IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 15, Issue 3 Ser. II (March 2021), PP 33-38
www.iosrjournals.org

A Comparative Study on Physical Properties of Bag and Lining Leather from Two Different Origins

Md. Farhad ALI[1],Mahbub KAMAL[2*]
[1,2]*Institute of Leather Engineering and Technology, University of Dhaka, Dhaka-1209, Bangladesh*

Abstract
In this study comparisons were done between the physical properties of bag and lining leathers from two different origins- cow and goat. Sample positioning, collection, preparation, conditioning and particular physical tests such as tensile strength, percentage of elongation at break, tearing strength, stitch tearing strength, water vapour permeability, grain crack load, scuff resistance, flexing endurance, bond strength between finish film and leather surface and colour rub fastness were done according to the standard ISO and SATRA methods. In some physical testssignificant differences were found between the bag and lining leathers.In case of bag leather the cow leather showed better results in the majority tests while the goat leather showed better results in grain crack load and flexing endurance tests only. Again, in case of lining leather, the cow leather showed better results in tensile strength, tearing strength, flexing endurance and bond strength tests while the goat leather showed better results in stitch tearing strength, water vapour permeability, elongation tests. In this case, cow and goat both types of leathers showed the same property in colour rub fastness test.
Keywords: Leather, Bag, Lining, Physical properties.

Date of Submission: 10-03-2021 Date of Acceptance: 25-03-2021

I. Introduction

Leather consists of collagen protein based fibrillary network. In various organs of the body the appearance, length and thickness of these fiber bundles are dissimilar. So the properties of a leather depend on the position and direction over its area and it is not a uniform material from a structural perspective.Besides, it is a rawindustrial product with versatile applications in downstream sectors.Leather garments and products, footwear,furniture and many other items were made from leather. Leather products need various physical, chemical and fastness properties and specific performance characteristics depending on the field of use. The physical and chemical properties depend on the physical structure, chemical composition and mechanical operations during the leather manufacturing operation. Leathers are demanded to have sufficient strength and flexibility for the preparation of the final products [1].So, the physical properties of leather have a great significance and importance in the manufacturing of different types of leather product. The physical properties of leatherdepend on the animal individually and the type of animal. The purpose of this project work was to compare between the physical properties of the particular different types of leather. Stitch tearing strength, tearing strength, percentage of elongation at break, tensile strength,scuff resistance, grain crack load, bond strength between leather surface and finish film, water vapour permeability, flexing endurance and colour rub fastness etc properties of leathers were examined.

Tensile strength and percentage elongation test is caused by a specified load and percentage elongation at break. A leather sample is elongated with certain speed until the force reaches a predetermined value or until the test piece breaks [2]. These two properties provide significant information about the quality of the leather texture [3].Tensile strength was determined by fibrous structures which constitute the collagen network structure and the modification of structure by tannins [4]. It is the ability of a material to withstand a longitudinal pulling force [5]. It is an important property as it relates to strength and performance of the material [6] The tensile strength increased with jaw speed, the rate of increase being least between 6 and 12 in./min. When the machine is operated by hand, the speed of the jaws may change from time to time [7]. Leather has very poor heat resistance. So, excess drying operation not only shrinks the leather but also makes the leather brittle and stiff as well as poor in tensile strength. Increase in drying time decreases the leather elongation at break [8].Elongation is the ability of a leather to extend when subjected to mechanical forces. It is an important consideration in the shape retention of apparels. Materials with low elongation tend to be stiffer than those with more elongation and keep their original dimensions during use. A low elongation value results in easy tear while a high elongation value causes leather goods to become deformed very quickly or even lose usability [9].During stitch tearing strength test, the force exerted is essentially perpendicular to the specimen and fibres. Stitch tear strength test provides information about weak points caused by possible defects of fabrication.Tearing strength test is carried

out on a leather to know the fibre strength of that leather. During tensile strength and stitch tearing strength determination, large number of fibres are ruptured all at a time. But, in tearing strength determination, few fibres are ruptured at a time [10].Grain crack load of a leather is the load at which the grain of the leather just starts to crack. It is an index of the overall strength of the leather. In order to determine this property, two types of instruments are available in the market. These are- (a) Lastometer and (b) Tensometer [10].Water vapour permeability describes a material's ability to allow water in its gases form to pass through it. Water vapour permeability of leathers has a significant role in wear comfort, hygiene and physiology properties. It is a measure of porosity. This test determines the amount of water which penetrates through a leather in the form of vapour if moisture-saturated air is on one side of the leather and completely dry air on the other side [3].Abrasion resistance is the ability of a material to withstand rubbing (frictional force) applied to its surface (as smooth surface has higher abrasion resistance than rough one). Real leather resist abrasion more than faux leather.

