PROJECT WORK
ON

STUDIES ON THE PRODUCTION OF QUALITY FOOTBALL LEATHER FROM COW HIDE

A DISSERTATION FOR THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR DEGREE OF B.Sc. IN LEATHER TECHNOLOGY.

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Dedicated

To

My beloved parents whose eternal love and affection

Inspired me at every walk of life.

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In the name of God who has created the whole universe and me and whose blessings directed me for the accomplishment of this dissertation.

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AIM OF THE THESIS

Bangladesh has been a source of raw materials, ranging from hides and skins at the beginning of mostly crust and some finished leather. Since 1990-91, Bangladesh has started exporting footwear and other leather goods. Export earning from leather goods, were negligible from 1972-73 through 1989-90 averaging only Tk. 0.114 million per annum. But it has increased considerably since 1990-91 and has reached around TK. 700 million in 1993-94. It is significant that the demand of football leather is increasing in the international Market.

Keeping in mind both the points the international demand and availability of raw hides and skins. I have intended to develop a recipe for the production of football leather. Moreover, Production capacity in finished leather and leather goods is developed in Bangladesh, new jobs will be acquired, and markets will be accessed.

CONTENTS

Chapter-1
Introduction

1.1. History of Leather :

Our prehistoric ancestors had very little choice of clothing. Some wire makeshift garments made from the leaves of giant plans. Others wore the skins of animals killed for food.

One of the most effective weapons used by these early hunters was made from hide. This was the `bolas', made by linking three stones, wrapped in skin bags, to each other with thongs of hid. The `bolas', which is still used by South Indians today- was hurled at the legs of an animal to bring it down so that it could be clubbed or speared to death.

Scientist's estimated firs wore anima skins during the loc Age, about 500,00 years ago. Archeologists have found flint scrapers dating back to that period which may have been used to scrape the flesh of animal skins.

Crude overcoats of hide gave some protection against the cold winds and rain of prehistoric times. Rough shoes protected the feel of Stone Age peoples from rocks and thorns, but the hides and skins worn by the people of those days had one big drawback – they decayed and rotted away in a very short time.

As the centuries passed, various methods were developed to make the skins and hides last longer. They were laid over logs and the hair and flesh removed with sharp, curved tools made from removed with sharp, curved tools made from animal bones. The skins were then pagged out in the sun to dry. Animal brains were rubbed into them to make them soft again. Fatty substances in the brains oiled soft again. Fatty substances in the brains oiled the skins, made them supple and brains oiled the skins, made them supple and provided a fair amount of water-resistance.

However, these garments could not have been too leaseant to wear. Another method was to smoke the skins over a slow-burning fire. These process did not convert the skins into true processes did congaed the length of time they could be used.

1.2 Hide; skin :

Hide : The outer covering of a mature of fully- grown of larger kind is termed as “Hides”

or heavy weight skins coming from large mature animals such steers, cattle, horse, camels, elephants, wholes etc are termed as “Hides”

Skin : The outer covering of an animal of the smaller kinds is termed as “Skins”

Or, light weight skins like those from small animals such as goats or, sheep, or from immature animals such as calves are referred to in the leather industry as “skin” More example are, Crocodiles, alligator, Caymans, turtles, lyards, snake, bulli8frog, many fish skins are in this group like different sharks, rays, seals, different dolphins, cod pallack, laddocd, etc.

Difference by weight between hides and skins:-

A skin is simply a small hide and in the case of cattle, a hide weighting less than 151bs in the green salted state is called calf skin. When it weighs from 15 to 25 was it is called a kip. When it weights from 25 to 3o Lbs, it is called an over weight kip. When it weighs more than 53 Lbs, heary cow.

1.3 Leather:

Leather is collagen in the tanned state, By it is a term which is processed by converting putrescible outer coverings of animals to non putrescible substances with definite physical, chemical and biological properties so that they can be used in our daily life and industries.

Leather is material made on animal skin which is subjected to chemical treatment (tannage) and mechanical treatment in order to give it new properties geared the intended application. This treatment does not however, affect the natural structure of the collagen fibre net work.

Leather in a non uniform material consisting of a collagen fibre net work, tanning materials, fat, dyestuff and moisture.

