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Leather:
AN OVERVIEW OF MANUFACTURE
(Part 7)
Small skins: wool bearing sheep
double face (two face), shearlings, and rugs

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Content and Structure:

This section includes a summary of hides and skins as raw materials.

Part 1: The removal of unwanted materials and extension of the structure.
Part 2: The introduction of new materials and extension of the structure.
Part 3: The removal of water and reconfiguration to a flat form.
Part 4: Application of the finish.
Part 5: Different types of bovine leathers.
Part 6: Small skins: hair sheep and goat: grain leathers.
Part 7: Small skins: wool bearing sheep: double face, shearling and rugs.
Part 8: Discussion.

Annex.

The manufacture of wool skin leathers

For the manufacture of two face *(or double face*) leathers, shearlings and rugs, the following matters need taking into account:

1] Skin collection, preservation and supply.

2] Structural differences.

3] Technical issues.

4] Value.

1] Skin collection, preservation and supply

Wool sheep originate often from large scale enterprise, with more centralised slaughter and preservation than hair sheep and goat.

Slaughter is not influenced by tradition to the same degree as hair sheep and goat, nevertheless, there are times of surplus and shortage, and this affects availability and supply.

The methods of preservation are mostly wet salting or dry salting, with global sales and movement.

There are frequently long storage times before manufacture.

2] Structural differences

These sheep have been bred for wool and meat. The fleeces are considerably greater in weight and volume than the coarse hair found on hair sheep and goat.

Accordingly, the skin structure is different too. It is thick, but relatively delicate, and may have a fat content of around 20% on the raw skin weight.

This influences the way that the leather is made. The skins are weaker and can be more easily torn in processing. There are more voids too, especially after the removal of fat held within the structure.

Over and above the importance of the skin structure, the predominant factor is the considerable quantity of wool when leather processing compared to the skin weight.

This wool is of high value, and can easily become matted or felted.

3] Technical issues

In manufacture, to reduce the stress on the skins and to reduce the problems of felting, it is essential to use very high floats when compared to other types of leather manufacture. The floats used may be as high as 500% as opposed to 50 – 150% for most other leather types.

The unhairing process is omitted too, with an absence of any high alkali treatment to avoid coarsening of the wool texture. As a consequence, there is no alkali swelling of the skin, or solubilisation of unstructured proteins as achieved in liming. Alternative techniques are needed to soften and extend the collagen structure.

In addition, the release of natural fats is hindered as the fat cells remain more intact. Other techniques have to be used as the natural fat content can be considerable.

The machinery employed is often suited to small skin grain leathers, but there is a need for specialised equipment to address the wool component. In addition, paddles and small skin processors operating at high float levels are required in the place of conventional drums.

4] Value

The major issue is to retain the quality of the wool, and avoid any wool slip. The value of the recovered wool after sheared to a specific length, is very significant.

The structure of wool-bearing sheep

Mixed flock of goat and hair sheep.

Wool-bearing sheep.

- There are clear differences between hair sheep and wool-bearing sheep.
- This is due to selective breeding, animal husbandry, feed, and the environment.
- Hair sheep are bred for milk and meat, with a structure more similar to goat skins.
- Wool-bearing breeds are bred with focus on the wool value and meat.
- The weight of the wool has a significant effect on the skin structure.

Section of leather from hair sheep.

Section of leather from wool- bearing sheep showing delamination.

- The structure of hair sheep skin is very dense when compared to a typical wool-bearing example.
- Due to the weight of the wool carried by the sheep, and a high fat content, the structure is weak.
- Much of the fat is carried at the junction between the grain layer and the corium.
- Too much stress in manufacture, or over-opening of the structure can readily cause delamination.

(Sections shown from final leathers - detail clearer than examples from raw skin)

Wool sheep skins leathers

The manufacture of three types of wool skins are described:

1] Two-face (double face), that is, high quality wool bearing, with a suede flesh side, used for footwear and various types of clothing.

2] Shearlings, generally lower quality and used for linings and industrial purposes.

3] Rugs.

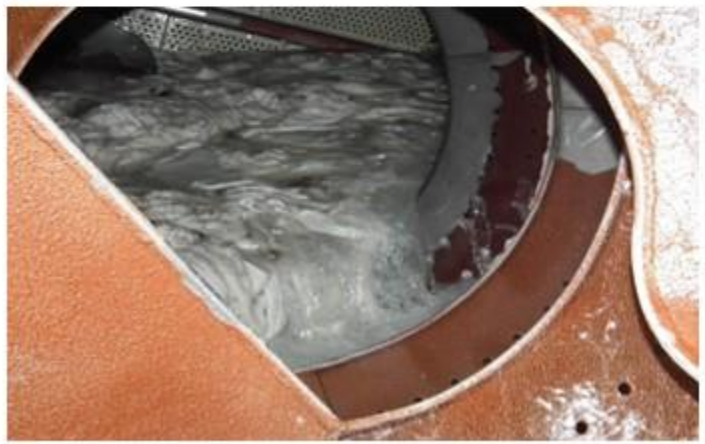
Much of the processing is similar in the initial stages, but with variations after pickle and tannage to the final state according the end use.