II. Materials And Methods

Materials

Four types of leathers were collected including cow bag leather, goat bag leather, cow lining leather and goat lining leather.

Instruments

Nine instruments were used in this study including - thickness gauge for leather sample thickness determination, tensile tester (STD 172) for tensile strength and percentage of elongation testing, lastometer (STM 104) for grain crack load testing, balance machine for leather sample weighing, water vapour permeability tester machine (STM 473) for water vapourparmeability testing, flexometer (2396) for flexing endurance testing, abrasion tester (STM 423) for scuff resistance testing, adhesion of finish tester (STD 112) for bond strength testing and colour rub fastness tester (STM 461) for colour rub fastness testing [10-11].

Methods

Sampling Location

Sampling location for all samples is done according to IUP-2 method [10-12].

Sample Preparation

All samples were prepared according to IUP-1 method [10-13].

Sample Conditioning

According to IUP-3 method, all samples were conditioned for 48 hours before testing in an atmosphere of 27±2°C dry bulb temperature and 65±2% relative humidity [10,13].

Testing Methods

ISO and SATRA methods were applied to carry out the physical tests such as - Tensile strength and percentage of elongation test was according to IUP-6 [10-14], stitch tearing strength test was according to IUP-44 [10-15], tearing strength test was according to IUP-8 [10,16], grain crack load test was according to IUP-9 [10-17], water vapour permeability test was according to IUP-15 [10-18], scuff resistance test was according to SATRA PM-140 [10], flexing endurance test was according to IUP-20 [10-19], bond strength test was according to IUF-470 [10,20], colour rub fastness test was according to SATRA PM-8 [10].

III. Results And Discussions

Discussion on Table-1

The results of the tensile strength test proved a huge difference between the two collected bag leathers. The cow bag leather had the average tensile strength value of 334.696 kg/cm^2 while the goat bag leather had the average tensile strength value of 255.459 kg/cm^2. Both test values were above the minimum acceptable value 200 kg/cm^2. So, both leathers were acceptable for the application as bag leathers. However, as the cow leather had higher tensile strength than the goat leather, the cow leather had better quality, overall strength, fibrous structure, reliability and suitability than the goat leather for the application as bag leather.

The percentage of elongation test showed a great significant difference between the two bag leathers. The average test value of the cow leather was 33.106% and the average test value of the goat leather was 53.027%. Only the test value obtained for the cow leather was within the required limit values 30 – 40%. So, the cow leather passed the test. On the other hand, the goat leather did not pass the test as the test value of this leather was very much higher than the required limit values 30 – 40%. So, only the cow leather showed a good result in this test. Thus, the cow leather had an acceptable, suitable and perfect stretchiness as well as elongation property while the goat leather had an unsuitable elongation property for the application as bag leather.

In the stitch tearing strength test, no significant difference was found between the two bag leathers. The observed average stitch tearing strength values were 143.597 kg/cm for the cow leather and 140.767 kg/cm for the goat leather. Both leathers showed excellent results in this test as both test values were very much above the minimum required value 80 kg/cm. So, both leathers had excellent seam strength, seam quality, durability and

suitability properties. As the cow leather obtained slightly higher test value, it had a little amount of higher stitch tearing strength than the goat leather.

Again, from the tearing strength test, it was observed that the cow bag leather had higher tearing strength than the goat bag leather. The obtained average tearing strength values were 97.573 kg/cm for the cow leather and 87.466 kg/cm for the goat leather. Both values were above the minimum required value 30 kg/cm. Although both values were acceptable, there was a small difference between the two obtained values. It can be said that the fibre strength and the fibre durability of the cow leather were slightly better than that of the goat leather for using as bag leather.