For leather manufacture several operations are essential these operations can be classed in to three groups. These are-

i. Pre-tanning or beam hose operations.
ii. Tanning operations.
iii. Post tanning.

1.4 Anatomical Structure of Hides/ Skins

1.5 Characteristic Properties of Hides & Skins:

Hides and skins differ in the in Structure, depending upon the habits or life of the animals, season of the year, age, sex, and breeding etc.

Characteristic properties of cow hides :

(1) Fibre length is medium

(2) Numbers of fibres are huge.

(3) Thickness of hair is medium.

(4) Fibre bundle of females is more uniform than male.

(5) Only one hair grows from one hair follicle.

(6) Fibre weaving is parallel.

(7) Fibre structure is compact at butt area and lower at beck and beilly.

(8) Hair root does not fully enters into the corium layer.

(9) Fat gland is optimum.

(10)Grain surface is smooth.

(11)Hair is random scattered on the grain surface.

Chapter-2

Condition of Bangladeshi hides and skin

2.1 General Condition of Bangladesh Cow Hides :

Basically, the condition of Bangladesh cow hides are not good al all. Because we don't take proper care of them like other developed countries. We get hides just as bi-product of the meat industry.

Bangladesh is an agricultural country. The farmers are having cows to plough the lands, to run carts and in the dairy firms (less percentage to get the milk and meat. The farmers utilize the cow like anything, which is enough to spoil the covering parts of the cows, body the hides). The poor cows even they are not getting enough food to eat. Moreover the lesions of animal parasites, many disease and injuries may occur. As far, we are getting the poor quality cow hides. Besides, various flaying cuts are seen for insincere flying. And very often faulty curing is done i.e. the packer, butcher or the farmer whoever he is doesn't cure the ides of skins properly. Sometimes, they use mud instead of salt to make the leather weighty and often the buyer is confused to defect the correct grading. Because the defects are hidden under mud.

Sometimes fresh salts are not used and inadequate curing. Less salt is done which causes putrefaction damage and growth of parasites. Above all of these and some other reasons cause faulty storage. Further more, temperature and humidity are not controlled properly where as in Europe, the green hides and skins are kept in freeze or brine.

So, proper curing with suitable salt like fresh Nacl, Napthalein and even some commercial bactericides should be used if we like to cure for longer period. the tanneries of Bangladesh, gene4rally we get high quantity of hides and skins and skins. This is the idea o very experienced leather technologist coming from abroad. Faulty storage causes many degradation like grain damage, less strength, poor substance, putrefaction etc.

2.2 Responsible causes for the poor quality of cow hides in Bangladesh :

The following defects available in our Bangladesh cow hides, defects whose are responsible for the poor quality occur in hides have specific cause originating either alive of after death. The former is called pre-mortem and the later post-mortem defects are expressed below.

Some defects may be common on hides of all animals while others are characteristic of hide particular causes of animals.

Defects of Hide

	Ante-mortem		Post-mortem
1.	Poor sunstance	1.	Flaying defects
2.	Sore marks of abscesses	2.	Inadequate curing
3.	Branded wire scratches	3.	Defects due to late-curing
4.	Rub mark, horn rake	4.	Curing with unsuitable salt
5.	Brand marks	5.	Faulty drying
6.	Goad marks	6.	Faulty storage
7.	Yoke marks	7.	Crack-grain
8.	Ticks, Fleas	8.	Vulture scratches
9.	Scabies	9.	Poor pattern
10.	Pox		
11.	Wable fly or grubs		
12.	Cockle		
13.	Borsatis & Danas		
14.	Ringworm sears		
15.	Soiling by dug and urine		

2.3 Tan, Tanning, Tanning agents:

The word “tan” and its inflectional form “tanning which are derived from the latin word for oak bark, were originally applied, and still are generally used, to

describe the process of converting and putrescible animal skin into the stable product “Leather”.

In a practical sense, there is no exact definition of tanning since numerous substances of greatly differing chemical nature can function as tanning agent and so many different leathers are made, each with its particular use. From the most primitive point of view, leather may even be defined as skin or hide modified by tanning so as to render it suitable for its intender use.

The substances of very dissimilar composition and nature possess tanning properties are called tanning agents. Such as basic chrome salts, vegetable tanning, aldehides, certain condensed phenols containing sulfonic acid groups (so called “Syntans” and unsaturated oils.)

