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Application of dryer bars

Scope

The purpose of this Technical Information Paper is to provide guidelines for identifying appropriate applications for dryer bars for increasing drying capacity and improving sheet moisture profiles in the dryer sections of conventional papermaking machines.

Safety precautions

Follow normal safety precautions when working around paper machinery. Tag, disconnect, and lock out all dryer drives and steam systems and follow vessel-entry procedures before entering dryers. Do not allow loose clothing or equipment to contact rotating machinery or ropes. Beware of thermal and slip hazards around the dryer section. Avoid direct contact with hot surfaces. Use hearing protection in noisy areas. Eye protection should be worn in all production areas. Safety shoes and safety helmets should also be worn where required. Inspect dryer internals regularly to check for proper dryer bar and syphon installation.

Utility

Dryer bars can be attached to or held against the inside of the dryer shell and the spacing between bars adjusted to increase turbulence in the rimming condensate layer. This increased turbulence can be used not only to increase the rate of heat transfer through the condensate layer, but also to improve the uniformity of the moisture profile of the paper. This Technical Information Paper reviews the theory of operation and offers guidelines for the proper application of dryer bars.

Background

At speeds over 300–350 m/min (1,000 ft/min), condensate inside dryers is generally in a rimming condition (1,2). This rimming condensate produces a resistance to heat transfer from steam to the dryer shell. There is a deceleration and acceleration of rimming condensate relative to the dryer shell due to the effect of gravity on the rising and falling halves of each revolution of the dryer. As a result, heat is transferred through the condensate layer by convection. This relative motion produces a high convective heat transfer rate at speeds just above rimming, but it has much less effect at high speeds.

The heat transfer through the rimming condensate layer can be increased by one of the following three methods:

- Bypassing the condensate layer
- Reducing the condensate thickness
- Generating turbulence in the condensate.

Similarly, the condensate depth in dryers with modern, close-clearance rotating syphons will be quite thin. If the dryer speeds are low (say, less than 400-500 mpm), the condensate heat transfer coefficient will be fairly high and the gain in heat transfer from installing dryer bars would not be expected to be very large.

Figure 3 shows in the shaded region the increase in drying rate that would be expected from adding dryer bars and improving the siphoning system. Note that at low speeds very little gain is expected because natural turbulence is already producing high heat transfer. But at higher speeds, drying rate may be increased over 20% depending on the existing equipment and operation. In general, those dryers with low contact resistance, well-ventilated pockets, and high steam pressures will have the highest percentage gain (7).

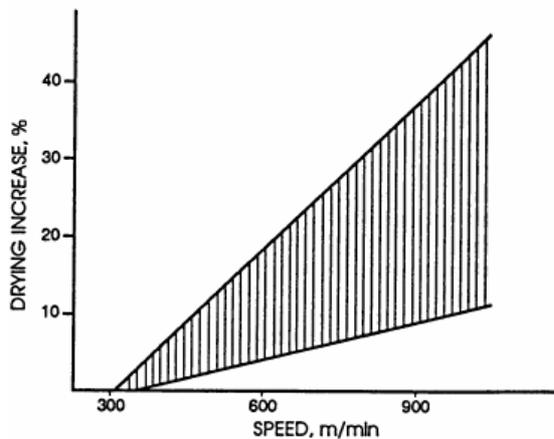


Figure 3. Drying improvement with dryer bars

Dryer bars are particularly applicable to high-speed machines that are operating with stationary syphons in the dryers. Dryers with stationary syphons operate with larger syphon clearances than dryers with rotary syphons, and with correspondingly thicker rimming condensate layers and lower heat transfer rates. A stationary syphon also increases the turbulence near the edge as it “plows” through the condensate layer. Dryer bars can be used to increase the level of turbulence in the center of the dryer to match the turbulence and heat transfer at the edge of the dryer. This results in a more uniform dryer surface temperature, as shown in Figure 4. When using dryer bars with a stationary syphon, the bars must be cut away to leave a gap for the stationary syphon shoe.

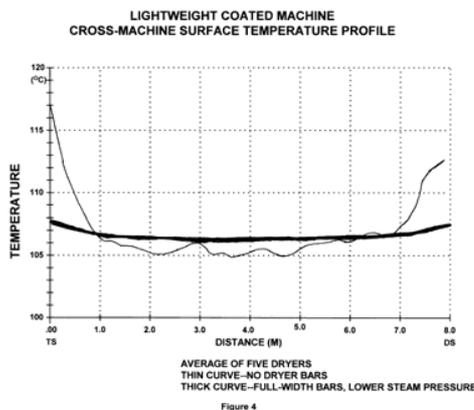


Figure 4. Effect of dryer bars in leveling the dryer temperature profile.

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