



Back to Basics: A Framework for Leather Manufacture

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Leather drying and conditioning: Toggle drying

Overview

In toggle drying leathers are under tension to regain area loss arising in first drying. The method is fixing and straining of leathers on frames for drying. Techniques are manual, semi automatic or automatic toggling. Static chambers and vertical or horizontal throughfeed drying machines are used.

Objectives and outcome

Toggle drying may be practised as a first-time drying operation after samm/setting or for second-time drying after staking. Temperature settings will vary accordingly. Both static and through-feed machines use fan driven air circulation. Division into zones allows a gradual lowering of the temperature profile as the leather progresses through the machine. Initial air flow temperatures may be as high as 60°C to 70°C in the first zones when first-time drying.

Final leather humidity level depends upon temperature settings, but with static chambers precise drying times can be managed to better achieve the required moisture content of the leather. Fan assisted extraction of humidity laden air is normally part of the system. If controllable, settings affect drying performance and energy consumption.

Affixing the leather by means of the toggles leaves an air gap of approximately 12mm between the leather and the toggle plate. Limited heated air flow occurs in this area.

Area retention and a flattening of the naturally rounded animal shape are principal objectives of toggling for first-time drying. This can also apply within second-time drying, particularly if the conditions used in first-time drying were to create a softer leather, but counter balanced by a predominant rounded form.

- The drying conditions are controllable. The leather is thus protected from harsh treatment.
- Drying across the leather surface is generally uniform aided by well

proven design of the airflow systems.

- The leather is subject to significant force. Both manual and automatic toggle can be used to exert a high degree of pull *or strain*. As drying progresses, the level of stress within the skin increases.
- Area gain apart is also governed by leather substance and type of chemical processing. The strain created by the pulling force affects the finished leather quality. Different kinds of leather are subjected to either more or less strain.
- Scars and cuts may be accentuated and opened up.
- In first-time drying, at relatively high temperature to reduce the moisture content of the leather to, for example, just below 30%, large area gains can initially be made. However, as the leather is still in an elastic state, much of these gains will be lost on subsequent conditioning, mechanical softening, and during second-time drying.
- In second-time drying, *the final leather moisture content of the leather* can be deduced to approximately 15% to 18%. An area gain based on the staked area in the order of 6% to 8% can become permanent if the leather is cooled under tension in a final section.
- The leather surface remains unaltered.
- The leather will be flat.
- The rounded animal shape largely disappears.

Static toggling cabinet (Panel E20/1)

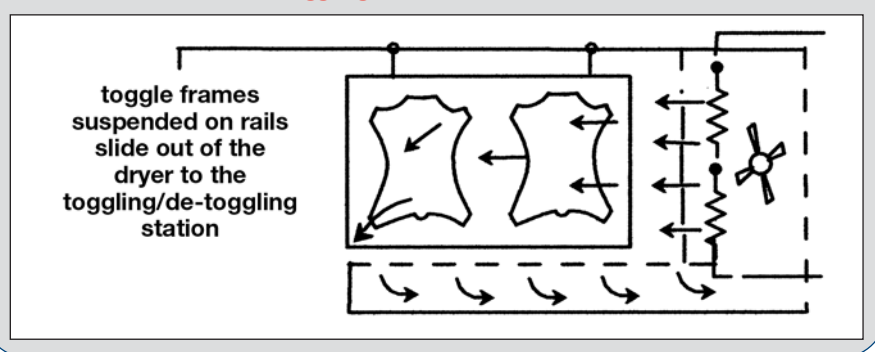
Referred to frequently as a bookcase dryer as the toggle frames are suspended vertically, and have the appearance of books on a bookshelf. The frames are manually slid in and out of the units, commonly holding either 10 or 25 toggling frames.

An insulated open front steel shell makes up the cabinet. Overhead rails are in the main compartment, one rail for every frame. The rails extend beyond the front of the cabinet giving access to the toggle frame along its length to enable loading and unloading.

In a typical arrangement there is at the rear of the cabinet a plenum chamber holding a centrifugal fan and the steam or hot water battery fitted upstream of the fan. The fan is dimensioned to create a degree of air pressure in this chamber. Slots at its front allow the air to escape with sufficient velocity to produce airflow horizontally across the full height of the toggle frames. A duct in the floor of the main compartment then receives the air which is ducted to return it to the plenum chamber under the suction of the fan. The air is reheated and the cycle is repeated.

Usually there is an outlet in the circuit for a determined amount of humidity laden air to be expelled. Another opening allows entry of fresh air. To prevent escape of heated air at the front of the cabinet, and to ensure that the flow pattern can function properly, the frames have a plate and flexible seal at their front. In this manner

Panel E20/1: The static toggling cabinet

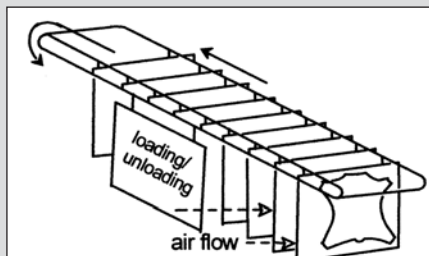




when all frames are in the cabinet the main compartment is effectively sealed.

