The nature and properties of leather *checked*	Bản chất và tính chất của đồ da (vật làm bằng da thuộc)

Roy Thomson Man and his early ancestors have exploited the uniqueproperties of skin and leather for millennia and almost all human cultures have developed specialist techniques to utilize this readily available raw material fora wide variety of purposes. Indeed, tanning has beendescribed as man's first manufacturing process. Butwhat are the properties which make these skin-basedproducts so special?	Roy Thomson Con người và tổ tiên từ thời xa xưa của chúng ta đã khai thác các tính chất độc đáo của da và đồ da trong hàng nghìn năm và gần như tất cả các nền văn hóa nhân loại đều phát triển các kỹ thuật chuyên môn để tận dụng các nguyên liệu thô có sẵn cho nhiều mục đích khác nhau. Thực vậy, thuộc da chính là quá trình sản xuất đầu tiên của con người. Nhưng những tính chất nào làm cho các sản phẩm da đặc biệt như vậy?
To begin with, leather is a sheet material with thearea of each piece ranging from tens of square centimetres to six, seven or more square metres depending on the animal from which it was obtained. Untilthe development of woven textiles it was the onlymaterial available in sheets of this size.	[redacted]
Then there is the complex physical structure ofskin and materials made from it. A close examinationof the make-up of a piece of skin shows that it consistsprimarily of long thick fibres and fibre bundles interweaving in three dimensions within a jelly-like'ground substance'. Other features such as hairsand hair roots, muscles, blood vessels and fat cells arepresent but it is this intricate, three-dimensional,woven structure that predominates and gives skinbased materials many of their unique physical qualities. These properties include flexibility, a relativelyhigh tensile strength with particular resistance to shock loads,	[redacted]
	[redacted]

resistance to tearing, puncturing and abrasion, low bulk density, good heat insulation andwater vapour transmission. They also include mouldability, resistance to wind and liquid water,and an ability to be stretched and compressed without distorting the surface. Many of these characteristics are common toboth leather and other skin products but linguistic studies suggest that the various materials such as rawhide, oil-tanned pelt, alum-tawed skin and vegetable tanned leather were differentiated from each other from early times. It was not until the late eighteenthcentury though that the actual nature of the tanningprocess was examined and the question posed as tohow leather was different from these other materials. A number of criteria have been put forward in anattempt to define what is a true leather (Bienkiewicz, 1983; Covington, 2001; Lollar, 1958; Reich, 1999).These will be considered. A fundamental property of leather is that while araw skin is subject to rapid bacterial degradation due in the main to the action of proteolytic enzymes,leather is resistant to such microbiological attack evenif it is kept wet. There are, though, a number of techniques such as salt curing, drying, solvent dehydration and acid pickling which will impart temporary preservation against bacterial attack. This resistance to decay, however, is lost if the fibres are allowed tobecome wet. Similarly the effects of the treatments involved in the preparation of parchment	[redacted] [redacted] (Bienkiewicz, 1983; Covington, 2001; Lollar, 1958; Reich, 1999). Chúng ta sẽ xét những tiêu chí này. [redacted]

or alum tawed skins, both renowned for their longevity, are reversed by repeated immersion in water.

Skin-based materials are prepared by many indigenous peoples around the world by thoroughly impregnating the raw hide with fatty materials andthen allowing it to dry out under carefully controlled conditions. The fats coat the individual skinfibres and fill the spaces between them. Even if thetreated hides are then immersed in water, the presence of these water-repellent fats ensures that thefibres remain too dry for bacterial attack to takeplace. They therefore appear to satisfy the criteriaof resistance to microbiological degradation. Theseproducts, which are found widely in ethnographic collections, have been termed pseudo leathers.

These pseudo leathers should not be confused with oil-tanned skins which are not treated with stable,water-resistant fats but with reactive, oxidizible oils often obtained from marine animals. These undergovarious chemical changes during processing to liberate compounds with true tanning actions. Examplesof these oil-tanned products include chamois washleathers and the buff leather employed widely in thesixteenth and seventeenth centuries to make protective jerkins for the military.

Another characteristic attributed to leather is that whereas if a raw skin is allowed to dry out it isexpected that it

will become hard, horny, brittle and translucent, a true leather is said to dry to give a soft,flexible, opaque product.