Success is dependent upon the detail of processing. In particular, care is needed to avoid wool tangling/matting, and within both wool and leather dyeings.

1] The manufacture of two face (double face) sheepskins

Gentle action of rotating paddles blades maintain skins in suspension.

Processors: greater mechanical action, but various loadings possible.



- To avoid wool matting, and to minimise stress on the skin, mechanical action through wet chemical processing is minimal.
- This means extensive use of paddles.
- These operate at very high float levels when compared to drums, and operate at a fixed volume.
- Processors of various construction are used too, where different loadings of skins and high floats can be managed safely.

Raw materials

Long wool sheep, wet salted from sub-artic region of Europe.

Dry salted sheep from China being tumbled to remove surplus salt.

- To off-set fluctuations in annual supply, large raw stocks are commonly held by tanners.
- The different species and environments produce different wool types and skin size.
- Sorting and grading is key for end-use. Often double face, shearlings, rugs and nappa are produced within the same tannery.
- Trimming is essential to avoid skin tangling and resultant wool matting.

Soaking and first time fleshing

High rate water feeds are required where high floats are used.

Removal of flesh and fat on first time fleshing of sheepskins.

- The objective of the first soak is to remove dirt from the wool and partially rehydrate the skin structure.
- The soaking time varies according to the preservation method.
- The skins do not need to be fully soaked, as some firmness is needed to improve the cutting action on first time fleshing.
- A considerable amount of fat can be removed at this fleshing stage.

Wool washing (scouring)

Discharged of wool skins following a processor based scouring process.

Centrifuge for removal of water from the wool and skin.

- After fleshing, the skins are lightly scoured to remove dirt and grease from the wool.
- The process uses a blend of wetting agents and sodium carbonate to adjust the pH to mildly alkali conditions.
- It may be that enzymes are used within this processing.
- Spin drying is mainly used to de-water and avoid any compression.
- In preparation for wool shearing, a mechanical combing may be used to free tangles and debris from the wool.

Feed to the shearing machine fitted with a mesh conveyor belt.

Wool skin following shearing of the butt area.

- The wool is then sheared to a uniform length.
- This is slightly longer than the final length, as accuracy is only possible when dry.
- On machine offer, the skin is held firmly to the mesh conveyor belt by vacuum.
- At the time of cutting, the wool is raised and extended by suction.

Hand shearing around the skin after mechanical shearing.

Exceptionally clean/extended flesh layer from second time fleshing.

- The wool around the skin edge is held flat to the belt by the vacuum during shearing, and remains largely uncut.
- This surplus is removed to length by hand shearing.
- With the wool at a uniform length, a very effective second time fleshing is possible.
- This provides a very clean flesh part, and more grease removal.
- The heavy mechanical action also extends the skin.
- Without the benefit of softening from liming, extension is a key part of skin softening.

Chemical offers are based on float concentrations not skin weight.

Drainings from pickle stacking are mostly collected for reuse *(recycling)*.

- The pickle process can be preceded by a bating stage.
- A sulfuric/formic/salt pickle is generally used, but other organic acids may replace formic acid.
- Once complete, the skins may be stacked down for several days to drain, thus avoiding compression of the wool and structure.
- This laying period allows some acid breakdown *(hydrolysis)* of the collagen structure too.
- The resultant softening is influenced by temperature, time and choice of organic acid.
- This part-compensates for the lack of a liming process.

Reloading paddles on completion of laying period after pickle.

After degreasing, the skins are tanned, then stacked to drain.

- A degreasing process is required after pickle and before tanning.
- There are several options according to grease content.
- For skins with low grease content, a de-acidification to neutral pH, followed by emulsification with wetting agent may suffice.
- A more usual technique is to raise the shrinkage temperature by a light pre-tan, often with a modified form of glutaraldehyde.
- The temperature can then be raised to soften/melt the grease, coupled with emulsification by wetting agent.
- This grease removal is enhanced by the extended laying period after pickle.

Wet wheeling: reliant upon grit size and pressure applied by the operative.

Retannage and fatliquoring using either paddles or processing vessels.