Chapter-3
FOOTBALL LEATHER

3.1 Defination of Football leather:

Foot ball leathers used are mainly chrome tanned leathers that have not been retanned or only lightly reatnned in thickness of 2.5 – 3.0 mm. But generally 'Football leather' is not used for footballs exclusively as it's name might imply, but it is used for making the outer coverings for the football, the volleyball, the water polo ball, the rugby ball and many other balls of a similar nature.

3.2 Characteristic Properties of Football Leather :

(1) Football leather must have high degree of resistance to the penetration of water. (great extent of water repellency)

(2) It should have high tensile strength.

(3) It should have high stitch tear strength.

(4) It should be non-stretchy.

(5) It should be non-elastic.

(6) It should have good abrasive resistance.

(7) It should have perfect fastness properties.

(8) Its fibre structure should have low angle of weave.

(9) The void space of the leather should be reduced filling with hard materials and its capillary action should be minimum.

(10) It should have tightness and its elongation must not be more than 4%.

(11) It should be thick (i.e. 2.1 mm-2.3 mm)

(12) It should be resistant on inert in acid alkaline medium.

3.3 The most important quality requirement for football leather:

Tests	Football Leather

	Chorme Tanned	Chorme/Alum Combination	Vegetable Tanned
01. Tensile Strength kg/cm^2			
(a)Parallel to Backbone	210 Min	210 Min	210 Min
(b)Perpendicular to Backbone	190 Min	190 Min	190 Min
02. Elongation at 70 kg/cm^2			
(a) Temporary	12% Max	12% Max	12% Max
(b) Permanent	4% Max	4% Max	4% Max
03. % of Elongation at break	-	-	-
04. Thickness (Min)	2.5 mm	2.5 mm	2.5 mm
05. Water Absorption	Max	Max	Max
(a) ½ hour	25%	25%	40%
(b) 2 hours	30%	30%	45%
(c) 24 hours	35%	40%	45%
06. Shrinkage temperature ^{0}C (Minimum).	95^{0}C	80^{0}C	77^{0}C
07. Stitch tea strength (Double hole) kg/cm thickness (Minimum)	70	70	70

3.4 Principles of Football Leather Production :

The Thick butt portion of cow hides are taken for making football leather. To get various desirable physical properties special care should be taken from soaking to finishing during manufacture.

Proper soaking is done with preservative. Liming is accomplished in such a way that less interfibrillary substances are removed. (i.e. Sharp liming). For high strength properties excessive swelling and splitting of the pelt should be avoided.

Delimiting is done just after fleshing and without batting it is pickled.

For high strength and low stretchiness, it is tanned with high percentage of unmasked chrome and properly rechroming is done with chrome syntan to get more fullness. It is neutralized with Na or k-sallts of organic acid for non-stretchiness and inertness.

Water-proofing fat liquor is used in fatliquoring with raw oil of high viscosity. After fat liquoring, chrome caping operation will be done with self basi8fying chrome.

It is dyed with full penetrative dye. Then it is finally dried under maximum stretched condition in all direction.

In finishing surface of football leather should be coated with water proofing agent in a thin finish film.

3.5 Manufacturing process of quality football leather:

Starting materials: Wet salted cow hide.

(All percentages calculated on wet salted weight)

Sorting :

Trimming : Done by knife.

Pre soaking : 300% Water
0.3% Wetting agent — Run-60 min
Drain out.

Main Soaking: 300% Water
0.5% Wetting agent
0.5% Soda ash — Run-30 min
0.2% Preservative

P^H - 9.0 - 9.5

Rinse well – Drain out.

Liming : 300% Water
1.5% Lime
2.0% Na^2S — Run- 30 min
0.25% Wetting agent
0.25% Mollescal PA

2.0% salt
Rest for 1 hour.
1.0% Lime
1.5% na_2S — Run-30min
Check P^H 12.5 – 13.0.

Again run for 5 min/hour
Total time — 24 hours
Drain out

Fleshing : Done by machine

Weighing : (% based on pelt wt.)

Washing : Running water for 30. min

Deliming : 100% Water

2.5% $(NH^4)_2$. SO_4

Check : with phenolphthalene.

PH – 8.2- 8.3

Drain out

Scudding : Done by machine.