Table 1. Result of Comparison of Physical Properties between Cow Bag Leather and Goat Bag Leather

Physical Properties	Cow Bag Leather		Goat Bag Leather		Required Value
Tensile Strength (kg/cm^2)	Sample-1: 296.610 Sample-2: 372.781	Average: 334.696	Sample-1: 277.311 Sample-2: 233.607	Average: 255.459	200 (Minimum)
Percentage of Elongation at Break (%)	Sample-1: 34.211 Sample-2: 32	Average: 33.106	Sample-1: 52 Sample-2: 54.054	Average: 53.027	30 – 40
Stitch Tearing Strength (kg/cm)	Sample-1: 113.281 Sample-2: 173.913	Average: 143.597	Sample-1: 146.341 Sample-2: 135.193	Average: 140.767	80 (Minimum)
Tearing Strength (kg/cm)	Sample-1: 86.207 Sample-2: 108.939	Average: 97.573	Sample-1: 95.339 Sample-2: 79.592	Average: 87.466	30 (Minimum)
Grain Crack Load (kg)	20		26		20 (Minimum)
Water Vapour Permeability (mg/cm^2-hrs)	10.734		6.101		0.8 (Minimum)
Scuff Resistance	After 400 cycles, no change was occurred.		After 400 cycles, no change was occurred.		Maximum 3 mm^2 damage is acceptable
Flexing Endurance	Sample-1: Break pipiness scale rating was 5 after 25,000 cycles. Sample-2: Break pipiness scale rating was 5 after 25,000 cycles.		Sample-1: Break pipiness scale rating was 2/3 after 25,000 cycles. Sample-2: Break pipiness scale rating was 3 after 25,000 cycles.		Break Pipiness Scale Rating: 1 – 3/4
Bond Strength (gm/cm)	700		300		250 (Minimum)
Colour Rub Fastness	Felt: Grey scale rating was 4/5 after 1,024 cycles. Leather: Grey scale rating was 5 after 1,024 cycles.		Felt: Grey scale rating was 3/4 after 1,024 cycles. Leather: Grey scale rating was 4 after 1,024 cycles.		Grey Scale Rating: 5 – 3

In the grain crack load test, the observed test values were 20 kg for the cow bag leather and 26 kg for the goat bag leather. Both test values were above the minimum requirement 20 kg but the goat leather obtained higher test value than the cow leather. So, the goat leather had better grain crack resistance than the cow leather.

In the water vapour permeability test, the cow bag leather showed a better result than the goat bag leather. The cow leather had the test value of 10.734 mg/cm^2-hrs and the goat leather had the test value of 6.101 mg/cm^2-hrs in this test. Both test values were acceptable as they exceeded the minimum requirement 0.8 mg/cm^2-hrs. However, as the cow leather had the greater value of the water vapour permeability test, it had greater porosity, better hygienic property and better cooling mechanism than the goat leather for using as bag leather.

Scuff resistance property has a great significance on bag leather. During using a bag, the outside bottom portion of the bag is frequently subjected to abrasion which is caused due to an impact or sudden hitting of the leather surface against an object. Therefore, the leather used for bag manufacturing must have very high scuff or abrasion resistance. The leather with very low scuff resistance is not applicable for bag manufacturing purpose. In the scuff resistance test, it was observed that the samples of the cow bag leather and the goat bag leather did not show any change after 400 cycles. It proved that both leathers had excellent scuff resistance property as well as excellent durability under abrasion, quality and suitability for using as bag leather.

The flexing endurance test showed that after 25,000 cycles, the observed break pipiness scale rating was 5 for both samples of the cow bag leather while the observed ratings were 2/3 and 3 for sample-1 and sample-2 of the goat bag leather respectively. As both samples of the cow leather exceeded the required break pipiness scale ratings 1 – 3/4, this leather had very poor resistance to flexing. On the other hand, both the test values of the goat leather were within the required values 1 – 3/4. So, in this test, it was proved that the goat leather had quite better quality and resistance under continuous flexing than the cow leather for the application as bag leather.

