



A modern semi-rapid vegetable tanning with high exhaustion

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A new approach to vegetable tanning has been developed that brings together the technical advantages of both pit and drum vegetable tanning systems.

The system operates with a very high uptake of vegetable tannins, and eliminates the need for common salt in the pickle stage that normally precedes drum tannage.

Vegetable tanned leathers are recognised as an elite product. High value items crafted from these leathers include bags, furniture, footwear and speciality seating in automobiles. Vegetable leathers are recognised for their comfort and tactile properties, and the fact that they are made using natural products which are naturally grown and harvested.

Two types of systems are mainly used in manufacture. The largely static pit-drum tanning systems that have evolved from traditional method that were originally pit based, and the rapid drum tanning systems that have developed more recently.

The techniques applied in the two systems after liming operations are summarised for comparison in *Panel 1*.

Panel 1:

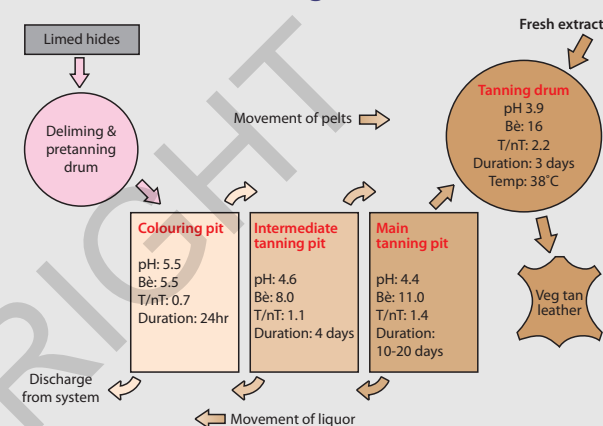
Drum-Pit and Rapid Tannage: Advantages/disadvantages	
Drum-Pit tannage	Rapid Tannage
• Total or partial delimed • No acid/salt pickle • Superficial pretannage • Tannage with astringent blend of vegetable extracts • High liquor/pelt ratio (typically 6:1) • Minimum mechanical action • Long tanning time (20 days)	• Full delimed • Acid/salt pickle • Pretannage to equilibrium • Tannage with blend of sweet (non-astringent) extracts • Low liquor/pelt ratio (typically 0.3/1) • High mechanical action • Short tanning time (1-2 days)

In the pit-drum system, the deliming and a light pretannage is performed in a drum. The hides are then moved into a series of pits with increasing concentrations of vegetable tanning extract. The hides are first offered to the pit with the lowest concentration of extract, and then move to the next pit which contains a greater concentration of extract and continues in this manner through the system. After removal from the final pit, the tannage is finalised in a drum tanning stage. Fresh extracts and water are added in this part of the process to replace the liquid moved to the pits.

After the drum tanning stage is complete, part of the used liquors are discharged to the last tanning pit. The liquors (*with reducing tannin content*) move pit-by-pit towards the first pit before final discharge from the system. This outlines a classic counter flow system combined with a final drum tanning stage, and is indicated in *Panel 2*.

The rapid tannage is a much simpler system, where the chemicals – auxiliaries, extracts and water – are all added to the same vessel. The system relies upon the mechanical action provided by the drum action to assist the penetration of the tanning extract, and a build up of heat in the vessel to increase

Panel 2: Pit drum tannage



Panel 3:

Drum-Pit and Rapid Tannage: Advantages/disadvantages	
Drum-Pit tannage	Rapid Tannage
• Long process time • High investment in stocks • High investment in equipment • Larger building area • Process needs analytical control • No mechanical damage • High yield • Low pre-tanning costs • Better colour control • Easier temperature control • Large batches	• Short process time • Low investment in stocks • Low investment in equipment • Smaller building area • Process control by formula • Mechanical damage • Low yield • High pre-tanning costs • Lack of colour consistency • Difficult temperature control • Small batches

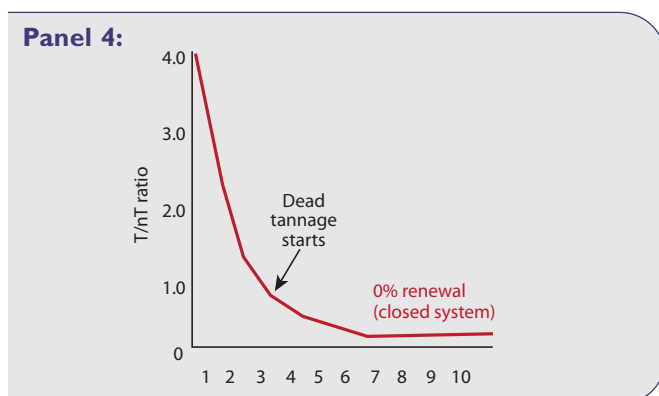
the uptake of tannins. The advantages and disadvantages of both systems are listed for comparison in *Panel 3*.

The best of both systems

It was considered by Silvachimica that it was possible to combine the advantages of both systems, and at the same time create a system where greater recycling of the vegetable tanning liquors could take place.

The first set of investigations was drum based, working with the same offers of tanning agents but using a 300% float, which was recycled every batch for the following tannage. The tans contained within this recycled bath were measured and made up to the appropriate concentration, and the cycle repeated 10 times.