It is true that if a raw skin is allowed to dry in anuncontrolled manner it is likely to give a product withthe properties described. If, though, the rate of dryingis regulated as with the production of the pseudoleathers described above, a soft opaque materialresults. Similarly if a dehaired skin is dehydrated by immersion in successive baths of a polar solvent such as acetone or one of the lower alcohols and the residual solvent evaporated, the resultant product will besoft, white, opaque and flexible. This flexibility will be enhanced by working the skin mechanically while it is still only just damp with the solvent. It will look and feel very similar to an alum-tawed or formaldehyde-tanned leather. These characteristics of solvent-dried skins are utilized in the solvent dehydration methods employed to conserve water logged archaeological leathers.

Parchment and vellum which are prepared bydrying unhaired pelts under tension also exhibit many of the physical properties of a true leather.

The different properties of the various untanned products made in the past depended on the amountand type of oil used to treat the unhaired skin and therate of drying. These properties enabled these materials to be used for such diverse purposes as malletheads, textile

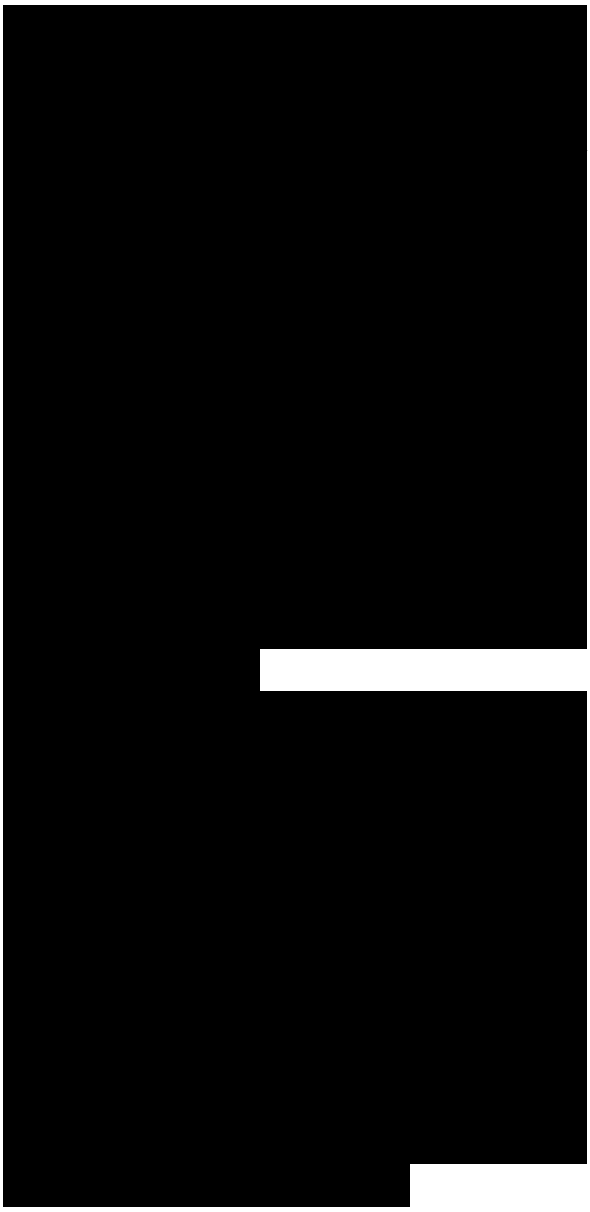
acetone hoặc một trong các loại cồn nồng độ thấp và cho dung môi dư bốc hơi, sản phẩm cuối cùng cũng sẽ mềm, trắng, mờ đục và mềm dẻo. Để tăng cường tính mềm dẻo cho da người ta tiếp tục gia công da bằng phương pháp cơ học trong khi nó vẫn còn ẩm trong dung môi. Nó sẽ có dạng giống như đồ da ngâm phèn hoặc da thuộc formaldehyde. Những đặc trưng của da được làm khô dung môi được sử dụng trong phương pháp khử nước dung môi để bảo tồn các sản phẩm da khảo cổ học chứa nước.

