

The milling drum—from blunt instrument to sophisticated process vessel

The purpose of dry milling is principally to restore the softness and suppleness to leather after drying or surface finishing operations. This is achieved simply by tumbling the pack of leather for several hours in a drum, normally equipped with plain internal shelves. The repeated tumbling and

flexing of the leather frees loose fibres and dust from the flesh side. Early milling drums were normally wooden, sometimes with numerous holes drilled in the circumference to allow the dust to escape, and sometimes of slatted construction, to achieve the same end. The release of the dry dust around the drum made for a very dirty working area, and was a considerable fire risk. Simple dust extraction systems were developed, with an external fan drawing dust-laden air through a hollow axle and into a separation cyclone for collection. Wooden drum drives were normally by ring gear and pinion, and horribly noisy. Re-humidification of the leather was sometimes carried out by injecting low pressure steam via a hollow axle, but this was a hit-or-miss affair, and could often result in irregular wet patches on the leather. So-called “stuffing” drums (*Figure 1*) were used with some types of leathers, with hot air blown through the hollow axles to aid the re-impregnation of the leather with oils and greases as it was tumbled in the drum.

Stainless steel construction

The availability of cheaper stainless steel led to the introduction of welded milling drums in this material, which soon became the norm. It had several advantages; the weight of the drum could be considerably reduced, requiring less power to turn it; large diameter bearings could be fitted, allowing ➤

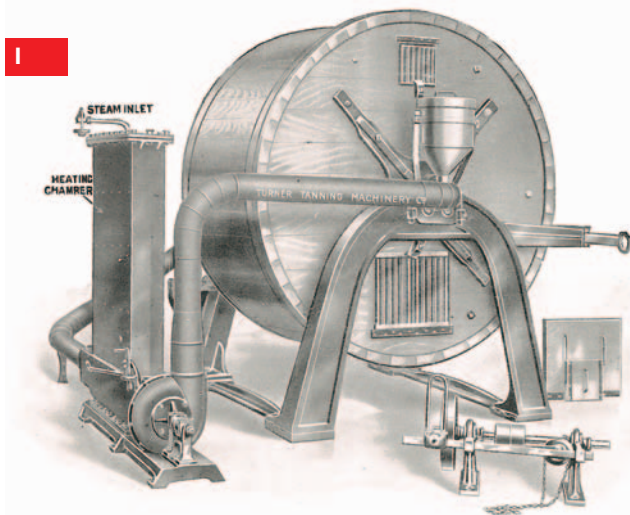


Figure 1: An early hot air stuffing drum

Figure 2: A modern, fully-enclosed and automated milling drum (Poletto Technology)

Figure 3: A belt driven milling drum with dust filter (right) and chemical addition tank (left) (Erretre)



THE MILLING DRUM—FROM BLUNT INSTRUMENT TO SOPHISTICATED PROCESS VESSEL

greater diameter hollow axles and hence greater extraction air flow; stainless steel offered smooth, polished internal surfaces with no possibility of leather damage by splinters. The stainless steel milling drum was a far more precise piece of engineering than its wooden predecessors. With drive by circumferential belts from a motor/gearbox unit at the rear it was much quieter and smoother in operation. Precision construction allowed proper sealed rotary joints at the axles, giving the opportunity to treat the milling drum as an effectively sealed vessel in which the environment could be closely controlled. Dust separation cyclones were replaced by filter sleeves in sealed housings (*Figure 4*), and the filtered air from the drum re-introduced through the opposite axle; internal diffusers were developed to spread the air flow into the body of the drum and reduce the possibility of blockage. This closed air circuit could then be monitored for temperature and relative humidity. Direct steam humidification was largely dropped in favour of atomised water spray, while temperature was separately controlled with a steam or electric heat exchanger. If temperature or relative humidity rose above pre-set limits, the closed air circuit could be vented to atmosphere and fresh air drawn in. The body of the drum and the piping of the air circulation system came to be routinely lagged with insulation material and clad with aluminium to minimise heat loss and condensation.

