



Back to Basics: A Framework for Leather Manufacture

Richard Daniels and Walter Landmann

Reciprocating multi-roller machines: Samming, setting and samm/setting machinery in operation

The Samming operation

Historically, the leather was placed between two flat plates under pressure to de-water. This expression of water was not uniform, and aggravated any folds or wrinkles. The accepted method now is to pass the leather between felt covered rollers under pressure in outfeed in a multi-roller samming machine. This also incorporates a bladed cylinder ensuring spread out and a fold free presentation. The felt covered rollers act as transport rollers, and only a pad roller presses the leather against the bladed cylinder. The samming machine is generally employed straight after drum tanning and before splitting.

KEY OBJECTIVE

The key objective of the samming operation is to mechanically remove water from saturated leather, normally down to about 50-55% water content.

The Setting operation

Setting is normally performed after dyeing, the operation taking place in outfeed. The leather must be damp for this operation, but should not contain water which could be mechanically expressed.

KEY OBJECTIVE

The key objective of the setting operation in the multi-roller setter is to:

- Spread and set out
- Flatten the grain
- Gain surface area
- Reduce the tendency for the skin to revert to its natural "barrel" shape.

SETTING MACHINE CONFIGURATION

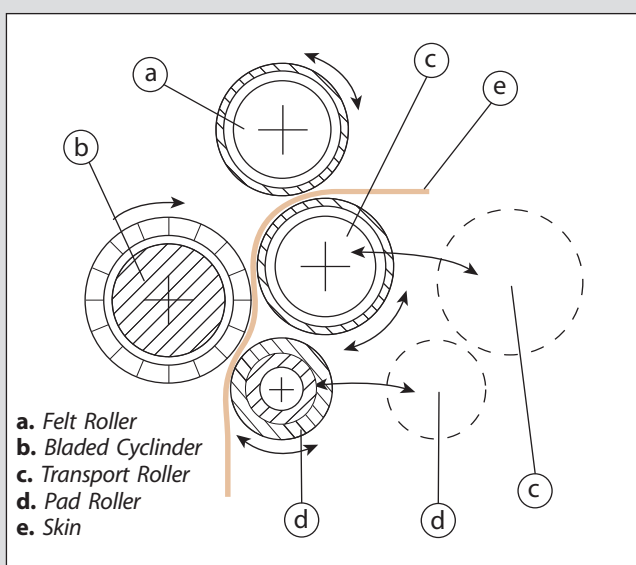
The configuration is not unlike that of the multi-roller samming machine but with important differences. No felt sleeve covered rollers are used. With reference to *Panel E13/1*, the lower transport feed roller

(c) has a softer rubber covered cylinder and also acts as pressure roller against the bladed setting cylinder (b). The upper transport roller (a) is hard rubber (ebonite) covered. The pad roller (d), is also rubber covered, is an auxiliary pressure roller.

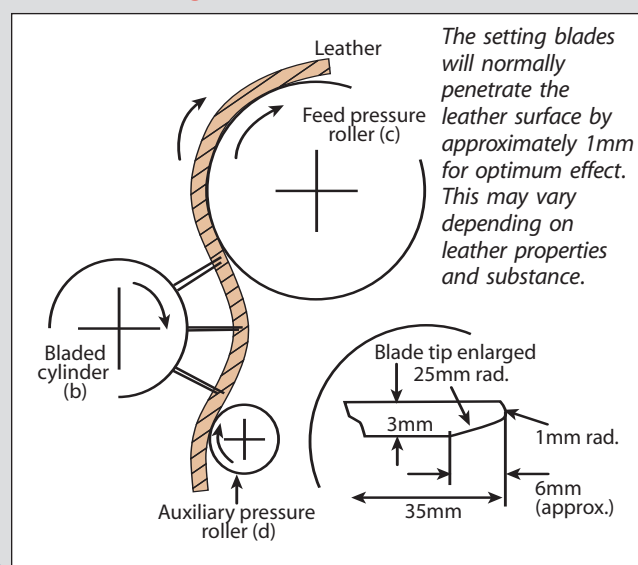
Setting occurs between the bladed cylinder (b), the transport/pressure/support roller (c) and the auxiliary pressure roller (d). Between the latter (d) and the transport/pressure/support roller (c), the leather travels in a substantial arc against the bladed cylinder. This gives scope to an extended spreading effect.

Older setting machines usually have an operator-actuated mechanism, which allows a reduction in the set leather travel speed to intensify the action if needed. More modern machines have a reversing facility, which repeats the action at the operator's will in critical areas of the leather. The leather remains in the machine when using this facility. A variant of the setting machine employs a heated and polished

Panel E13/1: Samm-setting in the combined multi-roller machine



Panel E13/2: Setting in the multi-roller machine setting machine



**Panel E13/3****Interactions and effects: Samming and Setting operations**

Differences in outcome due to the influence of temperature and moisture content of the piece are presented in *Essay 10*, where role of elastic and plastic behaviour in machine operations is discussed. The shifts in properties described should be taken into account within the following table.