- Once tanned, dewatering by draining or a light samm/setting.
- The flesh side is then wet wheeled.
- This operation abrades flesh residues from the shank and belly parts, and cleans the flesh side.
- It is part of making a uniform surface across the flesh part.
- It also causes a stretching and softening of the structure.
- On retannage, the focus is to develop a fine and consistent flesh structure suitable for level dyeings.
- The choice of fatliquors must favour a retention within the structure throughout a subsequent dry cleaning operation.

Skins may be spin dried in preparation for 1st time drying operations.

Setting is used to extend the skins without causing fibre compression.

- After retanning and fatliquoring the skins are washed and stacked to drain.
- This may be followed by centrifuging to part dewater the wool and pelt.
- They may then be lightly set on the flesh side to extend the skin in preparation for drying.

Tension free suspension drying for maximum softening.

Spray conditioning in preparation for mechanical operations.

- Once set, the skins can be suspension dried.
- This usually by free hanging using a conventional horizontal pole system.
- Alternatively, cabinets with the advantage of controlled temperature and RH.
- The drying is usually to around 12% moisture content.
- After a laying period, the skins are lightly conditioned by water spray.

Example of a ridged setting cylinder arrangement used for softening.

Top left: wool before shearing, lower left: wool after shearing.

- Staking is mainly based on cylinder arrangements that on rotation extend and apply a setting action to the flesh parts.
- There are many different machine configurations.
- The wool may then be sheared to a more precise length in preparations for ironing and straightening.

Cylinder of a small combined combing and ironing machine.

Wool before and after a combined combing and ironing.

- The wool is combed and ironed at raised temperature.
- This can include a wool straightening stage.
- This commences with a acid/alcohol spray to soften the wool, then extension by hot ironing.
- The spray may be incorporated within the ironing operation.

Industrial dry cleaning equipment used for grease removal.

Several buffings may be needed to form a high quality suede structure.

- The wool may then be re-sheared to create a very precise length.
- This may be followed by a dry cleaning using perchlorethylene to remove residual natural grease.
- Performed at raised temperature, the skins need a low moisture content to avoid shrinkage.
- Solvents are recovered for reuse.
- Recovered grease may be sold or used as boiler fuel.
- The skins are then lightly conditioned before buffing.
- Buffing is a particularly important to develop a clean and uniform nap in preparation for dyeing.

Paddle dyeing well open and free-flowing wool sheep skins.

Wool and suede may also be dyed in colour combinations.

- Dyeing is performed in paddles or processors using high floats.
- The uptake and development of colour is strongly influenced by previous processes.
- The wool is dyed first, using dyestuffs that favours wool fixation instead of the sueded side.
- The leather is then dyed to shade.
- It is also possible to dye the leather with the wool remaining undyed.
- These dyeings are more complex than either wool dyeing or leather dyeing alone.
- Risks of cross-uptake of the dyestuffs need taking into close account.

Setting and toggling produces a flat and firmer structure.

A light toggling may be used after hang drying to flatten and extend.

- Dependant upon the degree of softness required, after draining, the skins may be set, then toggle dried.
- For the softest result, they may be drained (or centrifuged) then hang or suspension dried.
- These operations are followed by conditioning, and restaking.
- The wool may receive a final iron, shear, and re-polish.
- If the skins have been suspension dried then a light toggling to shape.
- Many combinations of technique are possible.

Classic double face: a combination of fine wool and suede dyeings.

Aniline type finish on wool skin – an alternative to suede.

- This may complete processing for double face - a high quality wool skin, combined with a fine suede leather.
- However, the suede side may be finished.
- It can involve sealing the sueded surface then creating a light aniline type finish.
- It may be that transfers, or ultra fine laminations are used to create effects.

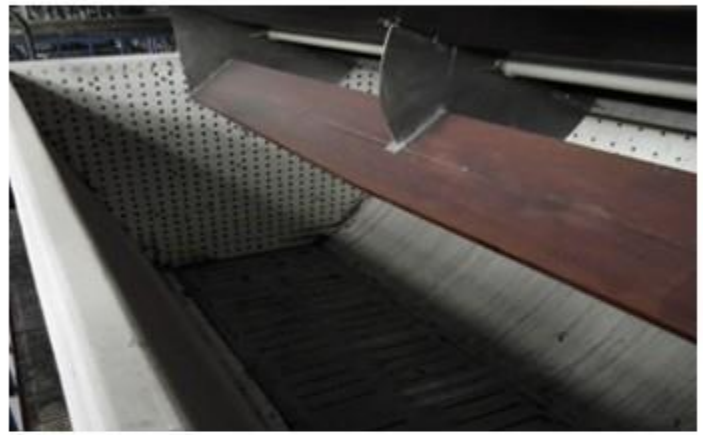
2] The manufacture of shearlings

Many selections for skin and wool quality crucial to maximise potential.