Giấy da dê và giấy da bê được chế tạo bằng cách làm khô các tấm da đã cạo lông đang kéo căng cũng thể hiện nhiều tính chất vật lý của đồ da thực sự.

machinery parts and the protective corners of basketwork skips. A modern successor to the latter is the use of rawhide to protect the corners and bottoms of baskets used by hot air balloonists. It is theunique combination of impact and abrasion resistance together with an elastic resilience which makesthis age old material ideal for its modern purpose.

While leathers produced for gloving and clothing are soft and supple, those made for shoe soleing are firm and resilient. In the period when the techniqueof chrome tanning was being developed during thelast quarter of the nineteenth century it was foundthat while a stable product could be made, this newtype of leather was liable to dry out to give a hard,cracky, inflexible material, in many ways similar tountanned skin. It was only with the introduction ofthe fatliquoring process, which coated the tannedfibres with oils, that a material could be manufacturedwith the properties required for it to be recognized asa true leather.

If a piece of wet skin, tanned or untanned, is heatedslowly it will reach a temperature at which it shrinksdramatically to about one third of its original area.This phenomenon has been likened to melting but isfundamentally different. The hydrothermal shrinkageof skin is irreversible and rather than being caused bya single physicochemical change is the cumulative result of a number of intermolecular processes.



The temperature at which this change takes placeis termed the shrinkage temperature and theamount by which any process increases the shrinkage temperature of a skin has often been consideredas a measure of its leathering ability.

The shrinkage temperature of a given sample ofskin will depend on a large number of factors. Theseinclude the species and age of the animal fromwhich the skin is obtained, what pretanning andtanning treatments the skin has undergone, themoisture content of the sample and the exact procedures employed in the determination. If, however,care is taken to carry out the measurement in a standardized manner, duplicate results within 1 or 2°Ccan be obtained. Using methods described in international standards, the following shrinkage temperatures are exhibited by typical commercial products:

Raw mammalian skin	58–64°C
Limed unhaired cattle hide	53–57°C
Parchment	55–64°C
Oil-tanned leather	53–56°C
Alum-tawed skins	55–60°C
Formaldehyde-tanned leather	65–70°C
Alum-tanned skins	70 – 80°C

Vegetable-tanned leather (hydrolysable) 75–80°C

[redacted]

[redacted]1 hoặc 2°C. Sử dụng những phương pháp được trình bày trong các tiêu chuẩn quốc tế, người ta đã xác định được nhiệt độ co của các sản phẩm thương mại điển hình như sau:

Da thô của động vật có vú	58–64°C
Da trâu bò cạo lông nhúng vôi	53–57°C
Giấy da dê	55–64°C
Da thuộc dầu	53–56°C
Da ngâm phèn	55–60°C
Da thuộc Formaldehyde	65–70°C
Da thuộc phèn	70 – 80°C

Da thuộc thảo mộc (thủy phân) 75–80°C

Vegetable-tanned leather (condensed) 80 –85°C
Chrome-tanned leather 100 –120°C
Most of these results confirm that tannage enhancesthe shrinkage temperature. There is, however, ananomaly with oil-tanned skins such as chamoistanned wash leathers or the brain-tanned ‘elk skins’produced by Native American and other cultures. Inthese cases the stabilizing process does not increasethe shrinkage temperature. These products exhibitall the characteristics of true leathers and what ismore they retain these after frequent washing anddrying in use. Oil-tanned leathers also exhibit anothersignificant difference in their hydrothermal properties.When other skins and leathers shrink in hot waterthey turn into a rubbery material which dries to ahard, brittle, product. When oil-tanned materialsshrink they retain their leathery handle and whendried retain their softness and flexibility to a significant extent. In addition, if a wet oil-tanned leather isheated above its shrinkage temperature and thenimmersed in cold water it can be stretched back tonearly its original size.

These exceptions to the various criteria proposedto define what is and what is not a true tannage haveled to attempts to explain the conversion of skininto leather according to the mechanisms involved.