Washing : with running water for 30 min.

Pickling : 80% Water

8% Salt Run – min

Check Be- 6.5

0.30% Formic acid – Run 30 min

1.2% H_2SO_4 (1:10 Soln) – Run 2-3 hrs.

30min+30min+30min

Check P^H : 2.8 – 3.0.

Chrome Tanning :

Drain ½ of the pickle liquor

5% Chrome powder – Run 60 min.

3% Chrome powder

1% Remsynol OCS -Run 60 min.

Check penetration

1% Sodium formate – Run 30 min.

5% Water at N. T.

1.2% Sodium bi-carb

(0 min + 30min + 30min)

0.2% preservative

Again run for 1 hr;

Check-PH – 3.73.7-3.8

Boil test

Drain out and pile up for a weak

Samming : Done by machine

Shaving : Thickness-1.3-1.5 mm

Weighing : (% based on shaved wt.)

Acid wash: 200% water at 35^0C

0.4% Oxalic acid

pH: 3.0-3.1 (bath)

Run 30 min.

Drain, wash.

Re-chroming: 150% water at N.T

0.3% Formic Acid –Run-20 min.

6% Chrome powder
3% Chrome syntan
1% Basyntan AN
0.5% Sodium formate
0.5% Fish oil — Run-60 min

+ 2% Relugan RF — Run-45 min

+100% Water

0.5% Sodium Formate

Tamol NA — Run-60 min

pH-3.6-3.8

Drain, Rinse, Horse up o/n.

Neutralization: 150% water at 45^0C

1% Tamol NA

1% Sodium formate — Run 60 min.

Check P^H 4.6-4.8

	1.5% Densodrin ENS	Run-30-40 min
	Drain, Wash well.	

After neutralization then separate the two sides of leather → one side for natural and another for dyed crust.

1. FOR BLACK FINISH

Retanning:

	150% Water at 45^{0}C	
	4% Paramel PA/RE	
+	2% Paradol WPM	Run-30 min
+	4% Relugan D/P- 100	Run-20 min
+	3% Black dye	
	1% Neosyn N	Run 30 min.
+	3% Tanigan OS / PFX	
	3% Mimosa	
	3% RWP	Run-45 min
	Check Penetration	
+	1.5% Formic Acid	Run- (20+25) min
	Drain, Rinse Well	

Fat Liquoring:

	200% Water at 55^{0}C	
	2% Filler Syntan (Butan 1908)	Run-20 min
+	6% Paradol WPM	Run-45 min
+	1.5% Paramel PA/RE	Run-30 min
+	1% Formic Acid	Run-30 min
	Drain, Rinse Well	

Top Dying:

	200% Water at 55^{0}C	
	1% Black Dye	Run-30 min
+	0.5% Formic Acid	Run-30 min

+	1% Basic Black ANC	Run-30 min
	Check the Bath	
	Drain Rinse Well	

Capping:

	200% Water at 50^0C	
	2% Chrome Powder	Run-20 min
+	2% Chrome Powder	Run-30 min
+	1% Paradol WPM	Run-30 min
	Drain, Rinse, Horse up O/N, setting, wet toggling to dry well (eight direction), trimming and kiss plate then ready for finish.	

NATURAL FOR WHITE FINISH:

Re-tanning:

	150% water at 45^0C	
	4% Paramal PA/RE	
	2% Paradol WPM	Run-30 min
+	4% Relugan D/P-100	Run-20 min
+	4% Tanigan OS/PFX	
	4% PWG/WO	
	2% Relugan D/P-100	Run-45 min
+	0.5% Formic Acid	Run-30
	Drain, Rinsey Well	

Fat Liquoring:

	200% Water at 55^0C	
	2% Filler Syntan (Butan 1908)	Run-20 min
+	6% Paradol WPM	
	1% White Pigment	Run-45 min
+	1.5% Paramel PA/RE	Run-30 min
+	1% Formic Acid	Run-30 min

Capping:

	200% Water at 50^0C	
	2% Chrome Powder	Run-20 min
+	2% Chrome Powder	Run-30 min
+	1% Paradol WPM	Run-30 min

Drain, Rinse, Horse up O/N, setting, wet toggling to dry well (eight direction), trimming and kiss plate then ready for finish.

