



In Parts 1 and 2 of this three-part series, detailed guidelines for the successful soaking and unhairing/liming of bovine hides were presented. These covered the different requirements of fresh, salted and dried hides, with close focus on the properties of the auxiliaries used, and the good working practices that should be taken into account in these formative stages of leather manufacture.

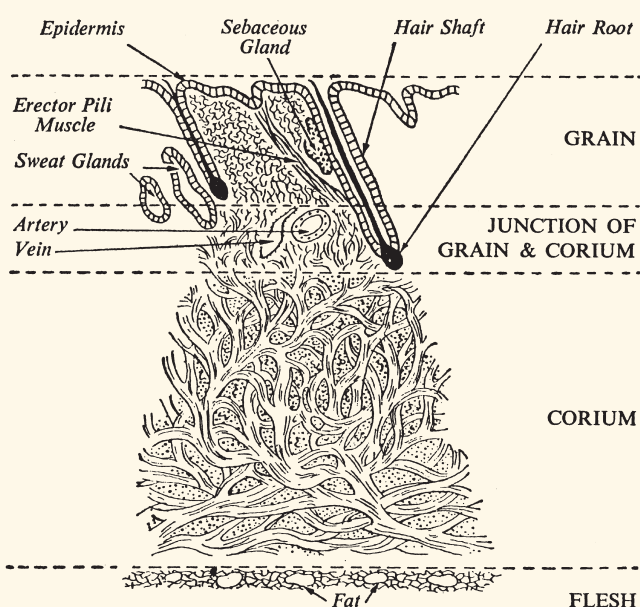
The soaking, unhairing and liming process

Part 3 of 3:

Managing the process formulation

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Panel 1: Cross section of skin⁽²⁾



Details have been given regarding the needs of the soaking, unhairing and liming process. This takes into account the different requirements of hides that result from various types of preservation.

But there is a problem in practical manufacture. Not only are these initial steps in leather-making the foundation of good quality leather, but the appearance of hides and skins after unhairing and liming is difficult to relate with the final leather. Many of the fine details that are central to the judgement of quality in the

finished leather can never be recognised at this early stage.

Another difficulty to the practical tanner is that although the fundamental chemistry of this key stage is well documented, there is little guidance to the way that the process should be managed to create the best results in terms of leather quality. That is, to ensure a fine smooth grain, a lack of wrinkles, minimisation of growth and draw, and a relaxed structure.

Insight into the way that the process is managed is given in the following hair-burn and hair-save process formulations.

These are not just guideline processes, but show the basic reasoning behind each step in this area of leather manufacture that is so often poorly understood in terms of both outcome and practical management.

It is recommended that the details presented in Parts 1 and 2 (*World Leather* November 2006 and April 2007) be taken into account when considering the following information. It should also be noted that although the following guideline processes are based on wet salted hides in good condition, the principles are good for many types of leather. ►



The hair-burn system

PHASE 1: THE DIRT SOAK

Add: 150% Water to provide a bath temperature of 26°C.

Add: 0.1-0.2% Bactericide
0.1-0.2% Non-ionic wetting agent
0.3-0.5% Soda Ash

Total running time 2 hours.

Drain well to reduce the dirt carried over to the main soak.

- It is preferred at this stage to green flesh. The hides should be flexible, but sufficiently firm to enable clean removal of the flesh. Unfortunately, because of contamination of the hides by dung, (a common occurrence in animals that spend winters inside) the practices of green fleshing have fallen out of favour in recent years. Where it is possible, this practice still offers considerable advantages.
- The quality of curing has deteriorated as the delay between kill and cure has lengthened, forcing the use of a bactericide in the soaking. The quantity used will depend on the condition of the hides.
- In cold climates, it is often necessary to have two warm floats to ensure that the temperature of the bath reaches 26°C. In this case the chemicals should only be added after the bath has reached the required temperature.
- For soaking we should aim for pH 9.5-10. Soda ash will help to achieve this level but the quantities used can vary, mainly due to the effect of dung which can lower the pH considerably. It is normal that the dirt soak will finish with a lower pH, but is corrected in the main soak.

PHASE 2: THE MAIN SOAK

Add: 150% Water to provide a bath temperature of 26°C

Add: 0.2-0.5% Soaking enzyme.
0.1-0.2% Non-ionic wetting agent.
0.3-0.5% Soda Ash

Total running time 3 hours.

Drain well to reduce the dirt carried over to the lime bath.

