Vegetable Tanning of Leather

In India Rural Leather tanning has played prominent role for many centuries since it has benefited rural flayers, footwear and leather product manufacturing by village artisans from the tanned leathers obtained from village tanners. They cater to the day-to-day requirements of farmers and others residing in villages, and small towns. The enterprise helps substantially in the rural economy.

Rural tanners, besides procuring hides and skins from native flayers, used to collect barks, shrubs, and fruits for vegetable tanning either free of cost from nearby forest areas, trees near rivers or ponds or by paying nominal charges to its suppliers and lime was also obtained from local kilns. Thus rural tanning is fully integrated and self-sustainable enterprise.

The system suffered some setbacks as the finished leather used to emit unpleasant odour, and became hard due to incomplete tanning and did not fulfill the needs of sophisticated customers. Moreover, the tools and techniques became old and full of drudgery and forced out many artisans from the profession.

This necessitated development of improved processes for rural tanning through constant endeavors of institutions like Central Leather Research Institute, Chennai and its Regional Extension centers located in different zones of India and many State Government organizations, NGOs and Khadi and Village Industries institutions.

It is worth mentioning that vegetable tanning is eco-friendly, discharging minimum pollutants and waste products such as bark, nuts, fruits which are a good source of organic manure for use in agriculture.

An improved and modified process of rural vegetable tanning developed at Central Leather Research Institute and demonstrated at many rural leather clusters is given below:

**Raw Material**

Locally procured green, semi-dried or salted hides and skins are used for vegetable tanning. Generally, buffalo and cattle hides are processed into tanned leather. Lower grade of hides and skins are preferred and good quality hides are sold to hide and skin traders from cities and towns as they fetch remunerative prices and lower grade hides give good returns after conversion into vegetable tanned leather. Skins of sheep and
Goats are commonly not processed by rural tanners since their demand for manufacturing leather products is not attractive. However, in rural areas around Kolhapur and Sholapur in Maharashtra vegetable tanned goat skins have good demand for making Kolhapuri Chappals.

PROCESS FLOW CHART

Soaking

Des and skins are soaked either in pit of dimensions 6’x4’x4 constructed above the ground with suitable outlet of waste water to an underground drain.

While green (fresh) hides require three to four hours time for soaking but in case of salted hides soaking is carried overnight till hides become soft and pliable. Dried hides in most cases are soaked for 18 to 24 hours depending upon the condition of hides. Prior to commencement of soaking, hides and skins are weighed in order to work out the requirement of chemicals and tanning materials. However, due to any reason if hides are not weighed prior to soaking this should be followed after soaking and draining excess water from hides to record soaked weight as it helps in determining the quantity of chemicals and tanning materials in the subsequent process.

Nearly 500 grams of bleaching powder and 500 grams of washing soda (sodium carbonate powder) may be used for a pack of 10 to 20 dried hides to prevent any putrefication during soaking as increase in time at this juncture leads to bacterial damage. It is better to wash hides in fresh water prior to actual soaking to remove adhering dirt, blood, and other impurities from hides. Sometimes, one more wash is given after first soaking for about to 3 hours so as to ensure sufficient soaking followed by liming. It may be noted that proper soaking and liming determines the quantity of vegetable tanned leathers specially from rural leather clusters.

As far as possible, hides should be flat and quite soft and slightly plumped after soaking.

Liming

Bigger hides are cut into equal half from head to tail along backbone line for ease of processing and handling by local artisans.

The soaked hides or skins are immersed in first pit containing a solution of 200 per cent fresh water and lime powder (calcium hydroxide) and 1 per cent sodium sulphide. The
dimensions of lining pits are same as that of soaking pit. The liming period normally ranges from 6 to 7 days and it can be curtailed by one day depending upon the condition of soaked hides.

Hides are hauled and replaced from first pit also called old liming pit daily two times in the forenoon and evening and hauling outside for about 30 minutes. This hauling and replacing helps in agitating lime liquor and early loosing of layer from grain side and developing mild swelling and plumping. After keeping in the old lime liquor pit hides are unhaired with a curved semi blunt knife to scrap of the hair and epidermal layer from the grain surface. Hides are now taken for reliming.

**Relimming**

**Duration 3 days**

Following ingredients are added to the pit water (sufficient water to keep the hides well immersed in lime solution avoiding any sort of oxidation)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Lime powder</td>
<td>6-8 per cent</td>
</tr>
<tr>
<td>Sodium Sulphide</td>
<td>1 per cent</td>
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<tr>
<td>Caustic Soda (Sodium Hydroxide)</td>
<td>0.5 per cent</td>
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</tbody>
</table>

Similar to old lime liquor, here too hides/skins are hauled twice daily for 3 days. During this period the flesh swells sufficiently and hides are ready for fleshing.