The results of the bond strength between the finish film and the leather surface test showed a large difference between the two leathers. The values obtained in this test were 700 gm/cm for the cow bag leather and 300 gm/cm for the goat bag leather. Although both values were above the minimum requirement 250 gm/cm, the cow leather had much better bond strength quality than the goat leather. So, the finish film of the cow leather had better flexibility, strength and adhesion properties than the finish film of the goat leather.

In the colour rub fastness test, a significant difference was found between the results of the cow bag leather and the goat bag leather. After 1,024 cycles, the observed grey scale rating of the cow leather was 5 and the observed grey scale rating of the felt used for the cow leather was 4/5. On the other hand, after 1,024 cycles, the observed grey scale rating of the goat leather was 4 and the observed grey scale rating of the felt used for the goat leather was 3/4. Though all the observed ratings were within the required values 5 – 3, the cow leather proved to have better colour rub fastness property than the goat leather.

IV. Discussion on Table-2

The results of the tensile strength test showed a huge difference between the two leathers. The cow lining leather had the average tensile strength value of 261.818 kg/cm^2 while the goat lining leather had the average tensile strength value of 147.436 kg/cm^2. The average tensile strength of cow leather was very much above the minimum requirement 150 kg/cm^2 but the goat leather could not satisfy the minimum requirement of lining leather. Thus, the cow leather had excellent tensile strength as well as very good quality, overall strength, fibrous structure, reliability and suitability for using as lining leather. On the other hand, the goat leather had very terrible tensile strength as well as very poor quality and fibrous structure.

The percentage of elongation test also revealed a significant difference in the case of two lining leathers. The average test value of the cow leather was 31.541% and the average test value of the goat leather was 44%. The test value obtained for the cow leather was very much below the minimum requirement (40%) for lining leather. So, the cow leather did not pass the test. On the other hand, the goat leather passed the test as the test value of this leather was above the minimum requirement (40%). So, only the goat leather showed a good result in this test. Thus, the goat leather had a good and acceptable stretchiness as well as elongation property and a good tendency of deformation under stress while the cow leather had a very poor elongation property for using as lining leather.

The stitch tearing strength test indicated no significant difference between two lining leathers. The observed average stitch tearing strength values were 80.893 kg/cm for the cow leather and 83.776 kg/cm for the goat leather. Both leathers showed good results in this test as both test values were above the minimum required value 60 kg/cm. So, both leathers had excellent seam strength, seam quality, durability and suitability properties. However, as the goat leather showed a slight better result than the cow leather in this test, the goat leather proved to be more acceptable than the cow leather for using as lining leather according to this test.

In the tearing strength test, a huge difference was observed between the test values of the two leathers. It was found that the cow lining leather had higher tearing strength than the goat lining leather. The obtained average tearing strength values were 132.662 kg/cm for the cow leather and 46.291 kg/cm for the goat leather. Both values were above the minimum required value 30 kg/cm. Although both values were acceptable, the cow leather proved to have a greater degree of fibre strength and fibre durability than the goat leather for using as lining leather.

In the water vapour permeability test, the results indicated a significant difference between the two leathers. In this case, the goat lining leather showed a better result than the cow lining leather. The cow leather had the test value of 18.566 mg/cm^2-hrs and the goat leather had the test value of 25.772 mg/cm^2-hrs in this test. Both test values were acceptable as they were above the value 2 mg/cm^2-hrs which is considered as the minimum requirement for lining leather. Good water vapour permeability property is a must for shoe lining leather. Because many important properties such as - good wear comfort, good feel, good relaxation, good hygienic condition of human foot and good cooling mechanism inside the shoe mostly depend on the excellent water vapour permeability of shoe lining leather. However, as the goat leather had the greater value of the water vapour permeability test, it had greater porosity as well as better wear comfort property, hygienic property and cooling mechanism than the cow leather for using as lining leather.