PLC control

With the development of reliable electronic temperature and humidity sensors, the programmable logic controller (plc) now came into its own in the milling operation. As with the Olcina INOX Turbo Mill the leather technician could develop a carefully timed programme of agitation of the leather at pre-set temperature and relative humidity, designed to optimise suppleness and ensure even

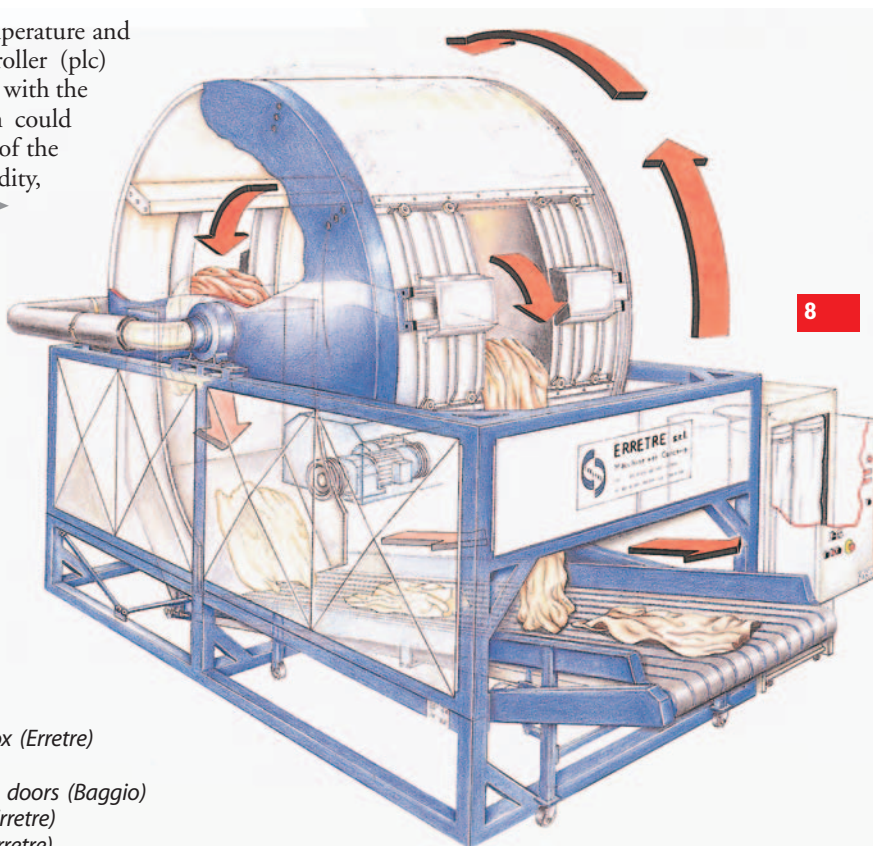
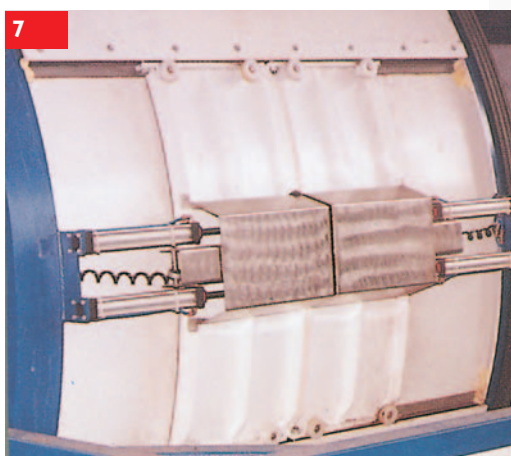
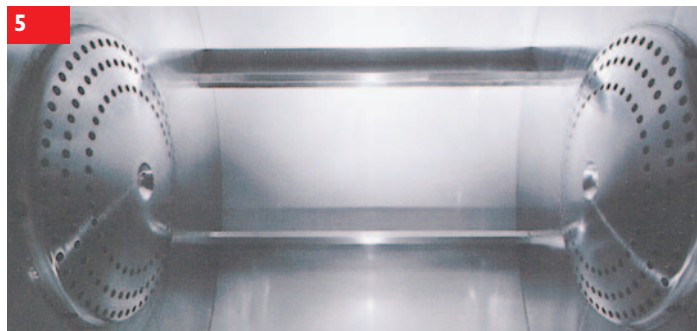


