Back to Basics: A Framework for Leather Manufacture

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Leather drying and conditioning:

Radiation drying

Overview

Two types of radiation drying have been adopted:

- High frequency for removing moisture and water based finish drying
- Infrared for finish drying

A third type, microwave generated radiation, was developed for leather drying but proved to be uneconomical and impractical for the purpose.

High Frequency drying (HF)

This type of drying, also referred as radio frequency, is in limited use for leather drying and conditioning. The radiation is in the form of electromagnetic wave formation produced by high frequency generators (alternating current between electrodes principle). Heat is generated by molecular friction in a non conducting material such as leather. The water contained in the leather absorbs the heat and evaporates. The higher the water content the more electrical energy is consumed, tapering off as the water content becomes less and less. As a result, the water content throughout the leather pieces is largely uniform at the end of the drying cycle. In practice the starting water content of the leather is limited to about 35% when using this method. HF generally operates at a point in the 1 - 100 Megahertz range. Wavelength is measured in metres.

Infrared radiation drying (IR)

Infrared drying is used extensively in the leather industry to dry finishing coats. Frequently produced by electrical resistance elements, or by catalytic action gas burners, this radiation does not penetrate the leather to any extent and only heats the surface. Further warming of the leather in the process occurs mainly by conduction within the leather from the surface heat. The wave length is in the micron (.000001m) range and can be modified by filtration or dispersion. Infrared radiation is in the ultra high frequency range. (Approximately half way between microwave radiation and visible light.)

Objectives and outcome

HF drying is intended to reduce or ensure uniformity of water content in leather and is suitable to dry from approximately 35% water content. (Microwave drying theoretically could be applied to dry wet leathers with 70% or 80% water content to reduce moisture content to the vicinity of 30%.) Infrared radiation is used to quickly and economically dry off spray or rollcoater applied preparation and finishing materials.

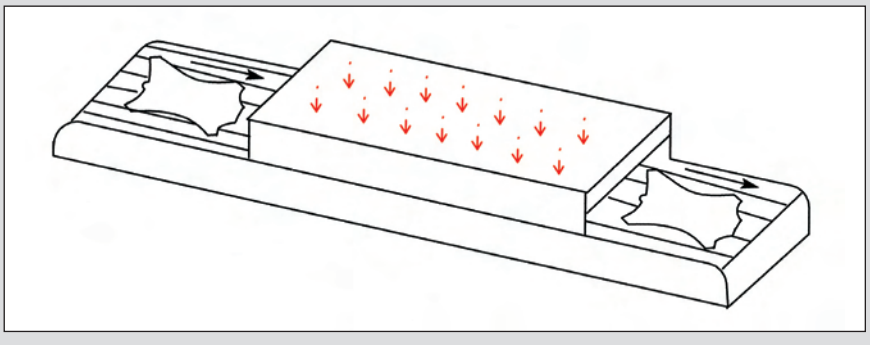
REDUCING OR EVENING OUT WATER CONTENT - HF RADIATION:

- HF radiation offers high uniformity of moisture content throughout the leather piece at the end of the drying process. Variation of water content from one area to the other may be not more than 3% compared, for example with 5% to 8% after vacuum drying.
- Final water content is largely controllable by exposure time and/or intensity of the radiation setting. Rehumidification for staking may therefore be unnecessary.
- Grain remains undisturbed.
- Leather remains relatively cool and drying out of the grain is avoided.
- The time taken by the water vapour passing out of the leather determines the leather temperature. For this reason heavier substance leather will heat more than light substance material.
- Shrinkage occurs and may be up to 10% depending upon residual water content.
- Elasticity of fibre structure is higher compared with vacuum or toggle dried leathers.
- Radiation drying results in softer leathers compared with vacuum or toggle drying.
- Radiation dried leathers regain moisture faster than vacuum or toggle dried leather when exposed to higher humidity ambient conditions.

DRYING APPLIED FINISHING COATS - HF AND IF:

- Solvent and water based products are dried rapidly.
- Correctly controlled HF radiation does not warm leather significantly. (HF radiation is particularly suitable when drying water based products.)
- Correctly controlled infrared radiation avoids both the surface drying of a finish film (skin-type formation on the still liquid finish), and heating the leather.
- IR generated by electric elements can lead to area losses of the order of 5% to 10%.
- Catalytic gas fuelled element radiation has no or little effect upon area.
- Catalytic gas fuelled element radiation

Panel E23/1: Radiation drying machinery



produces a small amount of carbon dioxide and humidity. This disperses radiation and reduces the drying intensity, leaving supple and soft leather unaltered.

Radiation drying machinery

HIGH FREQUENCY RADIATION DRYING UNITS

Through-feed tunnels are commonly employed to convey the leather through the radiation fields. The leather is placed onto horizontal, variable speed string conveyors. The radiation field is generated by the HF alternating current generator connected to the electrodes emitting the radiation which are positioned both above and below the string conveyor. The electrodes are mounted staggered and emit the radiation at an angle to the plane of the leather conveyor. A wide and strong field is thus created and the length of field and number of electrodes determine output capacity. As an example an electrode arrangement covering 18 metres in length would have a 140 kW rating. Longer tunnels with up to 240 kW rating systems are also manufactured commercially.

Interference with other electronic equipment can occur and for this reason HF generating plant is carefully shielded. With a fixed installation the rate of leather throughput, and the residual moisture required, is regulated by the speed of the conveyor. There is no internal air circulation in such a dryer but moisture saturated air is continually extracted from the tunnel and replaced by fresh, drier air.[Legend 1]

Infrared radiation drying units

IR is the most widely used form of radiation drying in the leather industry. The principal application is in solvent or water base finish drying or curing. Throughfeed tunnels with horizontal string conveyors fitted with catalytic, gas burning elements are frequently used. The so-called catalytic panels have internal gas (usually methane) burning nozzles behind a catalyst layer. The radiation emitted is diffused rather than focused, hence the uniform and gentle drying effect. Temperature is controllable by regulating gas pressure.

Another application is the tunnel fitted with electric heating elements. The preferred system uses electric elements encased in metal panels with guided radiation as exposed electric elements are now shunned. The drying effect is considered to be similar to that achieved with the gas fired panels. Both systems incorporate low velocity air circulation to aid the drying process. In the case of the catalytic gas elements, the circulated air also supplies the oxygen necessary to support combustion. Controlled extraction of either humidity or fume-laden air is provided for.

Effectiveness of radiation and economic viability cannot be related in general terms. Amount of water content affects electric power consumption. Cost of power varies widely and the high cost HF radiation equipment is a major factor.[Legend 2]

Panel E23/1: Typical high frequency radiation (RF) dryer used to equalise moisture content. (Cartigliano)

Additional Information:

"The Machines in the Tannery". Walter Landmann:
1) Radiation drying - Pages 238 to 239.
2) Infrared drying - Pages 283 to 285.