



Chrome tanning is a fast mechanised process.
CREDIT: WTP

Footwear Fundamentals

Chrome or vegetable?

There has been much debate in recent years over chrome versus vegetable tanning and the risk of chrome VI (hexavalent chromium) being present in footwear. The fact that it remains ongoing only goes to show how complex a subject it is. Now, several new tannages have appeared, the producers of which claim have all the benefits of the chrome process without the potential risk of chrome VI. While these new systems may well solve the problem, it will take some time for chrome to disappear so, until it does, the fundamental choice between it and vegetable tannage is likely to remain.

WHAT IS CHROME?

Chromium is a metal salt that in itself is harmless and also in compounds involving chrome III, which is the commonly used tanning agent. It has been found however that under some conditions that are still being studied, this chrome III can change into chrome VI which is both toxic and health risk. So, if there is this risk, why is chrome used to tan leather? The simple fact is that it is only comparatively recently that this factor has been recognised. We have in fact been wearing shoes made from chrome leather for over 100 years seemingly without any problems and, today, an estimated 80% of all leather

produced globally uses chrome tanning.

Tanners and shoemakers have worked hard to eliminate the formation of chrome VI and salts containing this form of the metal have almost entirely disappeared from the tanning industry. There remains the possibility however that some countries or companies may have been less than rigorous in eradicating it or that exposure to air, heat and light during the footwear manufacturing process or the aqueous-based adhesives that are involved may be causing the change. A further complication lies in the fact that there appears to be a genuine possibility of chrome VI suddenly appearing in



Most leather is now tanned to the wet blue state and sold on to be finished to specific needs. CREDIT: WTP

leather that has already been tested and approved. No one is as yet quite sure of how this can happen.

WHY USE CHROME TANNAGE?

Leather was traditionally processed in pits and vats using vegetable tanning agents and natural oils. It was essentially a rule of thumb craft procedure which produced extremely variable results. While shoemaking remained essentially a hand process, this could be accommodated. The mechanisation of the industry towards the end of the 19th century, however, called for more uniform materials in order to produce shoes of consistent quality. Fortunately, it also coincided with the emergence of the modern chemical industry which soon discovered how to convert chrome ore into a tanning agent that produced more consistent upper leather at a faster rate and a lower price.

Chrome also provides flexibility in manufacture. Most skins and hides are chrome-tanned to the wet blue state and sold on as a commodity material from which finishing tanners produce specialist leathers for the full range of end applications. This is not possible with vegetable tanning where the process has to be continuous from raw hide to finished leather. Chrome tanning is also much faster than vegetable tanning and uses much less water both of which make it a cheaper process.

Although only chrome III is used in

tanning, it can change into chrome VI through oxidation due to some fatliquors such as sulfited fish, lard and vegetable oils containing a degree of oxidising agent. These have been shown to act as 'starters' for the change to chrome VI. There is, however, no need for any of these oils to be used when producing upper leather. Furthermore, if chrome III should for whatever reason change into chrome VI, it will start to reverse itself after a three-week period. Chromium is itself a transition metal that can exist in a number of different oxidation states each of which have distinct properties:

Metallic chromium is a steel grey, hard metal found as chromite ore (it does not occur in the metallic state naturally). It is used to harden steel, manufacture stainless steel, to form alloys and produce corrosion resistant plated surfaces.

Trivalent chromium or chrome III compounds occur naturally in rocks, soil, plants and volcanic emissions. Chromium salts are also present in foodstuffs and form a key role in the metabolism of fats and sugars in the human body. Nutritional supplements are currently on sale containing chromium picolinate and chrome III is considered safe for use in leather manufacture.

Hexavalent chromium or chrome VI is the hazardous form of this element. It can be formed when trivalent chromium is oxidised. This usually occurs in the presence of oxygen combined with other factors such as

extremes in pH (hydrogen ions). The salts have a characteristic yellow colour, are classified as carcinogens and chrome VI is therefore not used in the tanning of leather.

WHY NOT USE VEGETABLE TANNAGE?

As stated, before the development of chrome salts as a tanning agent, all types of leather were produced using vegetable tanning agents. These agents were derived from a variety of trees and plants and exhibited a broad range of properties that dictated the type of leather that could be produced. Today, the main one used is mimosa, followed by quebracho and then chestnut.

Used as the main tanning agent, they produce firm leathers that vary in base colour from the pinky-beige of mimosa to the dark, nut brown of chestnut. They all tend to be light-sensitive and to redden or darken further on exposure to natural light. While they are eminently suitable for the manufacture of leathers for goods, belting and saddlery, they are less so for footwear uppers other than traditional products such as clogs.

Mimosa is however playing an increasingly important role in the retanning of chrome leather as the swing to more 'natural' leathers continues to grow, particularly for automotive seating. Used in this way, it would more easily find a place in footwear manufacture provided of course enough could be produced.

It is extracted from the bark of the Black Wattle tree which is found in the



Slow vegetable tannage in pits.

CREDIT: CONCERIA RIUNITE GB SPA

cool, mist-belt regions of Southern and Central Africa at altitudes in excess of 1,100m above sea level which limits where it can be grown commercially. Other than in South Africa, there is little commercial growing so that supply is strictly limited whereas chrome, on the other hand, is both plentiful and widely spread.

ARE THERE ALTERNATIVES?

Spruce also provides an extremely effective tanning agent and Russia and Scandinavia have vast spruce and birch forests that could be used as raw material. Unfortunately, the forestry industry in general has yet to be convinced that there is a sufficiently large and profitable demand for the product to justify the investment that would be necessary.

There are further disadvantages. First, up to five times the amount of spruce or birch tanning agent is required compared to mimosa, with a corresponding additional cost. This makes it an even less commercially viable proposition for mainstream tanners. Second, vegetable tanning of all types also leaves a residue or 'sludge' that, unlike chrome salts,

cannot be so readily recycled. While this does not create a serious problem in the quantities currently involved, it certainly would if it became a major player. And, finally, there is the matter of logistics. A major proportion of tanneries today are located in Asia and China, which is a long way from either South Africa or Scandinavia in terms of additional freight costs.

However, there are some specialist tanners using spruce or birch extracts and footwear manufacturers that use their leather. It is very small scale however and aimed at the top end of the market where price is less important. It is a classic chicken and egg situation where uncertainty over demand prevents the forestry industry from investing and no guarantee of supply stops tanners from considering a change from chrome.

WHERE VEGETABLE DOES SCORE

Vegetable tannages can, however, offer ideal properties for shoe lining leathers. The leathers feel warm, are naturally inclined to softness and exhibit a high resistance to perspiration. They readily absorb high quantities of

water vapour without becoming wet or losing their insulation properties, while moisture release is fast.

Applied to calf leathers, vegetable tanning provides excellent extension, compression and shape retention properties, making it very easy to last. Vegetable tanned leathers also cut easily and leave a tight clean edge. This is a particular advantage on under-edge trimmed toplines. They are also easy to skive and take a good seam, both from the point of view of stitch tear strength, as well as the actual set of the seam.

With the correct blend of tanning agents and the right processing, calf lining leathers in particular have a light natural tone. This is also uniform and, as no dyestuffs are used, there is no risk of any colour leaching. In addition, the relative lack of fatliquoring involved means there are no problems with migration or discolouration. Furthermore, due to the absence of any finishing, the grain surface remains intact to give the leather a fine classic appearance. This combination of properties makes vegetable tanned calf skin the perfect shoe lining and remains the material of choice for top quality footwear. 🍷