SmiTools - Strength

the causes and prevention of reduced strength properties

In this SmiTools Smit & zoon is sharing a synopsis on the topic 'Strength Properties'. Learn about the different ways to measure leather strength (e.g. tear strength, tensile strength), the causes of strength loss, and remedies to reduced leather strength.

Introduction

Strength properties have always been a topic of discussion, both for thicker, firmer leathers and for soft and light nappa's. A test to give oneself a first impression of the strength is done by cutting a small distance from the edge and then tearing it by hand.

It is simple but effective way of assessing the leather. Subsequent calibrated testing more often than not confirms one's suspicions.

Many factors influence the leather's strength properties. Insufficient strength properties are usually a result of a damaged fibre structure. It can occur in many stages of the process. The problem may be traced to soaking or liming, splitting or shaving and even to retannage and fatliquoring.

Causes

Conservation

Bad conservation of raw material leads to a notable reduction of the leather's strength properties. Bactericides during soaking can only stop further deterioration of the strength-giving structure, but do not go beyond this.

Liming

Uncontrolled liming with too much swelling from excessive amounts of sodium sulphide leads to excessive fiber plumping. The amount of sodium sulphide to be used is calculated on the basis of the amount of hair to burn. Its use serves no other purpose than hair removal. Although it is difficult to calculate the right amount, this fact should always be kept in mind when establishing a liming process. Random and "average" amounts of sulphide are to be avoided. Running times serve a purpose and lengthening the process without a necessity has its effect on the fibers, as does temperature. Although too low

Temperatures may increase a pelt's degree of swelling, too high temperatures can cause some real damage in the presence of high alkalinity.

De-liming

Insufficient or uneven de-liming of the hide is a known cause for low tear and tensile strength. Splitting the hides after liming would make matters easier, but as most hides are processed in unsplitted condition, careful observation of the de-liming process is therefore essential in the avoidance of strength problems.

Swelling

Swelling at an early stage is a potential hazard, also in pickling. Before the acid is added, the right amount of salt needs to be given time, in order to dissolve and penetrate. Too low amounts do not protect against acid swelling. Other than alkaline swelling, acid swelling is irreversible and causes severe and lasting damage to the hide. The amount of salt not only depends on the amount of float but also on the amounts of diluted acid added afterwards. The diluted acid reduces the salt concentration. When the acid is added the salt concentration should be 6°Bé.

Temperature

If all this is carried out in a well-controlled manner but the pickling temperature is too high (>25°C), the pelt reacts extremely sensitive. In the presence of acid, previously safe temperatures are suddenly experienced as heat. The damage to the hide is severe and lasting. Plumping is equivalent to the straining of the fibers. Different acids influence this behaviour. Sulphuric acid gives fuller leathers than hydrochloric acid. In certain cases when a raw stock of known sensitivity is used, hydrochloric acid may be more suitable to use.

Pickling

Pickling is a lengthy process, particularly on unsplit hides, and it is tempting to take short cuts in the processing time. However, uneven pickling and de-liming lead to uneven chrome distribution. This in turn causes uneven properties inside the leather and too early binding of the tanning agent. The amount of chrome offered influences the tensile and tear strength. For best properties the amount offered and fixed should not exceed the level necessary for a proper tannage. Higher offers reduce the strength.

Basification

Basification is the process in which chrome tanning is concluded. It is a constant source of irregularities and through improper chrome fixation it can cause further strain on the fiber structure.

Shaving & splitting

If the grain layer's thickness is more than a certain %-age of the final thickness, an impairment of strength properties can be expected.

In other words: the strength is reduced if too much of the original thickness is split or shaved away. Bigger and thicker hides easily make low-strength leathers when shaved down to the substance of a milling nappa. They may then have better grain tightness, but their strength is adversely affected by the removal of strengthening tissue. A general rule says that the grain thickness of wet blue = 0,5mm + (0,08 x unsplitted & sammed thickness). The strength diminishes quickly if the grain layer makes for more than 40% of the leather's final thickness.

Retannage & fatliquoring

The influence of retannage and fatliquoring on tensile and tear strength of leathers with internal damage is difficult to assess. The strength of a well-treated wet blue can be reduced by insufficient fatliquoring or wrong retanning. The leathers become weaker when excessive amounts of retanning agents are used. In retannage the leathers should be kept as flat as possible to prevent unnecessary fiber separation and plumping. Fullness is an impression caused by processes which took place on the outer layers. Fatliquoring plays a big role in this. A sulphated fatliquor (such as Polyol AK) always gives a fuller handle than a strong sulphited oil. The first remains just under the surface, while the latter penetrates deeper. If a leather has been damaged beforehand it therefore needs to be treated with care not to further weaken the fibers.

General remedies

The strength properties of a leather is a given fact and is the end result of a long chain of events which all may have their effect before the post-tanning processes are applied.