For many years it has been accepted that the cohesion of skin fibres is a result of the structure of the collagen protein

[redacted]

molecules from which these fibres areformed. These have been shown to be held togetherby a combination of a few, relatively strong, covalentbonds and many weak hydrogen bonds. It has beenthought that hydrothermal shrinkage occurs whenthe disruptive energy introduced by heating the sample exceeds the cohesive strength of the bondingwithin and between collagen molecules. Tannage hasbeen thought to introduce extra chemical crosslinking bonds between adjacent collagen moleculeswhich are resistant to microbiochemical attack. Thenature and strength of these crosslinkages vary considerably depending on the type of tanning materialemployed. Vegetable tannage for instance is thoughtto introduce many extra hydrogen bonds betweenfree amino side groups of the collagen protein andhydroxyl groups from the polyphenolic tanninmolecules. Chrome tannage on the other hand is aresult of side chain carboxylic groups on the proteinmolecule co-ordinating with the multinuclearchromium complexes present in chrome tanningliquors. The differences in the increase in shrinkagetemperature brought about by the different tanningsystems has been thought to be related to the combined strength of these crosslinking bonds. Recent work has shown that the energy associatedwith the hydrothermal shrinkage is similar for all thedifferent tannages irrespective of the temperature atwhich the shrinkage occurs. This has led to the concept of the formation of a	collagen và các nhóm hydroxyl trong các phân tử thuộc da poliphenol. Mặt khác, quá trình trình thuộc da Crom chịu tác động của các nhóm carboxylic chuỗi biên trên phân tử protein kết hợp với các phức chất Crom hiện diện trong các dung dịch thuộc da Crom. Sự khác biệt giữa độ tăng nhiệt độ co của các hệ thống thuộc da khác nhau được cho là có liên quan đến độ bền của những liên kết khâu mạch này. Công trình gần đây cho thấy rằng năng lượng ứng với sự co thủy nhiệt giống nhau đối với tất cả các quá trình thuộc da khác nhau bất kể nhiệt độ xảy ra quá trình co. Điều này dẫn đến khái niệm về sự hình thành nền siêu phân

supramolecular matrixaround the collagen molecule during tanning andthat it is the size and complexity of this matrix whichdetermines shrinkage temperature. This mechanismdoes not preclude the presence or importance ofcrosslinking reactions occurring during tanning butit does explain why oil tannage can be considered togive a true leathering effect without increasing theshrinkage temperature.	tử xung quanh phân tử collagen trong suốt quy trình thuộc da và chính kích thước và độ phức tạp của nền này xác định nhiệt độ co. Cơ chế này cũng không loại trừ sự hiện diện hoặc tầm quan trọng của các phản ứng khâu mạch xuất hiện trong quá trình thuộc da nhưng nó cho biết lý do tại sao thuộc da bằng dầu có thể cho các hiệu ứng da thật mà không tăng nhiệt độ co.
Although indicating the complexity of the problem, the question of what exactly leather is has notbeen fully answered by the above discussion. However, a definition which appears to take into accountthe points raised is as follows.	Mặc dù đã chỉ ra tính phức tạp của vấn đề nhưng phần thảo luận ở trên vẫn chưa trả lời được thấu đáo câu hỏi sản phẩm da chính xác là gì. Tuy nhiên, định nghĩa (có vẻ) xét đến những điểm nảy sinh như sau.
Leather is a material produced from the skin of avertebrate, be it mammal, reptile, bird, fish or amphibian, by a process or series of processes which rendersit non-putrescible under warm moist conditions. Atrue leather retains this property after repeated wetting and drying. Leather usually dries out to give arelatively pliable, opaque product but it can be hardor soft, flexible or rigid, stiff or supple, thick or thin,limp or springy, depending on the nature of the skinused and the process employed.	Sản phẩm da là vật liệu được sản xuất từ da của động vật có xương sống, đây có thể là động vật có vú, bò sát, chim, cá hoặc động vật lưỡng cư, thông qua một quá trình hoặc chuỗi quá trình làm cho nó không bị thối rữa trong điều kiện nóng ẩm. Sản phẩm da thực sự vẫn giữ được các đặc tính của nó sau khi bị làm ướt hoặc làm khô nhiều lần. Da làm khô sẽ cho ra sản phẩm mờ đục, tương đối dẻo nhưng có thể cứng hoặc mềm, linh hoạt hoặc cứng, khó uốn hoặc dẻo, dày hoặc mỏng, không co giãn hoặc đàn hồi, tùy thuộc vào bản chất của da và quy trình xử lý da.
It has been the aim of the tanner throughout theages to manufacture a product with just the combination of properties demanded by the end user. It should always be borne in mind that in	

a similarway to ‘metal’ or ‘wood’, leather is not a single material but a group of related products having manycharacteristics in common but each varying in itsproperties and reaction to conservation treatments.