Table 2. Result of Comparison of Physical Properties between Cow Lining Leather and Goat Lining Leather

Physical Properties	Cow Lining Leather		Goat Lining Leather		Required Value
Tensile Strength (kg/cm^2)	Sample-1: 264.706 Sample-2: 258.929	Average: 261.818	Sample-1: 115.385 Sample-2: 179.487	Average: 147.436	150 (Minimum)
Percentage of Elongation at Break (%)	Sample-1: 31.081 Sample-2: 32	Average: 31.541	Sample-1: 46.667 Sample-2: 41.333	Average: 44	40 (Minimum)
Stitch Tearing Strength (kg/cm)	Sample-1: 91.922 Sample-2: 69.863	Average: 80.893	Sample-1: 64.103 Sample-2: 103.448	Average: 83.776	60 (Minimum)
Tearing Strength (kg/cm)	Sample-1: 128.205 Sample-2: 137.119	Average: 132.662	Sample-1: 52.402 Sample-2: 40.179	Average: 46.291	30 (Minimum)
Water Vapour Permeability (mg/cm^2-hrs)	18.566		25.772		2 (Minimum)
Flexing Endurance	Sample-1: Break pipiness scale rating was 2/3 after 25,000 cycles. Sample-2: Break pipiness scale rating was 3/4 after 25,000 cycles.		Sample-1: Break pipiness scale rating was 4 after 25,000 cycles. Sample-2: Break pipiness scale rating was 5 after 25,000 cycles.		Break Pipiness Scale Rating: 1 – 3/4
Bond Strength (gm/cm)	900		525		250 (Minimum)
Colour Rub Fastness	Felt: Grey scale rating was 5 after 1,024 cycles. Leather: Grey scale rating was 5 after 1,024 cycles.		Felt: Grey scale rating was 5 after 1,024 cycles. Leather: Grey scale rating was 5 after 1,024 cycles.		Grey Scale Rating: 5 – 3

In the flexing endurance test it was found that after 25,000 cycles, the observed break pipiness scale ratings were 2/3 and 3/4 for sample-1 and sample-2 of the cow lining leather respectively while the observed ratings were 4 and 5 for sample-1 and sample-2 of the goat lining leather respectively. As both samples of the goat leather exceeded the required break pipiness scale ratings 1 – 3/4, this leather had very poor resistance to flexing. On the other hand, both the test values of the cow leather were within the required values 1 – 3/4. Therefore, in this test, it was proved that the cow leather had quite better quality and resistance under continuous flexing than the goat leather for the application as lining leather.

The results of the bond strength between finish film and surface of leather test showed a significant difference. The values obtained in this test were 900 gm/cm for the cow lining leather and 525 gm/cm for the goat lining leather. Although both values were above the minimum requirement 250 gm/cm, the cow leather had a quite better bond strength quality than the goat leather. So, the finish film of the cow leather had better flexibility, strength and adhesion properties than the finish film of the goat leather.

In the colour rub fastness test, no difference was found between the results of the cow lining leather and the goat lining leather. After 1,024 cycles, the observed grey scale rating of the cow leather was 5 and the observed grey scale rating of the felt used for the cow leather was also 5. Again, after 1,024 cycles, the observed grey scale rating of the goat leather was 5 and the observed grey scale rating of the felt used for the goat leather was also 5. As all the observed ratings were within the required grey scale ratings 5 – 3, both of the leathers proved to have excellent colour rub fastness property for applying as lining leathers.

V. Conclusion

Analyzing the table-1, it can be said that the goat bag leather comparatively exhibits better results in grain crack resistance and flexing endurance tests and the cow bag leather gave the better results on the context of the rest of the properties. There is no significant difference between the stitch tearing strength properties of the cow bag leather and the goat bag leather. Both of the bag leathers have the same scuff resistance properties. Again, both samples of the cow leather could not satisfy the required break pipiness rating after the flexing endurance test.

Analyzing the table-2, it is found that tensile strength, tearing strength, flexing endurance and bond strength properties of the cow lining leather are better than those of the goat lining leather but the goat lining leather shows better results in percentage of elongation at break, stitch tearing strength and water vapor permeability tests. The tensile strength value of the goat leather was slightly below the minimum requirement.

The percentage of elongation at break value of the cow leather was very much below the minimum required value. Both flexing endurance samples of the goat leather could not satisfy the required break pipiness scale rating after the physical test.

Acknowledgement

The author would like to give special thanks to Institute of Leather Engineering and Technology, University ofDhaka for providing lab facilities to complete this research work.

