Chemical testing of leather

Before any leather products are placed on the market, there are legal obligations to be met to ensure they are ‘fit for purpose’. Chemical testing of leather can form part of a good production control system to ensure that performance requirements are met. Testing can also be used to indicate possible causes of problems and/or faults in the finished article.

This article explains a few of the more common tests used for the chemical evaluation of leather, and details some of the consequences that arise due to unsatisfactory results. Possible reasons behind poor results and references to the test methods used are also included.

All of the tests described in this article are quantitative – that is, tests that are used to determine the amount of a particular substance in a material and give a numerical value as a result.

pH value
‘pH’ is a measure of the acidity or alkalinity of a solution or material. The pH scale measures this value on a logarithmic scale from 0-14, with 0 being the most acidic and 14 the most alkaline. The majority of leather produced today is chromium-tanned, and will have a pH value in the range of 3.2-5.5. Therefore, it is considered acidic.

The acidity of leather is determined by the leathermaking process. Extremes in the pH of the finished leather can indicate that the processes used in the manufacture of the leather have not been carried out correctly. A low pH may result in the premature degradation of the leather, and adjacent fabrics (such as textile linings) may also be affected. On the other hand, poor dye fixation – and, hence, poor colourfastness – may be a result of a high pH.

The use of damp indicator paper is a quick and non-destructive way of determining the approximate pH of a material. This is shown by a change in colour of the indicator paper. A more accurate means is by measuring the pH using EN ISO 4045:2008, although this requires the leather to be cut and is therefore destructive.

Grease content
Oils and fats give suppleness and softness to leather. The level of fatliquor (often referred to as the ‘grease content’) present in leather is controlled during the fatliquoring process. The final characteristics and performance of leather will be determined to some degree by the amount and type of fatliquors used. Poor control during this part of the production process may result in leather that is harder.
or softer than desired, or a leather that feels greasy. Another problem that can be attributed to the fatliquors is the possible formation of a fatty acid spue on the surface of the leather. This is caused by migration of fatty acids (predominately steric and palmitic acids) to the surface where they solidify, resulting in a white waxy or greasy substance on the surface. The amount of grease is determined by extracting with a solvent using the SATRA TM346:1994 or EN ISO 4048:2008 test methods.

**Chromic oxide content**
The tanning process, which is the conversion of hides and skins into leather, commonly uses chromium salts. When determining the level of chromium present, the result is expressed as chromic oxide ($\text{Cr}_2\text{O}_3$). Knowledge of the chromic oxide content is a useful quality control technique, and a reduction in thermal stability (poor heat resistance) could be attributed to a lower than required chromic oxide content.

There are a number of techniques available to determine the amount of chromic oxide present in leather. One such technique involves ashing the leather, followed by conversion of the chromium into the hexavalent state and, finally, titration. SATRA TM348:1996 and EN ISO 5398-1:2007 are methods that utilise such a technique.

**Total water solubles/sulphated ash of water solubles**
The level of water-soluble matter present in leather can indicate the degree of unbound tans and non-tans, salts and other substances present. The tanning process and chemicals/substances used will result in a proportion of the tannins being bound to the skin collagen structure via hydrogen bonding. However, there will always be a proportion that will remain unbound and these, along with water soluble salts and unfixed dyes, can be quantified.

The water soluble matter can be determined using the SATRA TM329:1995 or EN ISO 4047:1998 test methods. The level of water solubles present is determined by shaking the degreased leather in water. This resulting solution is filtered and a portion is evaporated, thus allowing the solubles to be quantified. The ratio of organic to inorganic substances can also be calculated by adding sulphuric acid to the dried extract (thereby converting any inorganic salts to the stable sulphate form) and then ashing to remove the organic portion.

**Moisture**
Moisture content is an important characteristic of leather and will change depending on the temperature and relative humidity of its surrounding environment.

Moisture and small amounts of volatile oils or solvents are included in a determination of volatile matter. As the oils and solvents are only a comparatively small part of the total weight lost during this test, the amount of volatile matter determined can be considered as a good estimation of the moisture present.

Changes in moisture can affect the physical properties of leather – one important factor being a gain or reduction in the area of a hide or skin. This can cause particular problems with production where leather is used in conjunction with other materials. Ideal moisture content is often considered as being 12 to 14 per cent. The methods for determining volatile matter (moisture content) are SATRA TM347:1996 and EN ISO 4684:2005. In this case, a sample of ground leather is dried to a constant mass at a temperature slightly above 100°C and the mass loss is calculated.

This article has considered only a very limited number of the chemical tests that can be carried out on leather. All of these can provide important information on how the leather will perform and, in many cases, they can explain physical problems with the final product. SATRA can provide a comprehensive range of services – from testing of finished products to leather cuttings. Our laboratory house state-of-the-art instrumentation to carry out these tests and comprehensive testing for restricted substances, and we are an ISO/IEC 17025:2005 accredited laboratory.

**How can SATRA help?**
Please contact chemistry@satra.com for further information on the chemical testing of leather.