

VEGETABLE TANNING; PART 4. TECHNOLOGY.¹

Details of the numerous processes used to make leather have changed considerably since the Industrial Revolution; based on increased knowledge of the science involved, and the application of advanced technologies. For example:

- machines to flesh more than 100 hides (or 400 skins) per hour; rather than a handful manually,
- high activity, biodegradable biocides for short-term preservation; rather than large quantities of intractable salt, and
- high activity biodegradable enzymes for improved soaking (dehairing, bating, etc.).

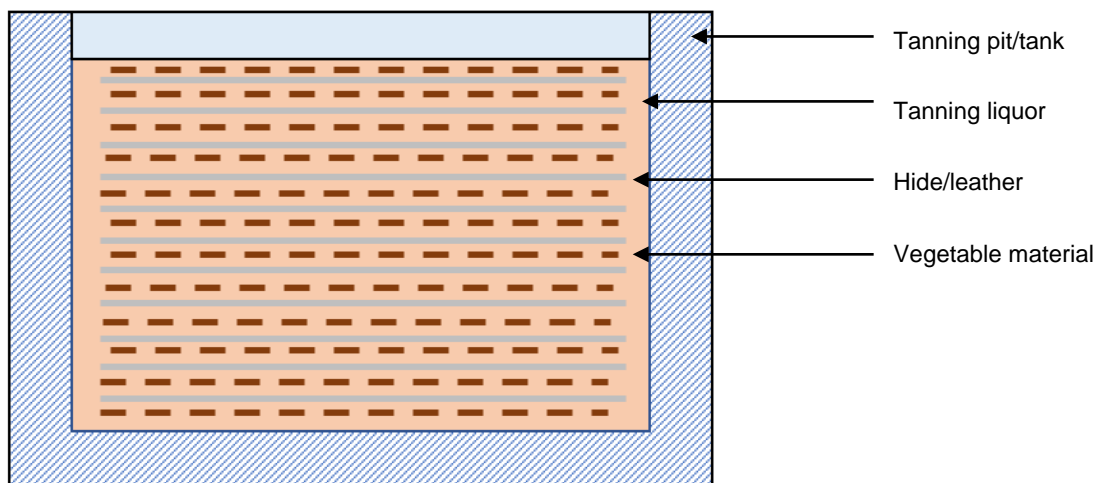
Despite such developments, the sequence of processes has remained largely unchanged, as has the particular purpose of each process.

Overall, the main incentives for improvements in the constituent leather-making processes have included:

- faster processing,
- increased effectiveness and efficiency (in use of raw materials, chemicals, energy, labour, etc.),
- nature of consumer demand,
- stricter environmental regulations,
- increased attention to governance, ethics, societal changes, contributions to circular economy, sustainability, etc.

Examples of related innovations are to be found in all the constituent leather making processes, but especially in the core process of the chemical combination between the collagen protein of hides and skins and the vegetable tannin.

Historically, the first occurrence of tanning was probably the fortuitous combination of a discarded hide (or skin) in a puddle of water containing debris from surrounding vegetation. This is assumed to have quickly developed into hides or skins being deliberately laid – intermixed with layers of selected bark, for example - within a purpose-built pit, topped up with water. Over a protracted period of time, the tannins would slowly diffuse out of the vegetable material and into the hide or skin.



Simplified transverse section of a (static) layered tanning pit/tank.

In the absence of high concentrations of tannin and without supplementary agitation and heating, the process was inevitably slow and is no longer used. However, a somewhat similar technique, using ground (grated) vegetation, and some amount of agitation, is still practiced in small-scale artisanal

¹ 'Vegetable Tanning; Part 4. Technology' is the fourth of a series of brief articles describing some basic aspects of vegetable tanning; and was preceded by the 'Introduction', 'History' and 'Science'. A final article will concentrate on current developments related to vegetable tanning. More detailed information on all topics (including theory and practice) will be provided during inputs to training planned for later in 2022.



Traditional (artisanal) pit tanning of cattle hides in Sudan.

operations, in certain countries. Though easily dismissed as crude and dirty, such artisanal processes illustrate the sort of innovation sometimes required at a local level, to make use of readily available material and techniques; required to supply nearby demands for everyday leather products (such as footwear).

Another example of innovation in (traditional) vegetable tanning techniques is the use of '*bag tanning*'. Here, the problem of making or acquiring a suitable vessel in which to complete the tanning, was overcome by using the hide itself (less often a skin) as the container. This is accomplished by stitching the pre-processed hide (soaked, limed, delimed, etc.) to form a crude bag, so that tanning liquor can be inserted, and retained with limited leakage. The process is not so widespread, but like traditional pit tanning, is still practiced in some countries on a small scale.



Bag (vegetable) tanning in Pakistan (Leach, 1995).