SAMMING AFTER TANNING AND DYEING:

With reference to the key objectives of removing water, flattening and spreading out, and minimising pleats:

- Leather significantly shifts from elastic to plastic behaviour.
- Water content is reduced to 50-55%; if water content remains higher the plastic shift will not be reached.
- If the plastic state is not fully achieved, the leather will return to the original shape. Area gain and flattening will not be retained.
- Service life of felt sleeves is related to progressive "loading" with chemicals. Felts become hard and the capacity to absorb water is reduced. Water extraction becomes inadequate. Effective pressure on the leather rises. This can cause pleating or aggravate existing pleats.

- Too high machine pressure settings can produce pleating and aggravate existing pleats. (Also accelerate felt degradation).
- Flattening, spreading and smoothing pleats is the function of the bladed cylinder placed below—but not in contact—with lower felt covered roller.
- The customary 70% blade helix angle action is strongly in direction of feed out. Some hides need a smaller blade angle to produce satisfactory lateral spread.

SETTING:

- Takes place after dyeing.
- Flattens hide generally and reduces the "barrel" shape which will have reappeared after drum dyeing.
- Smooths grain surface (pores are closed or reduced in size) and removes pleats and wrinkles.
- Limits stretch (depending on the type of leather). The fibre structure is tightened and grain layer/fibre structure bond is

strengthened. Surface area is increased.

- The "plastic" state is only partly re-established by prior samming because the water content in the dyed sammed state will be higher than after tanning at around 65%. As the skins show significant elasticity, further (non-mechanical) drying follows immediately, as otherwise the effects achieved in setting will be lost.

COMBINED SAMMING AND SETTING

- Takes place after dyeing.
- Setting effects are as under "Setting". Water extraction is achieved by upper transport roller equipped with felt sleeve.
- Pressure applied in samming mode largely maintains the set piece in the extended state.
- The higher the temperature of the piece, the greater spreading and flattening of the skin, the greater the fibre compression, and the better the water removal.

chrome plated upper transport roller, which produces an ironing effect of the grain.

Combined samming and setting

Combined samming and setting machinery is used after drum dyeing. The configuration is identical to that of the setter with the addition of a loose felt sleeve on the upper transport roller ("a" in *Panel E13/1*). The pressure between the lower and upper transport roller is greater on the combined machine to effect the samming action, i.e. the water removal.

This operation is carried out in outfeed. As with the setting-only machine the neck half of the leather is introduced grain up into the open machine. The machine closes and the transport roller draws the leather out against the rotation of the bladed cylinder. The action is repeated with the other half of the leather. In addition, if machine-working width permits, the flanks can be offered laterally to follow the natural stretch lines of the piece.

The initial water content and temperature of the material influence the effect upon the leather of both samming and setting operations.

THE MECHANISMS OF SETTING

The construction of the bladed cylinder

is fundamental. The cylinder normally carries 3mm thick stainless steel blades, tapered towards the end with a full radius. At 35mm high they give long service life. There is no in-machine re-grinding and they are replaced when worn down.

Generally, on larger machines, 18 blades per side are fitted. The pitch in most applications is set to form a blade helix angle of 70° which produces the major pull in the longitudinal (*downwards*) direction of the leather in the machine. This ensures the maximum setting and spreading effect in that direction.

Cylinder rotation speed is of the order of 750 rpm, giving a peripheral blade speed of about 600m/minute. Because of the extended arc of contact between the leather and the bladed cylinder, several blade ends are always in contact at the same time. At 750 rpm and with 18 blades fitted, 13,500 blade ends will pass a given point per minute. The feed out speed can be taken at 25,000mm/min. Therefore with purely tangential contact, every 1.85mm of skin would undergo setting. In practice, however, three blades can be assumed to be always in contact providing simultaneous setting action across every 0.6mm of the piece. (*Panel E13/2*)

Furthermore, taking the blade section into consideration at about 2mm at the

point, it can be shown that every part of the skin is being worked. The stroking action of the blade sets and spreads at the same time. The friction involved generates heat, warming the leather to a limited degree.

Excess water is expressed between the felt sleeve covered roller ("a" in *Panel E13/1*) and the pressure roller ("c" in *Panel E13/1*). The composition of the felt sleeve is important, particularly so, because of the high pressures employed with modern machinery. Normally, a mixture of 30% pressed wool (*in contact with the grain and absorbent*) and 70% needled synthetic material is used to give the necessary strength and resistance.