FOR BLACK FINISH:

Roto 250 kg p/70^0 C; sec.

Season Coat:

Dye	-	250 parts.	
Transparent pig	-	50 parts.	
Wax	-	35 parts.	
Water	-	365 parts	
Soft PU	-	150 parts.	
Soft Resin	-	150 parts.	Spray 2× Dry

Intermediate coat :

Black Solvent Liquor	-	500 parts.	
Thinner	-	490 parts	
Silocon Emusion	-	10 parts	Spray 2× Dry

Then, Roto or plain plate

100^0: 50 kg. P: 1 sec.

Hair cell 150 kg p/70^0C; 3 sec.

Top coat:

N.C. Lacquer	:	100 part
Water	:	50 part

Silicon	:	2 part
Cross linker	:	1 part
		Apply spray 2×
		Heavy spray.

Then, Roto or plain plate

100^0 c : 50 kg. P : 1 sec.

NATURAL FOR WHITE FINISH:

Season Coat:

Dye	-	250 parts.	
Transparent pig	-	50 parts.	
Wax	-	35 parts.	
Water	-	365 parts	
Soft PU	-	150 parts.	
Soft Resin	-	150 parts.	Spray 2× Dry

Intermediate coat :

White Solvent Liquor	-	500 parts.	
Thinner	-	490 parts	
Silocon Emusion	-	10 parts	Spray 2× Dry

Then, Roto or plain plate

100^0: 50 kg. P: 1 sec.

Hair cell 150 kg p/70^0C; 3 sec.

Top coat:

N.C. Lacquer	:	100 part
Water	:	50 part

Silicon	:	2 part
Cross linker	:	1 part
		Apply spray 2×
		Heavy spray.

Then, Roto or plain plate

100^0 c : 50 kg. P : 1 sec.

3.6 Information of Chemical used in production :

Mollescal PA	: Lime auxiliary
Remsynol OCS	: Chrome stable synthetic fatliquor.

Tannesco HN	: Chrome syntan.
Derugan 3080	: Gluteraldehyde.
RF	: Polymeric acrylic resin
Selasol NG	: Neutralizing syntan.
Paramol PA	: Acrylic resin.
Densotan A	: Water repellant acrylic resin.
Tanigon OS	: Replacement syntan.
Retingan R7	: Malamine resin.
Basyntan AN	: Amphoteric resin.
Ukatan IN	: Replancement syntan.
Ukatan AG	: Malamine resin.
DLE	: Bleaching syntan.
Brown RN	: Acid dye.
Brown 574	: Acid dye
Black OT 600%	: Acid dye.
Black NT	: Acid dye.
Basic AM	: Basic dye.
Paradol WPR	: Water proof fat liquor.
Paradol WPS	: Water proof fat liquor.
Intan EG	: Anionic Resin syntan.
Eupolon IN	: Softy washable water repellent fat.
Bay chrome A	: Self basifying chrome.

Chapter-4

PHYSICAL TEST AND RESULTS

4.1 Physical test of prepared sample:

Physical properties of leather : The finished leather sample prepared from the supplied wet salted goat skin as described was tested for they're various physical properties. These properties indicate quality of the produced finished leather.

4.2 Tensile strength : Based on SLP-6 (UP/6)

The tensi8le strength and elongation at break was measured by ten some SLP-6, IPU/16.

Tensile strength is force (kg) per unit area of a cross section required touches a rupture of the test specimen.

$$\text{Tensile strength, kg/cm2} = \frac{\text{Breaking load in kg}}{\text{Thickness in cm} \times \text{width in cm}}$$

4.3 Elongation at the break : based on SLP- (UP/6)

The extent of elongation of the leather specimen at the time of its breaking while applying the tensile force, expressed as the percentage on the original length of the specimen in the elongation at break.

Hence,

$$\text{\% Elongation at the break} = \frac{\text{Distance increase by breaking} \times 100}{\text{Distance of the two jaws in normal}}$$

4.4 Tongue Tear Strength : (LP9/IS: 5914-1970; PM30/SATRA)

The load (kg) required to the leather beyond the cut made perpendicular to its surface, expressed per unit thickness (cm) of the test specimen is the tongue tear strength.