References

[1]. B.O. Bitlisli, B. Basaran, O. Sari , A. Aslan , G. Zengin. Some physical and chemical properties of ostrich skins and leathers.Indian Journal of Chemical Technology.2004;**11**:654–658.
[2]. M. Hylli, G. Guxho, S. Drushku. Determination of some chemical and physico – mechanical indicators of Albanian leather.ZaštitaMaterijala (Journal of Materials Protection).2012;53:102–108.
[3]. G. John, Possible Defects in Leather Production (1997).
[4]. A. Kuria, J. Ombui, A. Onyuka, A. Sasia, C. Kipyegon, P. Kaimenyi, A. Ngugi. Quality Evaluation of Leathers Produced By Selected Vegetable Tanning Materials from Laikipia County, Kenya. IOSR Journal of Agriculture and Veterinary Science. 2016; 9:13–17.
[5]. N.M.H Mohamed, N.N.E. Hassan. An investigation into the physical and functional properties and sew ability of Faux leather. International Design Journal. 2015;5:375–382.
[6]. K. Phebe, K. Krishnaraj, B. Chandrasekaran. Evaluating performance characteristics of different fusible interlinings. Indian Journal of Fiber & Textile Research. 2014; 39:380–385.
[7]. R.B. Hobbs. Effect of Speed of Pulling Jaws on the Tensile Strength and Stretch of Leather.Journal of Research of the National Bureau of Standards. 1940;25:207–214.
[8]. C.K. Liu, N.P. Latona, M.A. Ramos, N.M. Goldberg. Mechanical properties and area retention of leather dried with biaxial stretching under vacuum. Journal of Materials Science. 2010; 45:1889–1896.
[9]. N. Örk, H. Özgünay, M.M. Mutlu, Z. Öndoğan (2014). Comparative Determination of Physical and Fastness Properties of Garment Leathers Tanned with Various Tanning Materials for Leather Skirt Production. TekstılveKonfeksıyon (Journal of Textile & Apparel). 2014;24:413–418.
[10]. S.S. DUTTA. An Introduction to the Principles of Physical Testing of Leather. Journal of Indian Leather Technologists' Association. 1990.
[11]. Indian Standard, Methods of Physical Testing of Leather.1988; 64–65.
[12]. ISO 2418: IULTCS/IUP 2, Leather — Chemical, physical and mechanical and fastness tests — Sampling location. Journal of the Society of Leather Technologists and Chemists. 1958; 42: 382–385.
[13]. ISO 2419: IULTCS/IUP 1 and IUP 3, Leather — Physical and mechanical tests — Sample preparation and conditioning. Journal of the Society of Leather Technologists and Chemists. 2000;84:241–243.
[14]. ISO 3376: IULTCS/IUP 6, Leather — Physical and mechanical tests — Determination of tensile strength and percentage extension. Journal of the Society of Leather Technologists and Chemists. 2000; 84:317–321.
[15]. ISO 23910: IULTCS/IUP 44. Leather — Physical and mechanical tests — Measurement of stitch tear resistance. Journal of the Society of Leather Technologists and Chemists. 2000; 409–412.
[16]. ISO 3377-2: IULTCS/IUP-8, Leather — Physical and mechanical tests — Determination of tear load – Part 2: Double edge tear. Journal of the Society of Leather Technologists and Chemists. 2000; 84:327–329.
[17]. ISO 3379: IULTCS/IUP 9, Leather — Determination of distension and strength of grain — Ball burst test. 1976.
[18]. ISO 14268: IULTCS/IUP 15, Leather — Physical and mechanical tests — Determination of water vapor permeability. Journal of the Society of Leather Technologists and Chemists.2000; 84:353–359.
[19]. ISO 5402-1: IULTCS/IUP 20, Leather — Determination of flex resistance — Part 1: Flexometer method. 2017.
[20]. ISO 11644: IULTCS/IUF 470, Leather — Test for adhesion of finish. Journal of the Society of Leather Technologists and Chemists. 1990; 74:155–160.

Md. Farhad ALI, et. al. "A Comparative Study on Physical Properties of Bag and Lining Leather from Two Different Origins." *IOSR Journal of Environmental Science, Toxicology and Food Technology* (IOSR-JESTFT), 15(3), (2021): pp 33-38.