The physics of removing the water are elementary. The leather is trapped as it enters an initial zero pressure zone between the two rollers. When it proceeds to the maximum pressure zone halfway between the rollers the felt progressively absorbs the water. As the felt sleeve travels from the high-pressure zone to the outgoing zero pressure zone the water drains off. The transport speed commonly used is variable between 20m/min and 25m/min. The felts used accommodate irregularities in thickness between hide parts and make the pressure more uniform. ⚙



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Samming and setting in throughfeed

Both water removal (samming) and setting of leather by classic multi-roller machinery is labour intensive and this has been the driving force in the development of throughfeed equipment. The first of such machines consisted of a pair of mangle rollers with a bladed spreader roller at the entry point. A number of tannery machinery builders quickly came into the field of making such a simple machine with the result that many different versions appeared. Continual improvement in performance through inventive designs followed. Combined throughfeed samm/setters can now satisfactorily handle the majority of leathers, both straight out of the tanning drum and also after dyeing.

KEY OBJECTIVES:

Primary objective:

The primary objective of the true throughfeed samm/setter is to reduce the free water content by mechanical wringing.

Secondary objective:

The secondary objective is setting.

Around 50% of the water is removed by mechanical wringing with a further aim to distribute residual water evenly across the total area of the leather. Together with the pressure exerted upon the leather, the employment of felts with a good degree of elasticity creates a pressure zone rather than pressure points. This is an essential factor in meeting the objectives.

The free drainage concept is based upon felt permeability and its ability to release water readily in the zero pressure zones. A typical construction of a latest generation machine in diagrammatic form is shown as Panel E13/4.

Progress over the years in the efficacy of de-watering can be charted in terms of the number of pressure rollers employed. From the simple two roller machine, evolution went through three and four pressure rollers to the five and six found

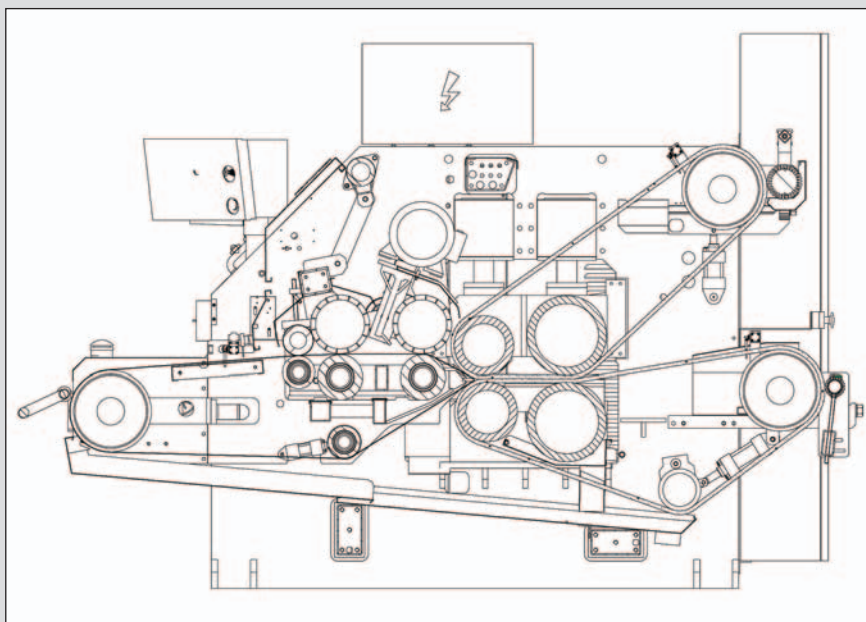
in current constructions. These also include sophisticated pressure controls and infinitely variable speed drives. De-watering in a typical modern system is achieved between upper and lower felt conveyors in say five pressure zones

created by six pressure rollers. 

Additional Information:

"The Machines in the Tannery" – Walter Landmann *Samming and Setting Machines*, pages 98-105 and *Throughfeed Samming and Setting Machines*, pages 106-115.

Panel E13/4: Modern throughfeed samm/setting machine



Performance characteristics of the system

Total squeezing pressure, normally up to about 150 tons, is distributed across the pressure points. This significantly limits the possible damaging pressure upon the leather. (In addition the zone pressure upon the expensive felt conveyors is also lessened leading to much longer service life). The squeezed out water drains away in the zero pressure points, which means effective water removal.

Setting and spreading in these machines may not be adequate for some leathers, in fact, it may not be as effective as in classic reversible samm/setters. Attention to this aspect has produced designs with a separate smooth faced feed-in conveyor, working in conjunction with several bladed rollers, and plain support rollers.

The optimum configuration of the blading in terms of pitch, variable pitch, effective diameter, controllable roller speed, roller oscillation and reversibility can now often produce comparable setting. Presentation is pleat free and flat to the first nip.

Reversing of the leather in the setting mechanism at the operator's will is a feature of some samm/setters. Specialist throughfeed machine makers are now able to offer tailor-made blade configurations to suit the particular characteristics of the leather to be processed. When processing full hides, large helix angle blades in the middle of the cylinder and small helix angle ones at either side are typically employed.