Hence,

$$\text{Tongue tear strength} = \frac{\text{Tearing load in kg}}{\text{Thickness in cm}}$$

4.5 Grain crack strength : (Based on SLP-8. SLP-9 (IPU-12):

The pressure required to cause strength. It is expressed unit thickness (cm) of the specimen.

Hence,

$$\text{Grain crack strength} = \frac{\text{Crack load in kg}}{\text{Thickness in cm}}$$

4.6 Grain Bursting strength : Based on SLP-8, SLP-9 (IPU-12):

The force is required, kg per unit thickness, cm. Of the test specimen to completely burst the grain is grain bursting strength.

Hence,

$$\text{Grain bursting strength} = \frac{\text{Bursting load in kg}}{\text{Thickness in cm}}$$

4.7 Stitch tear strength (Double Hole) LP 8/IS: 5914-1970: E13/ALCA:

The load (kg) required to tear the leather between two holes of 2mm diameter each whose centers ins 6 mm apart, expressed on its unit thickness (cm) is the stitch tear strength. So, stitch tear strength of the specimen was calculated using following formulae.

So,

$$\text{Stitch tear strength Kg/cm thickness} = \frac{\text{Tearing Load (Kg)}}{\text{Leather Thickness (cm.)}}$$

4.8 Water Absorption : Gravitation method (LP-11/IS; 5914-1970; SLP-20-IPU-7)

The amount of water absorbed by a given weight of leather in a given time under stationery condition, expressed as-

Percentage on the weight of the leather is the percent of water absorption of the leather in that given time.

4.9 Wet and dry rub fastness: Test base on DN 54021, SLF – 5:

This method determines the fastness of color to felt with which it is rubbed. For this test, a sample of leather is rubbed with a revolving felt pad, and the wimbea of revolutions of the pad required to produce certain effect is measure.

The German standard, DIN-54021, and SLF-5, specifies a method by the “krais” tester of “Veslic” in which a white felt at a force of 1kg. Load moves back and forth on the grain oxide of the leather through a distance of 10cm. The felt will be dry for for the dry rub fastness test and felt will be wet for the wet rub fastness test. In SATRA instrument the circular dry felt at a load of 2.5kg, rotates on the grain sides of the leather in the case of rub fastness test and in the case of wet rub fastness test, the wet felt is kept under the load of only 0.75 kg. For this investigation SLF-5, method was followed. In both the cases the stained felts are compared with the grey scale.

4.10Shrinkage temperature :

Leather has the unique property of shrinkage abruptly at a particular critical temperature if heated in liquid. The temperature at which it thus shrinks is defined as the shrinkage temperature in that liquid (Ts). It is measured by means of shrinkage meter.

4.11Experimental Data

The results obtained by different fastness properties testing on the prepared leather samples are tabled in this chapter followed by short description of the result. All these fatness test are accomplished by using different international standard methods as described in section three.

- **Result of tensile strength & elongation:**

Sample No	Result of tensile strength & elongation at			
	Parallel		Perpendicular	
	Tensile Strength Kg/sq. cm	Elongation %	Tensile Strength Kg/sq. cm	Elongation %
1. Black Sample	360	26.98	286	35.38
2. White Sample	355	22.98	282	33.30

- **Tongue tear strength:**

Sample	Thickness (cm)	Tongue tear (kg/cm)
1. Black Sample	0.14	28.57
2. White Sample	0.14	26.25

- **Result of lastometer test:**

Sample	Lastometer test

No.			
	Grain crack Strength kg/cm	Grain Bursting Strength Kg/cm.	Distention at Grain Crack (cm)
1. Black Sample	228.57	607.1	5.63
2. White Sample	225.67	605.1	4.12

- **Stitch tear strength:**

Sample No	Thickness (cm)	Stitch Tear (kg/cm)
1. Black Sample	0.14	135.71
2. White Sample	0.14	133.25

- **Result of water absorption test :**

Sample No	Water absorption %		
	½ hour	2 hour	24 hour
1.Black Sample	23	28	38
2.White Sample	21	26	36

- **Results of dry and wet rub fastness test :**

Sample No	Dry rub fastness						Wet rub fastness					
	32 Rev.	64 Rev.	128 Rev.	256 Rev.	512 Rev.	1024 Rev.	32 Rev.	64 Rev.	124 Rev.	256 Rev.	512 Rev.	1024 Rev.
1.Black Sample	5	5	6	4.5	4	3	5	5	5	4.5	4	3.5
2.White Sample	4	4	5	4	3.5	2.5	4.5	4.5	4.5	4	3.5	3

- **Shrinkage temperature :**

I got the shrinkage temperature of the black sample is 106^0C and for white sample is 104^0C.

