## 2.4 Tanning - Health and ecology

The environmental impact of the various different tanning agents and tanning processes used in the production of leather and their effects on the environment have repeatedly given rise to controversial discussion. A careful evaluation needs to be made of the pros and contras of each method, because no single tanning process can ever give optimum results in every respect. The following applies to all tanning processes, whether they employ mineral, synthetic or vegetable tanning agents.

- The potential hazards posed by the particular tanning agent in question have to be known, and appropriate working procedures have to be selected with a view to minimizing or eliminating the possible risks involved.
- The decision on which tanning process to use depends on the properties that the finished leather is required to display.

### 2.4.1 Chrome tanning agents

Chrome tanning is a very effective method for producing high-quality leather cheaply and quickly, and it is superior to all other tanning methods in this respect. Much criticism has been directed towards the use of chromium salts in leather tanning, but it has to be borne in mind that chromium can occur in different oxidation states and its compounds behave differently. Most chromium(VI) compounds are highly toxic and classified as MAK III A 2 carcinogens, but chromium(III) is an important trace element in man and animals. Chromium(III) is a constituent of human glucose tolerance factor, which plays an important part alongside insulin in regulating blood sugar levels. Animal experiments have shown that a chromium deficiency can lead to arteriosclerosis and retarded growth. Chromium(III) stimulates the growth and metabolism of certain microorganisms.

Chromium compounds are, or at least used to be, one of the most common causes of occupational skin disorders. Chromium(III) is not regarded as being sensitizing, because it does not readily penetrate the skin, but water-soluble chromium(VI) compounds penetrate the skin very easily. Chromium(VI) is then reduced intracutaneously to trivalent chromium, which enables it to react with the proteins in the skin and trigger an allergic reaction.

Chromium(III) compounds form very stable metal-protein complexes with the collagen when they are used to tan leather. The stability of these complexes has been demonstrated in experiments to assess the migration of chromium from tanned leather. The migration has been shown to be only 0.2 - 0.3 % in the 2.5 - 11.2 pH range. The low level of migration and the precautions that are taken in the leather industry nowadays mean that the risk of illness caused by sensitization to chromium to workers employed in the leather industry is virtually nil. This has been confirmed by the statistics on industrial diseases.

Nowadays, the state of the art is to use chrome tanning agents that consist entirely of compounds of chromium(III). No chromium(VI) can be detected in the **Chromitan** types supplied by BASF. A great advantage of **Neutrigan** is that it also prevents traces of chromium(VI) compounds from occurring. A similar effect can be achieved by neutralizing of wet blues with **Tamol® NA**.

The dermatological evidence is that the incidence of allergic reactions to leather has increased slightly in recent years, but the proportion of allergic reactions to leather of all allergies is negligible. The evidence suggests that the reason for this increase is the increasing popularity of sporting and leisure activities in which leather footwear comes into

direct contact with the skin, which is intensified by perspiration. A clear causal relationship between allergies and exposure to chromium can rarely be established, and the evidence suggests that various different interrelated factors are at work. All in all, there are no objections to chrome-tanned leather because of its effect on health, provided the leather is tanned properly.

Emissions of chrome-tanning agents in waste water can be minimized by modifying the tanning process to increase the exhaustion and by recycling chrome (see Section 1.1.5 on heavy metals).

### 2.4.2 Vegetable tanning agents

Vegetable-tanned leather is often referred to in public as "natural leather", and it is usually perceived as being more "natural" than chrome-tanned leather. This is based on the misassumption that, because vegetable tanning agents are of "natural" origin, they are incapable of having any adverse ecological or toxicological effects. Vegetable tanning agents are chemical compounds, just as synthetic products are, and care needs to be taken to ensure that they do not pose any hazard to man or the environment.

Tannins are contained in a wide variety of plants at different concentrations. They are present in foodstuffs such as raspberries, rhubarb, red wine, tea, herbal extracts and cocoa, as well as in the bark of chestnut, mimosa and quebracho trees and in witch hazel and walnut leaves. Their physiological function is still unclear, but they are strongly astringent and it is assumed that their antiseptic action helps to protect the plant.

Plants that are rich in tannins have long been used for medicinal applications, and some tannin extracts can be applied externally or taken internally as a remedy for various inflammatory processes. Plants of this type can also contain substances such as alkaloids, which can severely damage health if they are abused. Quebracho trees, which are a popular source of vegetable tanning agents, contain the alkaloids quebrachine and yohimbine, which can cause diarrhoea and stomach cramps if they are abused.

A knowledge of the toxicology of vegetable tanning agents is essential in order for them to be handled safely and properly.

Vegetable tanning agents also can pose problems from the ecological point of view. One particular problem is the vast amount of raw material that needs to be processed in order for tanning agents to be extracted. The tannin content depends on the species in question and the part of the plant from which tannin is extracted. Quebracho trees grow in the forests of Brazil, Argentina and Paraguay. Trees that are 100 - 200 years old are particularly popular because of their high tannin content. The gradual erosion of tropical rain forests is a serious ecological problem, because trees are not normally systematically replaced when they are felled. Extensive monocultures of mimosa trees have to be planted in order for sufficient raw material to be available to meet the demand for tanning agents extracted from their bark.

The non-tannins or phlobaphenes that are not taken up by the skin also cause a large increase in the COD and suspended solids content of the waste water, and additional effluent treatment is necessary (see Section 1.1.1.).

The advantages and disadvantages of natural leather have to be seen in perspective. There is no single solution, and so attention needs to be paid to optimizing every single stage of

the production process. Combination tannages with mixtures of different tanning agents can offer a viable alternative in some cases.

We at BASF have developed an advanced vegetable tanning process which employs a combination of vegetable tanning agents and syntans. The process takes advantage of the benefits provided by vegetable tanning, such as comfort, compatibility with the skin, high dimensional stability and ease of disposal by dumping, incineration or composting. Combining vegetable tanning agents with syntans enables the amount of vegetable tanning agents to be reduced, which also leads to a large reduction in the COD of the waste water. The leather has a more elastic grain and is paler in colour, which allows it to be dyed to clearer shades. Advanced vegetable tanning makes it possible to produce a wider variety of leathers with shorter, simplified processes. Special polymeric tanning agents can also be used alongside conventional syntans in order to obtain leathers that are water-repellent to a certain extent and resistant to staining by water droplets.

*We at BASF supply a wide range of products for tanning all types of leather. The type of tannage and the products used depend on the requirements that the leather is expected to meet. The scope ranges from classical chrome tanning through to full vegetable tannages, metal-free tannages and combinations.*