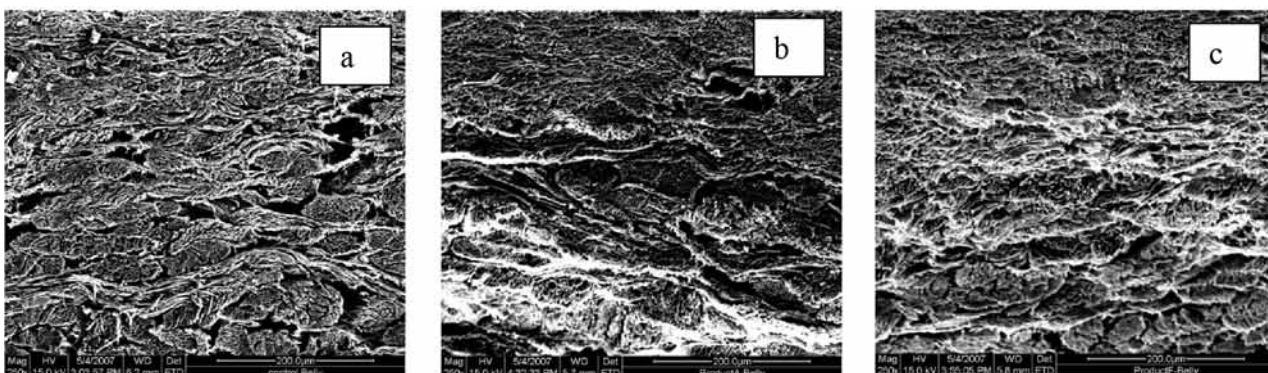


Figure 4. Scanning electron micrographs of cross section of the belly portion of the samples a) Control b) Product A c) Product F.

TABLE VIII
Hand Evaluation of Leathers Retanned with Product A and F as Against Control

Samples	Fullness	Roundness	Smoothness	Softness	Tightness
Product A	8	7	8	8	5
Product F	7	7	6	5	7
Control	6	7	8	7	6

TABLE IX
Comparison of Reflectance Values of Leather Retanned with Product A and F as Against Control.

Samples	L	a*	b*	Hue	C
Product A	22	-2	3	123	3.6
Product F	21	-1	1	45	1.4
Control	25	-4	6	123	7.2

TABLE X
Difference in Butt and Belly Strength Values of Leathers Retanned with Product A and F as against Control Leather

Samples	Tensile strength difference Δ TS (kg/cm ²)	Tongue tear difference (kg/cm) Δ TT	Load at grain crack difference (kg) Δ GC	Distention at grain difference crack (mm) Δ DGC
Product A	75	5	4	0.5
Product F	86	7	6	0.5
Control	80	8	3	0.8

TS: Tensile Strength; TT Tongue Tear Strength; GC: Grain Crack Strength; DGC: Distention at Grain Crack

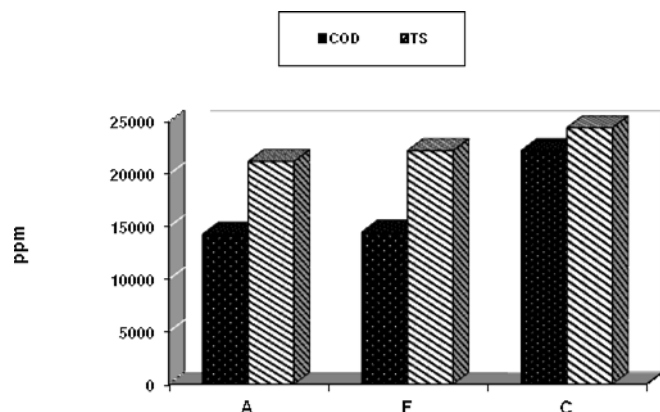


Figure 5. Comparison of amount of chrome, COD and TS for leather retanned with Product A and F as against control.

belly alone, thereby providing strength to the belly, while retaining the properties of the butt region. The study however indicates that it is possible to obtain compact leathers using Product A or Product F.

Environmental Impact of the Processes Studied

The primary objective of this study was to develop a synthetic tanning agent from natural sources, which could be used as a replacement for current day products. In the current context of "leather with care", it is imperative that such products do not add additional load to the environment. It is in this direction that a synthetic tanning agent was developed from natural sources. The environmental impact data has been assessed only for Product A and Product F as these products exhibit

better characteristic leathers. A comparison of the chemical oxygen demand of the wastewater and total solids in the wastewater has been made and is presented in Fig. 5. The COD and TS values are more or less similar. The COD values can be considered as a measure of the uptake of the retanning agent. Based on the results obtained from the strength characteristics, performance analysis, SEM analysis and environmental assessment, it is possible to process leathers with uniform compactness using Product A or Product F.

CONCLUSIONS

In this work, six products have been developed based on biopolymeric materials such as chitosan and alginate for providing compact leathers. Product A and Product F have been screened to have better properties as compared to other products. FTIR studies on various products indicate the complexation between the chitosan and alginate in the products. Incorporation of polyacrylic acid and urea in Product F improves the grain tightness of the final crust leather. SEM analysis indicates better compactness for leather made using Product A as compared to Product F. Butt–belly region comparison is similar for leathers made from Product A and F. Strength characteristics of the leather made from Product A are similar to control leathers. Softness of the leathers made from product A is better and comparable to control, whereas the grain tightness of the leathers made from product F is better. Weight ratios for different regions indicate that the leathers made from Product A are comparable to control leathers thereby providing compact leathers. Apparent density values are similar for all the leathers made from Product A or Product F for different regions except for belly. Weight ratio distribution in different regions for leathers made from control and Product A are better except for the belly indicating uniform distribution of compactness. Environmental assessment indicates that the experimental process, employing Product A or F, gave lower COD and TS as compared to control process. Hence it could be concluded that it is possible to make compact leathers using Product ‘A’ or Product ‘F’ prepared from natural materials.

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