Hides on seventh day morning are lightly rinsed in the fresh water and taken for fleshing.

For efficient and quality production it is preferable that hides now called pelt are fleshed on a wooden beam kept in inclined position. Fleshing is done using a semi curved sharp single edge knife. Some rural tanners prefer to use RAMP for fleshing and carrying out fleshing on a flat big smooth stone slab but it results poor output and causes back pain to artisans due to excessive bending of body.

Rubber gloves must be used during fleshing work to avoid contact of hand and palm with limed pelt containing injurious chemicals like sodium sulphide and caustic soda. After fleshing pelts are scudded on grain side with semi curved blunt knife to remove hair roots, fat, etc.

Fleshed weight of pelts is noted down in order to calculate the quantity of chemicals in subsequent operations.

Fleshed pelts are washed in fresh soft water to remove surface lime, sulphide, scud etc.

**Deliming**

Deliming is carried out in a pit for overnight using following chemicals:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Water</td>
<td>100 per cent</td>
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</table>
Next day pelts are trampled in deliming bath for about one hour with feet to remove the adhered lime.

Completion of deliming can be checked with phenolphthalein solution. Pour few drops of phenolphthalein on cut section of pelt. If it shows a streak of pink colour it indicates that deliming is almost complete. If phenolphthalein is not available then deliming may also be checked with Turmeric powder solution. Pour few drops on cut section of pelt. A streak of pink colour indicates completion of deliming. After deliming pelts are once again scudded with blunt semi curved knife by placing pelt on inclined wooden plank, tree or locally available knot free beam. This is done to remove the remaining scud from the pelt.

Pelts are washed again in fresh soft water and water is drained out for 8th day.

The deliming pelts are transferred one by one to the salt solution made earlier in a pit and kept here for about an hour.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Ammonium sulphate</td>
<td>1 per cent</td>
</tr>
<tr>
<td>Sodium Bisulphite</td>
<td>0.5 per cent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common salt</td>
<td>5 to 6 per cent</td>
</tr>
<tr>
<td>Water</td>
<td>50 to 60 per cent</td>
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</tbody>
</table>

Later diluted sulphuric acid solution prepared earlier is added very slowly to the pit containing salt solution.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Percentage</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Sulphuric Acid</td>
<td>0.5 per cent</td>
<td>Pelts kept in the pit for about 2 hours</td>
</tr>
<tr>
<td>Water</td>
<td>10 per cent</td>
<td></td>
</tr>
</tbody>
</table>

Note: Percentage of chemicals used above are based on pelt weight.

After further handling the pelts in the pit, pH of the cross section of a piece of pelt cut from pelt is checked with the help of pH paper and when pH reaches to 5.5 (Approx). Pretanning is carried out in the same pit so as to facilitate uniform tanning at later stage.

**Pretanning**

1 per cent of pretanning syntan such as Basyntan P of BASF or P vernatan P of colourchem or any suitable pretanning syntan and 10 per cent water.
Syntan is dissolved in water and added in 3 to 4 installments at an interval 30 minutes. After the addition of last installment, pelts are further handled with hand in this pit and left immersed overnight.

Malani

9th Day

Malani which is also called colouring pit is the beginning of first step of prior to bag tanning. In one vegetable tanning pit of dimensions 6’x4’x4’ which is already in use the following materials are added.

Mixture of Babool Bark and crushed myrobalan nuts in the ratio of 3:1.

25 per cent of the above mixture is added to a vegetable tanning pit containing 300 per cent once used tanliquor. This pit is kept ready one day earlier prior to Malani process. The strength of vegetable tan liquor in this pit should be about 15 degree barkometer. The leather is placed one by one in this pit and handled with hands continuously for 3 to 4 hours to avoid any sort of oxidation and development of patches so as to obtain uniform colour on the leathers are well immersed in the pit avoiding air pockets between leathers. It may be noted that in the absence of proper handling in the malani tanning pit chances of patches on grain surface of leather are quite possible.

Leather is kept in the malani first tanning pit for 2 to 3 days depending upon the convenience of vegetable tanning.