4.12 Comparative Studies :

1. The tensile strength of the prepared according to black sample lies in the range of 286 to 360 kg/cm2 and for white sample 282 to 355 kg/cm2, which is good tensile strength of standard football leather. The % of elongation of the prepared according to black sample lies in the range of 26.98% to 35.38% and for white sample 33.30 to 22.98% which indicates good result.
2. The grain cracking as well as grain bursting strength indicates the structural stability of leather samples.
3. The dry and wet rub fastness of the samples are good.
4. The stitch tear strength of the black leather sample is 135.71 kg/cm and for white sample is 133.25 kg/cm, which indicates good tearing property of those samples of leather.
5. The tongue tear strength of the black leather sample is 28.57 kg/cm and for white is 26.25 kg/cm, which is nearer to standard result.
6. In football leather the water absorption property is the important characteristics, here the table is showing its good water proofing capacity.
7. Lastly shrinkage temperature of the black leather sample is 106^0C and for white leather sample is 104^0C. When is very nearer to the standard result and it is satisfactory.

Chapter-5

Conclusion & Recommendation :

Modern worldwide leather market is now a days very fond of football leather. Finished leather is also an intermediate product. Which serves as a raw material for finished leather is therefore, fashion driven, requiring more responsiveness to the

market, whereas crust leather is more a commodity type product. Since 1990-91, Bangladesh have started exporting footwear and other leather goods. Bangladesh currently export leather footwear to Europe and Japan. As production capacity in finished leather and leather goods is developed in Bangladesh, new jobs will be acquired, and markets will be accessed. The football leather are manufactured mainly from the thick butt portion of cow hides. In standard quality specification, thickness of football leather is min. 2mm. The Europe, Australian and Indian cow hides are generally thick. So, it is easier to keep the thickness 2mm. Of those countries leather. But in our country's cow hide quality is not good for many reasons. So it was not possible for me to deep the saving thickness 2mm. Hear I kept the thickness of black sample is 1.3 mm and for white sample is 1.2mm. Therefore, the availability of cow hides, the international demand for it as well as the quality has intended me to develop a recipe for the production of football leather.

5.1 Samples Attached

5.1.1 Black Leather Sample

5.1.2 White Leather Sample

Football Leather

5.2 Bibliography:

1. S.S. Dutta, “An Introduction to the principles of leather manufacture”, ILTA Mercantile Building, Lalbazar, Calcutta.

2. K.T. Sanker, " Theory and practice of leather manufacture" revised edition, 1995; 4, Second avenue, Mahatma Gandhi Road, Madras 600041.
3. Gerhard John' " Possible defects in leather production: Definitions, cause, consequences remedies and types of leather". D- 68623 Lampertheim.
4. S.S. Dutta " An introduction to the principles of physical testing of leather." First edition. ILTA, Mercantile Building, Lalbazar street, Calcutta-7001.
5. Richard Gibbs; "Leather" L First published in 1981. Publisher- Wayland publishers limited, 49 Lansdowne place, Hove East Sussex Bn 3 IHF, England.
6. P.S. Venkatachalaro; " Lecture notes on leather" A.P.O. Project no: TRC/IV/62.
7. "Hides and skin and leather under the microscope." BLMRA, Milton park, Eghal, Surrey.
8. J.H Sharphouse, "Leather technician's handbook" Leather producers' association, Kindgspark Road, Multon park, Northampton, U. K.
9. "Official Methods of analysis 1996. SLP" Society of Leather Technologists and chemists, Registered office, 1, Edge Court, Moulton, Northampton, U.K.
10. "Official methods of analysis 1996, SLF" Society of Leather Technologists and Chemists, Registered office; 1, Edge Court, Moulton, Northampton, U.K.
11. " Official methods of analysis 1996, SLC" Society of Leather Technologists and chemists, Registered office; 1, Edge court Nothampton, U.K.