- Soaking enzymes can vary in active substance, so the amount used will depend on the manufacturer's recommendations. The enzymes used in soaking help to remove the soluble proteins and encourage re-hydration of the hide fibre, thus assisting the penetration of the unhairing/liming chemicals. The non-ionic wetting agent will assist the penetration rate.
- Soda Ash is used to achieve pH 9.5-10, the optimal for the activity of the enzyme. This increase in pH will also minimise the pH jump experienced in liming.

PHASE 3: THE UNHAIRING/LIMING PROCESS

Add: 40-60% Water to provide a bath temperature of 26°C

Add: 0.5-0.8% Unhairing/liming agent containing Thiols.

0.3-0.4% Sodium Hydrosulfide
0.1% Non-ionic wetting agent.
Total running time 90 minutes.

- The amount of float added will depend on the efficiency of the drainage after main soak.
- The float level is judged by filling the drum to a pre-designated volume. This ensures the chemical concentration is standard from day to day. Float levels will effect not only the mechanical action, but also the rate of penetration of the chemicals into the leather.
- A working temperature of 26°C is preferred as this gives the advantage of a warm liming, but also a safe working temperature.
- The non-ionic wetting agent will assist the penetration of the unhairing/liming agent to the hair root area where it can begin to hydrolyse the keratin of the hair sheath and root.
- The unhairing/liming agents based on Thiols are sulfide-free and normally contain 20% active substance.
- The time that is required is dependent on the penetration of the unhairing/liming agent to the hair root.
- The hair will not be removed at this stage as the liquor will still be low (pH 9.5-10)

PHASE 4: FIRST ALKALI ADDITION

Add: 1.5% Lime

Total running time 20 minutes.

- The addition of part of the total lime offer at this point in the process helps to produce a smoother grain and less belly draw, when compared with making a single lime offer as part of the Main Alkali Addition (Phase-5).
- This technique stems from the hair-saving system (HSS), where an offer of lime alone is made (see HSS Phase-4) before loosening the hair (see HSS Phase-5) and opening up of the hide structure (see HSS Phase-6). This results in a smooth grain and minimum belly draw, which are better in comparison than the conventional hair-burn liming process. The addition of 1.5% lime into the hair-burn system in this manner is a means of creating the conditions and benefits of the hair-saving process.
- It is noted that the running time in lime is reduced (20 mins) when compared with the hair-save process (60 mins) as there is no need to immunise the hair.

PHASE 5: THE MAIN ALKALI ADDITION

Add: 1.0-1.5% Sodium sulfide.
1.5% Lime
Total running time 90-180 mins.

- Because of the pre-conditioning of the hair roots by the Thiols and Sodium Hydrosulfide, the hair and epidermis are removed very quickly. The hair will break down and be removed in the lime wash (Phase-7).
- After an initial 60 minutes running, the hides can be run intermittently until penetration is complete.

- The total time in this phase should be enough to ensure penetration of the alkali into the middle of the hide; this can be controlled by checking a cut section with an indicator, particularly the thicker neck parts.
- At the end of this phase, the hides should be clean but flaccid, with no remaining hair or epidermis.

PHASE 6: CONTROLLED SWELLING WITHIN THE LIMING PROCESS

Add: 50-60% Water at 26°C to cover the hides.

Total running time 30 minutes to mix well, followed by 10 hours automatic running (10-minute run followed by 50 minutes rest).

- The lime bath is lengthened to induce water into the hide structure by osmotic swelling. The initial low-float treatment in Phase-5 will have ensured that the alkali is fully penetrated throughout the structure, but without causing swelling. Attention to this important detail in technique encourages a controlled and uniform swelling. This ensures a minimum distortion of the grain throughout the full hide structure.
- The float is increased by filling the vessel to a designated level, usually to the axle on a drum. The hides must be covered with float.
- A check after the first 30-minute run is important so that float adjustments can be made before the automatic run over night.
- The running time at this stage should be at a slower speed to prevent accentuating any drawn grain.
- The time allocated for this phase is based on a 24-hour production cycle, starting with the dirt soak.
- The actual process time must be 22 hours, as 2 hours are needed to drop and reload the next load.

PHASE 7: CONTROLLED WASHING

Drain the liming bath

Add: 150% Water at 26°C

Run 15 minutes

Drain again

Add: 150% water at 26°C

Add: 0.5% lime

Total running time 15 minutes.

Drop for fleshing when machine is ready.

- It is important that the hides are not over-washed. The second wash float containing lime will help to minimise any osmotic swelling that results from the difference in concentration between the float and the hide structure. Swelling at this stage will accentuate growth, draw, and belly wrinkles, increasing the entrapment of dirt/scud within the grain.
- It is also important that the hides are not unloaded before they are able to be fleshed, as limed hides are susceptible to lime-blast (formation of calcium carbonate in the grain) if left in contact with air for any amount of time before deliming.