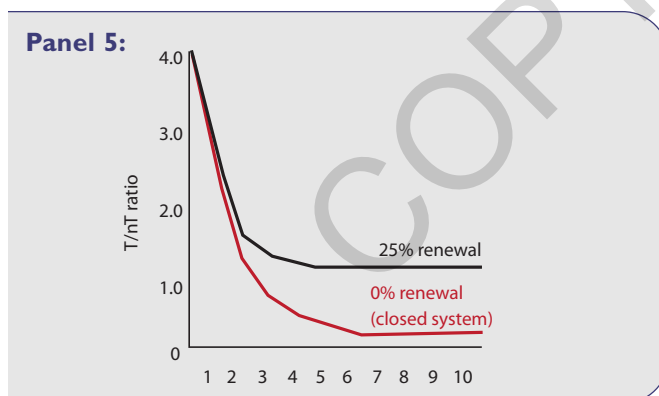
This revealed that the cycle could be repeated four times, but after this the leather created had a “dead” handle. This was due



to a build up in the non-tans within the system, and the progressive increase in ratio of tans/non-tans is shown in *Panel 4*.

These investigations identified a limit to the tans/non-tans ratio, and it was clear that only part of the exhausted main float could be recycled. The optimum degree of recycling was determined by repeating the first set of trials over 10 cycles, but with renewal with 25%, 50% and 75% fresh liquor in the tanning bath (*based on pelt weight*). This showed that a workable tans/non-tans ratio could be achieved after four cycles with 25% renewal of float: this ratio consistently remained at equilibrium up to the end of the tenth cycle. The equilibrium achieved in this situation is shown in *Panel 5*.

Renewals at 50% came to equilibrium at three days, and 75% renewals came to equilibrium at two days, producing tans/non-tans ratios of 1.74 and 2.00 respectively at the end of the ten cycles. However, for practical applications a 25% renewal of float for the main tanning bath provided optimum uptake of tannins, and produced fully satisfactory leathers.



Full utilisation of tannins in the system

Over and above this recycling of the tanning bath, an extra stage was introduced before the tannage where part of the used tannin bath was used for pre-tannage: this was named as a “colouring” stage.

An analysis of this used bath at the time of discharge as waste water showed a tannin content of 0.6 to 0.8%, representing an uptake of 98.3%. It was, however, realised that this low tannin content could be reduced further.

The acid/salt pickled pelt was very reactive, and a pre-colouring stage with the used colouring bath acting as float proved very effective as the remaining tannins in the weak solution became chemically bound to the pelt. Another step was thus added to the process, but the uptake of tannins was now fully achieved.

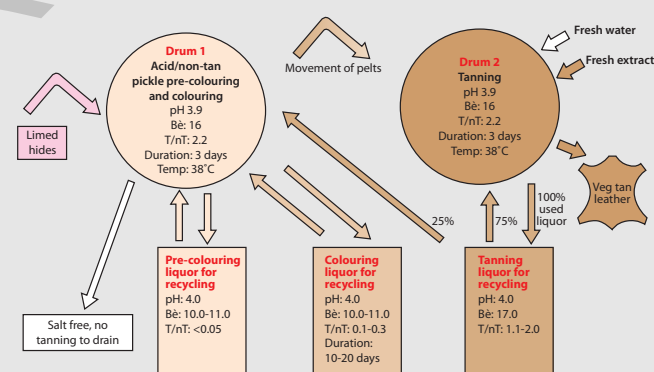
Replacing salt in the acid/salt pickle

The wastewaters that now remained for discharge from the process were free of tannins, but still contained non-tans being largely a mixture of non reactive salts and sugars. However, the concentration at approximately 10% of these solids in the waste water was sufficient to act as a swelling suppressant under acid conditions. This meant that the float from a pre-colouring stage, if used as the float for an acid pickle, could eliminate the need for common salt in the pickle bath.

Investigations were undertaken, and this was found that this technique was very effective: the acid swelling was effectively suppressed, and the process further rationalised. This resulted in a system where the water use was considerably reduced (*more than 75% reduction*), the tannins fully exhausted from the system, salt eliminated from the pickle process, accompanied by a COD reduction in the final effluent.

In practice the process requires two drums for processing and three holding tanks. The first drum is used for a 3-day process for acid/non-tans pickling, pre-colouring and colouring, and the second drum for a 3-day tanning process. Three holding tanks are required for holding the floats used for recycling: the pre-colouring liquor, the colouring liquor, and the main tanning liquor. The movement of floats and hides, and the outline conditions is illustrated in *Panel 6*.

Panel 6: Semi-rapid vegetable tannage. High exhaustion, salt free



Summary of the new semi-rapid vegetable tanning method

- A new approach to the conventional pickle enables completely exhausted vegetable tanning baths to be used within an acid pickle system that completely eliminates the need for salt.
- From this starting point, it is possible to make a vegetable tannage in a relatively short time and with minimal damage to the grain due to mechanical action.
- The residual liquor from the tannage can be recycled until there is complete uptake of the tannins by the hides.
- A fully efficient system can be created by a partial renewal of the vegetable tanning liquor, together with a specified tans/non-tans ratio at equilibrium.
- By varying the percentages of renewal, all types of leather can be obtained. ☺