Focus for mechanical softening on the flesh side.

- Manufacture follows the same basic processing as double face to the retanning and fatliquoring processes.
- However, at the time of tannage there may be high additions of stable fatliquor.
- A clean flesh side is needed, but there is not the high emphasis as required for a fine suede surface.
- If the wool and leather structures require a natural appearance, preparations for the most pristine dyeings are not needed.
- In this situation, these wool skins are not wet back after drying or subject to further chemical processing.
- Post drying operations vary according to end use.

Paddles may be fitted with false interiors to facilitate drainage.



Interiors may elevate and tilt to assist unloading after drainage.

- As with double face, care and attention is needed to maintain the wool in the optimum state.
- In tannage, retan and fatliquoring, the floats are very high.
- These processes can therefore be chemically inefficient, however, there is considerable scope for chemical and water savings.
- With standard tanning processes - especially natural *(undyed)* processing - recycling can be very viable.
- On discharge floats can be collected, screened, and made up to concentration for re-use.
- There are many options to save chemicals, water, and energy.

3] The manufacture of rugs

Undyed aldehyde/aluminium and chrome tanned woolskins.

Continuous attention to eliminate tangling and enhance appearance.

For the most basic processing:

- The wool may be left unsheared.
- There may be an extended lay period in the pickled state *(considerable variations: 3 -10 days)* to develop softening.
- Chrome, aldehyde/aluminium combinations and veg tannages are used to create leathers with "natural" appearance.
- Heavy reliance upon a combined tanning and fatliquoring process.
- On small scale, a hand application of fatliquor on the flesh parts may take place after tannage.
- Longer laying periods for draining are used to avoid mechanical action.

Final care and attention to detail.

Many different types of wool textures and effects.

- **Extensive wheeling is reduced: a clean flesh is needed, but not fineness to the extent of double face and shearlings.**
- **Post drying operations are less intensive that for double face.**

For the highest value products:

- **Most of the elements of double face manufacture are included.**
- **May involve special wool dyeing effects, with high focus on the wool structure after drying.**
- **Wool textures can be developed in finishing for ultra smoothness, sheen and silkiness to touch.**

The value of wool

Recovered wool - washed, drained, dried and graded for sale.

Wool recovery is essential at both cottage and major scale.

- Attention to the quality and value of wool is central to success in wool skin manufacture.
- And the requirements for fine wool processing are not always the best for leather manufacture.
- Also, the properties of the raw skin are a consequence of a requirement for wool.
- These factors create limitations for making these often conflicting combinations work.
- When sheared or removed intact in leather processing, wool recovery is essential.
- Wool is a major component in the viability of wool-bearing sheep skin manufacture.

Review

Although the most basic leather-making stages are comparable, the manufacturing finesse required by small skins differs strongly from the needs of bovine hides.

The equipment required for skins is smaller and lighter, often with specialised purpose. Chemical applications are different too, and a higher level of individual attention is demanded by the smaller pieces.

Mechanical actions, chemical processes and handling reflect the differences in structure and end-use.

There is also variation in raw material supplies in terms of volume and quality that is not experienced in bovine manufacture.

There are quite different objectives within small skin manufacture too:

- For grain leather manufacture, the aesthetic value of the grain layer is of main concern. The tightness and break characteristics, a defect free grain, and levelness of appearance and colour.
- For wool skins, the focus is to develop the wool characteristics to specification. The leather needs to be soft and tactile, but with emphasis on the flesh part as opposed to the grain. The appearance and handle of the flesh part – either suede or supporting a finish - must complement the appearance and texture of the wool.

There are five issues in particular when comparing the processing of wool bearing sheep skins to hair sheep:

- **The structure is comparatively weak.**
- **There is a high grease content that must be removed.**
- **The wool must be retained intact.**
- **High alkali treatment – such as liming – must be avoided, although the leather must be soft.**
- **The requirements for wool processing are often detrimental to good leather making.**

To address these needs there is a need for:

- Use of paddles and skin processors operating at a high float, with minimal mechanical action throughout chemical processes.
- A softening of the structure that may involve an extended pickle based on selected organic acids.
- Heavy application of force in machine operations to extend the structure as part of the softening process.
- Aqueous degreasing processes to remove grease from both the wool and skin structure, mainly coupled with solvent degreasing.
- Very specialised dyeings, with different requirements for both the wool and skin.
- A heavy focus on the wool component throughout all operations.

Continues as:

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Discussion

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