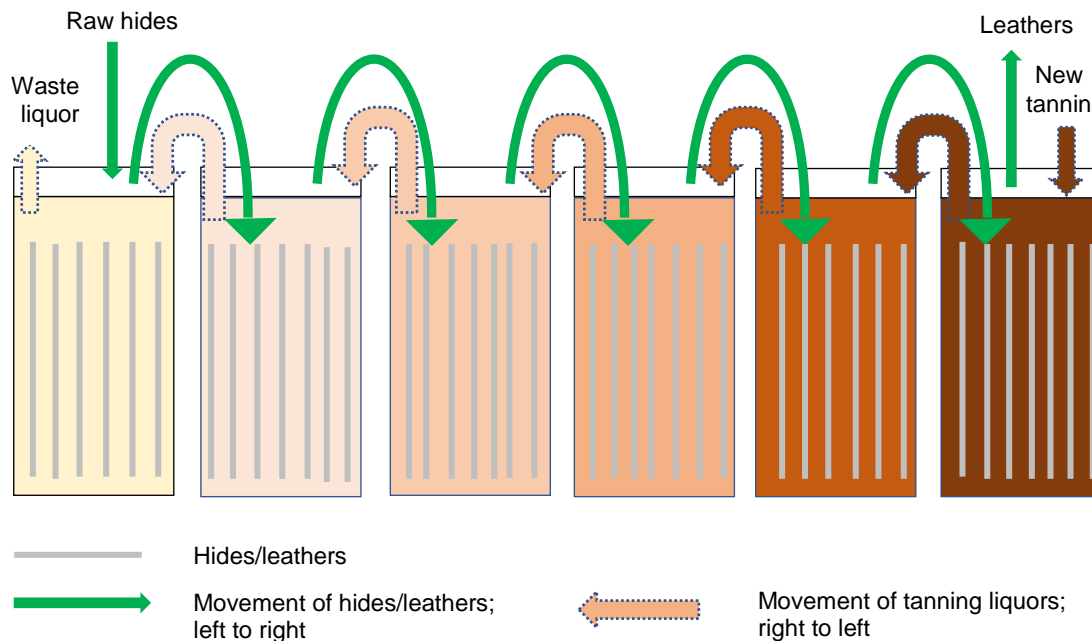
Currently, the (commercial) vegetable tanning process is most often undertaken by:

- suspension in pits (or tanks), or
- use of drums (or opened ended processors).

In modern pit tanning, hides are suspended vertically in a series of tanks, containing large excesses of increasingly concentrated liquor (the '*float*'). The concentration of tannin in the first tank is low enough to avoid case hardening, but high enough to start the process of diffusion of tannins into the hide. Ultimately, after progressing through all the tanks and being removed from the last (most concentrated) tannin liquor, the leather is ready for finishing. At least 20 or 30 hides may be processed in each of the 10 to 15 tanks, for up to a week or more, so the whole process can easily take a couple of months to complete. To promote the diffusion of tannin into the dermis, the suspended hides may be agitated manually each day (or continuously with a mechanical rocker system). For similar reasons, the contents of the tanks may be heated as well. Depletion of tannin throughout the systems (from the liquor surrounding the hides), is offset by additions of concentrated liquor into the end tank; accompanied by overflow (backwards – pit-by-pit - to the start of the series of tanks). Ultimately, as the hides are moved through the pits/tanks, a small portion of the used liquor in the first tank is discarded.

In practice, because of the large size of hides (typically 2.5m square) it is more common to process them as '*sides*' (produced by cutting a hide along the backbone). Moreover, because of the variations in thickness, density of collagen fibres, etc. across a hide, it is common to remove the shoulder and

bellies and process different parts of a hide separately. This sorting and separation contributes to improved consistency in the tanning process (and elsewhere in other stages of leathermaking).



Schema of the counter current vegetable tanning process.

Once established, the counter current pit tanning system usually settles into an almost permanent operation; containing many hundreds of hides, but with smaller (manageable) numbers of new raw materials entering every few days, and a similar number of finished leathers being removed. Subject to regular monitoring and control, the levels of tannins, acids, pH, salts, etc. remain relatively constant throughout the system and only regular, low level maintenance (removal of debris, dirt, etc) is required.

Despite the utility and popularity of the counter current pit tanning system, it does suffer from three obvious disadvantages:

- requires a lot of space,
- is time-consuming, and
- ties up a lot of material as 'work-in-progress'.

These are largely avoided in an alternative method; using drums or 'processors' (cement mixer-like machines). These provide scope for more intensive agitation and heating (to promote the diffusion process) albeit at the risk of damage to the hides and leathers if not carefully monitored and controlled. Drums and processors – with appropriate precautions – can provide for completion of the tanning process within hours.

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10 August, 2022.

Leach, I.B. Hides and skins for the tanning industry. FAO. 1995. 153 pages.