Steam or water radiator heating systems produce appreciable heat losses. Many modern book case type machines use gas burners to heat the air in circulation, thus minimising such heat losses.

Panel E20/2: Vertical tunnel throughfeed toggle dryers



frames travel from the loading/unloading station along a single rail through points into dryer on two parallel rails

Advantages compared with the static cabinet:

- close control of drying parameters
- programmable control of drying parameters
- automatically controlled timing
- possibility of conditioning and cooling
- conveyor controlled toggling and de-toggling

Construction details of these machines vary considerably. The following description is generic.

The suspended toggle frames are mechanically pushed from the toggling station along a single rail, through a set of points and onto two parallel rails. The frames travel sideways suspended from these parallel rails through the drying tunnel. On leaving the drying tunnel, they are once again re-oriented onto a single track when the conveyor returns them to the toggling/de-toggling station. De-toggling and toggling is manual but removing the clips is frequently aided by a tension release device working in conjunction with split expanding type frames. Automatic toggle sheet expansion mechanisms are also sometimes in use reducing operator fatigue. Leather is toggled on both sides of the sheet.

Toggle dryer capacities may be from about 25 up to 300 frames. The machine is divided into zones, each with its own specific climate, and depending on machine length comprises of several cells.

Frames are manufactured in sizes practical for either small animal skins, leather sides or whole hides.

Each cell has its own plenum chamber containing the heat exchanger and a fan. The air is heated and is under pressure in the chamber. It is expelled from the chamber to flow uniformly across the gaps between the frames and toggled leathers at full height. A chamber opposite to the plenum chamber receives the air from where it is ducted back to the plenum chamber to be reheated. Thus the circuit is complete. Cross-air flow reverses direction by alternating plenum chambers left and right in successive cells.

Tunnel entries and exits are always open as doors are not practicable. The frames and the inherent air flow are an effective bar to excessive heat losses or to the entry of unwanted fresh air.

Temperature and humidity is programmed and monitored in each zone. Fans normally extract humidity laden air controlled by relative humidity sensors. Setting and monitoring frequently takes place by means of PLC systems. Admission of fresh air is usually by air vent control.

Zones at frame entry normally run at the higher temperature and there is no humidity control. Temperature becomes lower in successive zones. Steam or water mist injection facilities are often provided to re-humidify the leather in a final zone section where it cools.

Steam heater batteries are generally fitted but gas burner air units are also sometimes employed, because such systems are significantly more energy efficient.

Toggle frames and clips in static cabinets and in vertical tunnel dryers

The most common frames consist of perforated steel sheets mounted in a rectangular steel frame. The leather is gripped by toggle clips which are pegged manually in the most suitable perforation in the sheet. These clips close tightly when the leather is tensioned. Both sides of the toggle frame are used.

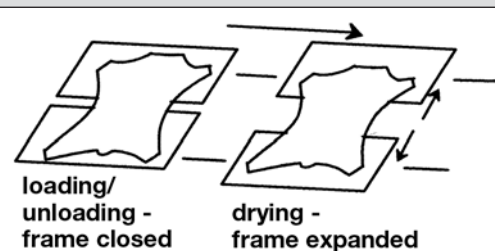
With the fixed type of frame the tension (or pull) is exerted directly by the operator as he places each clip. Other frame types are split into two halves which after fixing the leather expand mechanically using a lead screw system, or by applying compressed air to a piston mechanism,

part of every frame. Modern machines using expanding frames which release tension automatically when the dried leather returns to the operator station.

Generally the toggle sheets are mounted in a so called swivel frame so that they can be turned into the horizontal position for toggling and de-toggling. These are latched vertically whilst going into the dryer. The frame assemblies are suspended from overhead rails, running on small wheels.

The main categories are manually operated, semi-automatic and automatic machines.

Panel E20/3: Horizontal tunnel throughfeed toggle dryers



Expanding type toggle frames are presented to the operator on a horizontal base. Leather is toggled only at the facing (upper) side and frame expansion is activated. A transport mechanism moves the frame into the drying chamber where they are stacked horizontally. Simultaneously a frame holding a dried leather exits the chamber and is presented to the operator for de-toggling.

Frame expansion is mechanically relaxed to ease removal of toggles. Controlled heated air flow and humid air extraction is usually employed in the drying chamber. The whole process is more ergonomic and is also more economical in its space requirement. The unit is limited in the number of frames it can hold. Divisions into cells and zones to manage the drying environment accurately are not normally possible.^[Legend 2]

Automatic toggling relieves operator fatigue and results in more controllable straining. Toggle clips slide on radial bars or rods mounted on the drying table. Their correct position for engagement is electronically sensed and the force of pull is preset. The table enters the drying chamber. The clips disengage automatically at the end of the cycle.

Legend

"The Machines in the Tannery" - Walter Landmann:

1) Vertical tunnel toggle dryers: Pages 222 to 228.

2) Horizontal tunnel toggle dryers: Pages 230 to 234.