Figure 4: Dust is collected in a removable wheeled box (Erretre)

Figure 5: Internal stainless steel air diffusers (Erretre)

Figure 6: Octagonal milling drum with vertical sliding doors (Baggio)

Figure 7: Pneumatically operated side-sliding doors (Erretre)

Figure 8: Drum equipped with unloading conveyor (Erretre)



THE MILLING DRUM—FROM BLUNT INSTRUMENT TO SOPHISTICATED PROCESS VESSEL



conditioning of the leather. The plc allowed precise control, repeatability, and the opportunity to carefully optimise the process parameters to achieve the desired result. The operator simply had to load the drum, start the programme, and then unload when finished. It was also now possible to automatically record the data of temperature, humidity and agitation for quality control purposes. A development in recent years has been the introduction of so-called 'chemical milling' processes pioneered by Erretre. Liquid chemicals are introduced into the milling drum via atomising sprays, to modify the suppleness and feel of the leather or to add lustre to the surface finish. Other techniques can be used in dry milling to change the surface finish, including milling with abrasives to give a matt, velour finish, or using high temperature to cause a pebbling effect on the grain.

Non-cylindrical vessels

Recent developments in milling technology have been mostly in trying differently shaped vessels to increase the mechanical action on the hides, and hence to increase the loading possible in a given size. An octagonal drum is offered by Baggio (*Figure 6*), which is claimed to give a better mechanical action than the more common cylindrical shape; this design also incorporates extraction at the shelves off the drum rather than the axles, which is claimed to be more efficient. A cuboid milling drum has been offered in the past, rotating about its diagonal axis, and other odd shapes have been promoted in recent years, claimed to maximise working of the leather and reduce milling times. The majority of designs, however, remain simply cylindrical with shelves. The largest milling drums of today are up to 3.5 metres in diameter, and will take a loading in excess of 2 tonnes dry shaved weight.

Automated loading & unloading

Most manufacturers of milling drums now offer their machines with large sliding doors, sometimes almost the full width of the drum, which can be automatically operated by pneumatic cylinders (*Figure 7*), and with conveyors to speed up unloading. The conveyors are normally telescopic, folding up



Figure 9: A five drum installation with loading and unloading conveyors (Baggio)

Figure 10: Control panel for temperature, humidity, direction and duration of rotation (Poletto Technology)

Figure 11: A large scale milling drum installation with unloading conveyors (Erretre)

beneath the drum and inside the guarding during milling, and extending outwards and upwards for unloading, presenting the hides at a convenient height for the operator to transfer to horses or tables (*Figure 8*). It is also possible now to automate the loading of batteries of milling drums with conveyor systems arranged to deliver hides to a preselected drum—one particularly neat system is shown in *Figure 9*. An elevator conveyor, shown here in the 'parked' position, lifts the hides to a series of overlapping conveyors, each with their lower end positioned centrally over a drum. If each conveyor is run forwards, it drops the hides onto the next conveyor in line. If the drum selected for loading is stopped with its open doors at the top, and its associated conveyor is reversed, the hides will be dropped into the body of the drum.

There are several areas in tannery machinery where the application of modern technology seems to have been an over-elaboration; sometimes plc controllers seem to be grafted onto machines more to make them look modern than for any real benefit. The milling drum, however, is a real exception, where the application of modern sensors, control technology and automated handling has turned a blunt instrument into a sophisticated process vessel, capable of repeatedly reproducing subtle effects in the nature of the leather produced. ⚙

TMM