12th Day

Bag Tanning: Actual bag tanning consists of two parts. In the first part, the leathers undergone preliminary or partial tanning is stitched using locally available date or palm leaves or sisal fibre or moonj. The bag is stitched from butt region of the leather to neck region. The bag of leather stitched on sides is filled with babool bark and crushed myrobalan nut mixture in ratio of 3:1, leaving a wide opening near the neck region to pour tan liquor. For three days the tan liquor is poured at regular interval in the leather bag placed over a wooden log. The leather bag is suspended from a wooden log or pole kept perpendicular over tanning pit of size 7’x4’x3’ filled with vegetable tan liquor. For three days pouring of vegetable tan liquor is continued avoiding exposure to direct sunlight. By this time the completion of tanning in thickest portion of butt region is checked by knocking with hand giving typical sound.

15th Day

On 15th day the bag is lifted and removed from the wooden pole kept on the base of bag tanning pit on a used gunny bag and neck side opening is stitched with palm or date leaves or moonj and a wide opening is made with the help of sharp steel knife on the base or tip of the butt portion for filling with tan liquor. The leather bag is again hanged
on the wooden pole kept over bag tanning pit and tan liquor pouring is continued for 2 days to complete the vegetable tanning in the neck region. After ensuring complete vegetable tanning the bag is removed from the wooden pole cut open to remove tanning materials filled on the flesh side of leather. The used bark is transferred to the bag tanning pit to extract remaining tannin content.

The bag tanned leather is lightly rinsed in the tan liquor available in the bag pit.

17th Day

If necessary bag tanned leather may be bleached to remove any undesirable stains on grain side and further improve the colour into light cream colour with the following chemicals.

<table>
<thead>
<tr>
<th>Sodium Bisulphite</th>
<th>1 per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>20 per cent</td>
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</table>

Applied with a used gunny cloth or salt goat hair brush on grain side and kept in this condition for 30 minutes.

Next apply solution of:

<table>
<thead>
<tr>
<th>Oxalic Acid</th>
<th>0.5 per cent</th>
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<tbody>
<tr>
<td>Bleaching syntan</td>
<td>0.5 per cent</td>
</tr>
<tr>
<td>{Like FCBJ-3 (BASF) if available}</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>20 per cent</td>
</tr>
</tbody>
</table>

This mixture is gently applied on grain surface of tanned leather and kept for 45 minutes to 60 minutes. After this the leather is lightly rinsed in the tan liquor pit.

18th Day

The tanned leather is sometimes kept for 2 days in the bag tanning pit layering with 20 per cent vegetable tanning mixture (Equal parts of babool bark and crushed myrobdan nuts). This tanning mixture is sprinkled on flesh side of leather keeping in pile flesh to flesh and well immersed in the tanning pit. This layering with vegetable tanning mixture further improves vegetable tanning.

20th Day

Leather is taken out from vegetable tanning pit rinsing well to remove adhering bark mixture.

The tanned leather is kept in a pile for 3 to 4 hours either on a flat wooden platform or over a R.C.C. table of size 7’x4’x3’, having 5 inch thick top to drain excess of tan liquor.

18th to 20 Day
The tanned leathers are hung in a row close to each other tied by jute ropes inserted in the small holes made on tips of the butt and neck region for conditioning. The room in which vegetable tanned leather are hung may have windows near to roof but there should not be exposure to direct sunlight as sunlight leads to oxidation and darkening of colour of tanned leather. After ensuring the proper conditioning (removal of excess moisture), the leathers are removed from the wooden poles by untying the knots.

Setting

20 day: Leather are hand set on the R.C.C. table described as above with the help of wooden semi curved blunt stone or stainless slicker to remove wrinkles and making the grain surface smooth and leathers flat.

20th to 21st Day

Hand set leathers are again hung in drying room tied with jute ropes and when almost dry are once again hand set to enhance smoothness, flatness and look of the leathers and hung up for complete drying in the drying room. When completely dry the tanned leather is kept in a pile for one to two days for aging.

Yield

Dried and aged vegetable tanned leathers are weighed to find out the yield-percentage. Yield calculated on pelt weight basis may range between 42 to 46 per cent depending on the type of raw material and the method of vegetable tanning.

Vegetable tanned may be sold on piece basis or weight basis depending upon market practices.

In this way good quality vegetable tanning may be completed in 21 days or alternately vegetable tanning in pits may be carried out using 6 tanning pits starting from 10° barkometer to 50° barkometer gradually increasing strength of tan liquor using babool bark and crushed myrobalan nuts fortified with vegetable tanning extract procured from tanning chemical suppliers. This is known as pit tanning.

Advantages

- Employment generating low cost technique at the rural Level at the cost of 5-10 lakhs.
- Environment friendly technology with minimum use of chemicals.

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