



Avoiding poor tensile strength values

Dr Gheorghe Bostaca, former president of the
Romanian Leather Producers Association APPBR



The tensile strength of leather is a physical-mechanical property which is directly linked to the properties of the raw hide, chemical processing, and the physical operations involved in manufacturing a particular leather.

The tensile strength performance is essentially dependent upon the density, the degree of splitting and separation of the fibre weave, and the mobility of the collagen fibres in the modified reticular layer in the final leather.

If the value is too low, it will restrict the suitability of a leather for many uses, and influence the behavior and durability of the end product. ^[1]

The lower limits required to ensure good tensile strength performance are the subject of discussion within the American Leather Chemists Association's Leather Chemist forum, Leather Discussion board, (The Leather Lab). It is useful to refer to the following comment made by Dr. Waldo Kallenberger ^[2]:

"Many companies struggle to establish minimum leather strength requirements. There is always the disagreement about what is good and what is not. Obviously the way to establish a minimum is through statistical evaluation of your product to see where failure rates become unacceptable. Just as obviously, that takes time, money and a long history of producing and monitoring your product.

As a beginning mark, most US facilities learned that a minimum

of at least 2000 lbs/square inch (140.5 kg/square centimetre) are necessary for leather to be considered strong enough to function in most applications (clearly some such as climbers belts and other safety devices may well want a much higher minimum).

Since leather is typically in the 4000 to 6000 range, 2000 seems very liberal. However, some upholstery companies argue that due to their softness and thickness requirements the value should be 1800 psi, but simple handling of such leather reveals that it is indeed fragile and prone to seam tearing, etc."

The cause of poor tensile strength values

Essentially, the following causes lead to a defective structure, hence low tensile strength. They are also closely related with tear, stitch-tear, elongation and lastometer values.

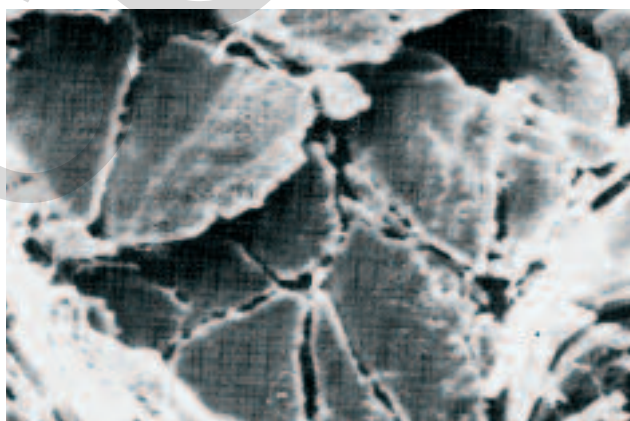
- The genetic characteristics of the animal hide.
This refers to the vertical fibre defect (VDF) and results in a vertical orientation of the corium fibre. This can lead to a reduction in tensile strength down to 50% of normal values. It sometimes is found in the Hereford breed of cattle, which are found in large numbers in Australia, USA, and UK ^[3].
- Animal welfare, especially the practice of forced fattening.
- The improper preservation, storage and transport conditions of the raw hide, the semi-processed product, or even storage of the finished leather.
- Inappropriate manufacturing technologies.

An overview of the causes of low tensile strength values and preventative techniques that can be used in leather manufacture are set down in *Panel 1*. ☺

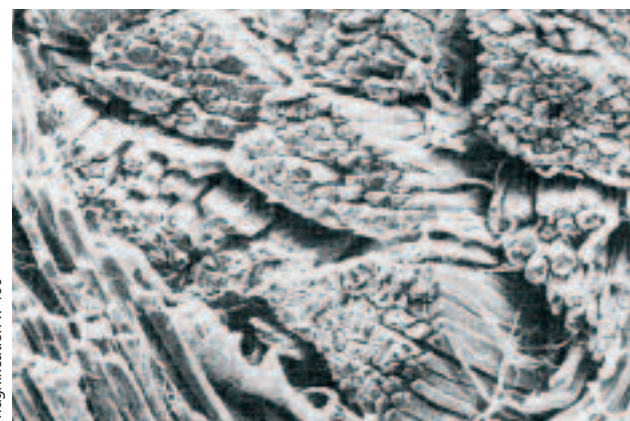
References:

1. Multicriteria analysis of leather performance, J. Rudecka, M. Pawlowa, M. Bakar and Z. Piasta, JSLTC, vol. 93, p. 162.
2. leatherchemists.org/forum, (The Leather Lab) from 05 February 2013.
3. Problems caused by vertical fibre defect, Amanda Michel, Leather International, November 2004, p. 36.

Panel 1a: Fibre structure: small splitting up.



Panel 1b: Fibre structure: large splitting up.





Panel 2: Low tensile strength - Overview of preventative measures in manufacture.

AVOIDANCE TECHNIQUE	
Process stage	Degradation of fibre structure
• Preservation • Soaking • Enzymes • Liming • Bating • Pickling • Tannage • Neutralising • Storage	• Adequate salt content, suitable temperature, moderate humidity (max 65%). • Use of bactericides. • Selective enzymes to avoid collagen damage, and careful temperature control. • Careful control of temperatures, especially if high alkalinity (max 29°C). • Products with known and reliable enzymatic activity. • Acid/salt as appropriate, temperature below 25°C. • Maximum basicity of chrome 38. • Avoid high pH conditions, use neutralising agents with moderate pH values, and avoid long running times. • Pickled stock requires chilled conditions. Minimum use of formic acid. • Preservatives for wet blue and crust leathers.
Process stage	Poor opening of fibre structure
• Soaking • Liming • Deliming • Pickling • Tanning/ Basification • Retanning	• Adequate soak required. • Close attention to swelling and fibre splitting. • Uniform and complete deliming required. • Salt concentration min 6° Be. Temperature max 25°C. • Avoid pretanning with aldehydes. Chrome tanning: Minimum 3.5% as offer as 33 Basic chrome. Maintain a slow and uniform basification process. • Avoid overfilling: favour use of resin-type products.
Process stage	Fibre adhesions, reduced mobility, and lack of flexibility
• Retanning • Fatliquoring • Drying	• Avoid high vegetable tannins or fillers in interfibrillar spaces. Filling as required, with minimum amounts of vegetable tanning agents. • Ensure sufficient offer of fatliquor. For soft leather, use a step-by-step approach (apply in pickle, tanning, pre-fatliquor and main fatliquor). Seek uniform distribution of fats. Avoid “dry” fats. • Avoid over-compression in samm/setting. Use lower drying temperatures.
Process stage	Over-stress of fibre structure
• Mechanical action • Drying	• Avoid excessive running when pelts are in sensitive condition (when under-soaked, during swelling phase in liming, lime washing etc.). Avoid incorrect internal configuration of processing vessel. Rotation speed (peripheral speed) of vessel too high. • Ensure that strain is not too great in relation to wet processing formulations and type of raw material.
Process stage	Shearing/rupture of fibre structure
• Process vessels • Splitting/shaving • Mechanical	• No formulation to relate speed of rotation to diameter. High dependency upon internal construction and fittings (pegs-shelves and their dimensions) Speed and loading- vary to suit raw materials and production stage. Essential to closely observe effects under practical conditions. • Avoid too high ratio of weak grain layer to corium major. • Avoid excessive pressure/strain in samming, samm/setting, wet stretching/staking, drying, staking, and milling. Moisture contents post drying as appropriate.
Process stage	Low moisture content in final leather
• Retan/fatliquor • Drying • Storage	• Avoid “dry” fatliquor blends. Consider using humectants, especially with vegetable tanned leathers. • Avoid over-drying at first time drying, and within subsequent drying operations. • Suitable relative humidity in storage/transport (60-65% and temperature (5-25°C).