The hair-save system

The hair-saving process is similar to the hair-burn process, but modified, mainly in order to immunise the hair.

When using hair-saving processes, the liming vessel must be fitted with a float recycling system. This is so that a filter can be added to remove the hair, and then return the filtered liquor back to the drum. There are many types of filter available on the market, the best having small reservoirs to minimise the reduction of float in the liming vessel during filtering.

It is noted that float recycling systems are available on most liming drums these days. This is because the constant movement and distribution of the liming liquors caused by recirculation makes the liming more efficient, so fewer chemicals are needed.

QUALITY ADVANTAGES OF THE HAIR-SAVE SYSTEM

The hair-save liming process is based on the impregnation of the basal-layer of the epidermis, the hair roots, and most of the entire hair shaft. A chemical attack on these soft types of keratin must be carried out without the use of strong reduction chemicals such as sodium sulfide, in order to avoid swelling at this early stage.

The environmental advantages of hair-saving systems are well documented. But there are significant advantages in terms of leather quality:

- Hair-save systems are noticeably flatter, with significant reduction in belly draw, when compared with conventional liming.
- The colour of the limed hides is also cleaner. The hair immunisation prevents the release of pigmentation from complete hair disintegration, that occurs in the hair-burn process.

PHASE 1 and PHASE 2: THE DIRT and MAIN SOAK

These soaks are carried out as set down for the hair-burn system.

PHASE 3: CONTROLLING THE IMMUNISATION OF THE HAIR

Add: 50-60% Water to provide a bath temperature of 26°C.
 Add: 0.5-0.8% Liming agent containing Thiols (such as Mercaptoethanol)
 0.1-0.2% Sodium Hydrosulfide flakes.
 0.1% Non-ionic wetting agent.
 Total running time 90 minutes.

- The offer of Sodium Hydrosulfide is a safety factor. It will stop the hair from complete immunisation should there be a power/equipment breakdown during processing.

PHASE 4: IMMUNISING THE HAIR SHAFT

Add: 1.5% Lime powder
 Total running time 60 minutes

- By adding lime we obtain immunisation of the external part of the hair shaft.
- The total running time can be continuous or partly stationary.
- This Phase also helps to produce a very smooth grain and minimum belly draw (Reference: comments Hair-Burn system Phase-4)

PHASE 5: LOOSENING THE HAIR

Add: 1.0-1.5% Sodium Sulfide
 Total running time 30-40 mins

- The increase in pH from the sulfide addition will further hydrolyse the hair roots, causing the hair to loosen and fall out. This is assisted by the mechanical action.
- Because of the hair immunisation in Phase-3, the hair will be more or less intact.

PHASE 6: FILTRATION OF THE HAIR FROM THE FLOAT

Add: 20% Water at 26°C if required.
 Add: 0.1% Non-ionic wetting agent
 Total filter time 60-90 minutes.

- Filters are frequently shared between two or more drums or vessels, thus restricting the amount of time for each process. After 90 minutes most of the hair has been removed, with the commonly used systems.
- The addition of a non-ionic wetting agent before filtering starts will reduce the chemicals sticking to the grease on the hair. This avoids chemical loss from the system during filtering.
- The extra water offered at this stage is to compensate for the amount that will be in the recycling and filtering system. This ensures the float in the liming vessel is not reduced during hair removal, as well as assisting the filter action.

PHASE 7: OPENING UP THE HIDE STRUCTURE

Add: Water at 26°C - to the full float level.
 Add: 0.2-0.4% Sodium Sulfide
 1.5% Lime powder.
 Running time 60-90 minutes.
 Then automatic, 10 minutes every hour over night
 Total time 10 hours.

- The lengthening of the float, together with the additional lime and sulfide, will obtain the required structural opening up of the hide as well as eliminating any residual hair. This can be compared with the hair-burn system Phase-6, where a gentle and controlled swelling of the hide structure is used to avoid distortion of the grain and hide structure.

PHASE 8: CONTROLLED WASHING

Drain liming float.
 Add: Maximum float at 25°C
 Run 15 mins and drain.
 Add: Maximum float at 25°C
 Add: 0.5% Lime powder
 Run 15 mins.
 Drop when fleshing machine is ready.

- Process comments as Phase-7 hair-save process.

Legend

1) John Basford has worked in the tanning industry for more than 50 years, first as a tanner, but mostly as a technician for a chemical company. He has travelled and worked extensively in numerous regions of the world,

and has substantial beamhouse experience on many different raw materials.

2) Image courtesy 'Leather Technicians Handbook', J.H.Sharphouse. 