Good care taken during retannage and fatliquor not to further weaken the fibres is of much greater relevance than a product-based approach. When strength is a matter of concern, it is advisable to consider some basic influences these processes may have.

Do not retan more than necessary. Retanning reduces the fibers flexibility and creates tension, eventually leading to a structure sensitive to external stress forces.

Do not exaggerate the amount of filling agents applied (melamine, DCD). This class of products is meant to fill and therefore plump the fibers. Above a certain point this may lead to a notable reduction of their elasticity.

Use suitable fatliquors. A certain amount of natural oils is beneficial in many cases and to be preferred above combinations entirely composed of synthetic oils.

Use as little mimosa as possible.

Use the right sized leathers for each purpose. For thin leathers the use of smaller hides is to be preferred since they still contain relatively more of the strength-giving corium major.

High amounts of acrylic syntans could have an adverse effect on the strength properties.

Strength – expression

Various measures exist for expressing strength – as a value

Absolute

For this purpose only the force found when the leather breaks is of importance. The absolute value measured.

Example: if 200N are measured, the result is expressed as 200N = 200 N.

Per mm thickness

For this purpose the leather's thickness is measured in defined areas.

The absolute value measured is divided by the leathers thickness in mm.

Example: if 200N are measured and the leather is 2mm thick, the result is expressed as 200N/2mm = 100 N/mm.

Per square area

For this purpose not only the leather's thickness is taken into consideration, but also its width. The absolute value is then divided by the square of its thickness and width.

Example: if 200 N are measured and the leather is 2mm thick and 20mm wide, the result is expressed as 200N/ (2mm x 20mm) = 5 N/mm2

These methods of calculating are to be considered when interpreting the results found.

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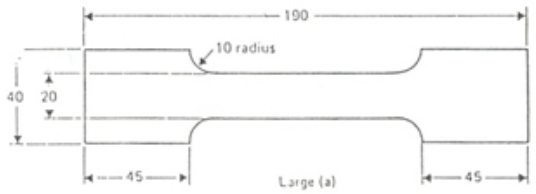
Strength – types

Tensile strength & elongation

Tensile strength measures the force required to pull something such as rope, wire, or a structural beam to the point where it breaks.

Specifically, the tensile strength of a material is the maximum force that it can be subjected to before failure. The definition of failure can vary according to material type.



Elongation is the degree of stretch in % at the point of failure.

Tensile strength is tested according to DIN EN ISO 3376, IUP 6. A test specimen in extended at a specified rate until the test piece breaks. The maximum force is recorded and expressed in “N/mm”.

Elongation is tested according to DIN EN ISO 3376, IUP 6. A test specimen in extended at a specified rate until the forces reach a predetermined value or until the test piece breaks. The increase of the sample’s length at this point is recorded and expressed as “%”.

Tear strength

Tear strength is a measure of the resistance of a material to tear forces. The tear strength of a notched specimen is calculated by either the maximum force recorded or average of x peak forces recorded (= mean force). Two types of tear strength are to be distinguished:

- single-edged
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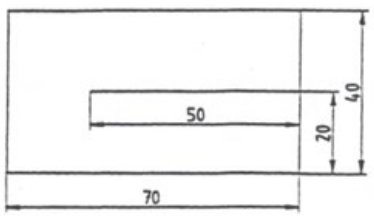
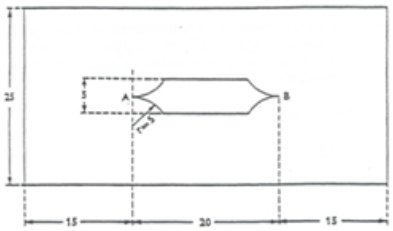


Double edged tear strength is tested according to DIN EN ISO 3377-2, IUP 8. A rectangular test specimen with a hole of specified shape is placed over the turned up ends of a pair of holders attached to the jaws of a testing machine.

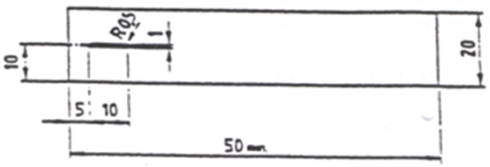


The highest force exerted during tearing of the test piece is recorded and expressed as “N”.

Stitch tear strength

Stitch tear strength is tested according to DIN 53331, IUP 44. A leather test piece is pulled against a mandrel of specified shape and dimensions inserted trough a slit in the leather.

The force required to tear the leather is recorded and expresses as “N”.



Contact Smit & zoon for further information

The information given in this SmiTools is just a short synopsis on the topic. We would be glad to help you further in case of questions, the sharing of information or help with choosing the right wet-end products for your application. Please feel to contact our Leather Service Centre or your usual relation within Smit & zoon.

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