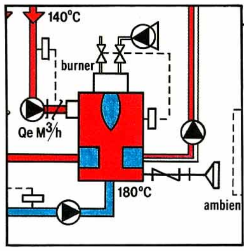

POCKET VENTILATION IN A PAPER DRYER WITH A DIRECT NATURAL GAS HEATING SYSTEM

SITUATION

In the paper industry, the limits of the dryer often prevent improvements in process efficiency and production capacity.

PROBLEM

Increase of the machine speed generates excess steam inside the pockets. This results in a permanent high moisture level in the pockets, hindering the mass transfer between paper web and ambient air. This means that once the dryer reaches its maximum evaporation capacity, its speed can no longer be increased.

Besides, improper drying of the felts lowers paper drying performance as well as the quality of the product.

SOLUTION

Pocket ventilation using air heated through a direct natural gas system helps increase sensible heat and, even more important, improves mass transfer in the dryer exactly where it is most needed.

An air flow blowing at high speed flushes out the humidity, lowers partial steam pressure inside the hood and improves hood balance while drying cylinder felts efficiently.

This improves the evaporation rate of the dryer; making it possible to increase output.

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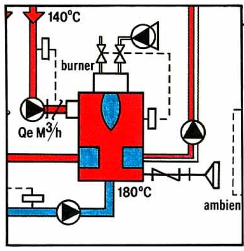


THEORY

The paper drying process requires a sufficient heat transfer to the paper web to turn the water into steam. A mass transfer from the steam into the surrounding air also occurs at the same time.

Paper drying usually entails a combination of contact, convection and radiant heat transfer.

The drying curve normally consists of three stages: sheet warm-up, constant rate zone, and falling rate zone. Figure 1 shows the drying rate variation (kg of steam produced/h/sq. m) in the various dryer sections, according to the amount of heat transferred to the paper web.

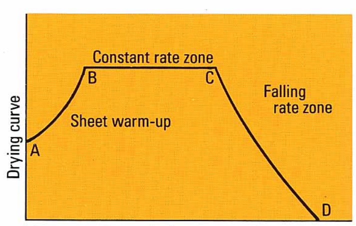
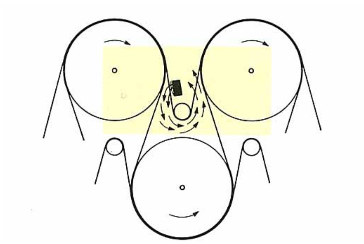


Figure 1 – Paper drying rate variation.

In a multicylinder dryer, the paper passes over steam-heated cylinders. Figure 2 indicates the location of the blowing duct as well as pocket ventilation process.

The cross machine ducts feature nozzles that impinge hot dry air exactly where it is most needed. The film of water covering the paper web reaches its highest temperature when the sheet leaves the felt but is still in contact with the cylinder. This is when the evaporation rate is at its peak.



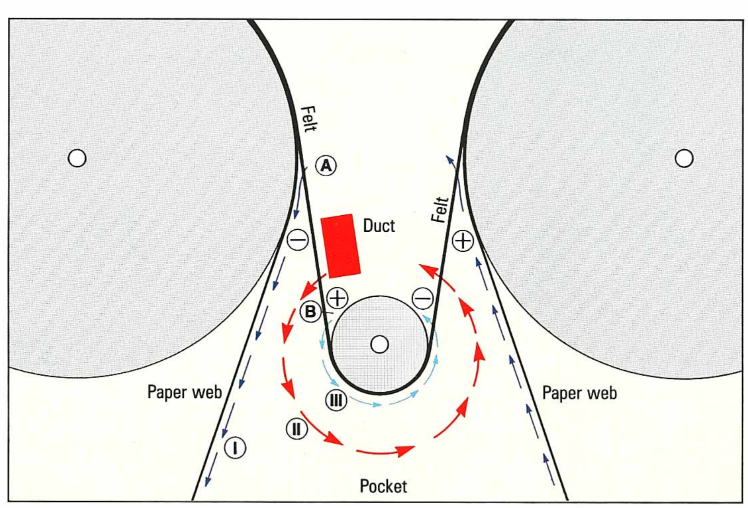


Figure 2 – Impact of pocket ventilation and blowing duct position in a multicylinder dryer.

The negative pressure generated at point A sucks n the water through the felt into the pocket, while the positive pressure at point B pushes the remaining windage air into the pocket. Inside the pocket, the incoming air has three possible paths:

1° Follow the boundary layer of the paper web (I arrows);
2° flow slowly through the center of the pocket, across the cylinders, before being released at both ends of the dryer (II arrows);
3° be caught in the porous felt material (III arrows).

The air exits mainly through the felt at the downstream cylinder nip, which has a vacuum and compression wedge as on the inlet side to help flush it out of the pocket.

The latter point is very important because the evaporation rate depends on the partial pressure differential between the water covering the boundary layer and the steam contained in the ambient air. It is therefore essential to impinge hot dry air (with low partial steam pressure) exactly where the paper web is hottest (high partial water pressure on the sheet). The paper drying process generates a film of water on the paper web along with a laminar sublayer. Evaporation at this particular point occurs through molecular diffusion. Figure 3 shows the various stages of vaporized water diffusion.

The impingement of high velocity air in the pocket breaks through the laminar sublayer and the buffer layer. This increases turbulence near the boundary layer, thus improving convection vaporization.

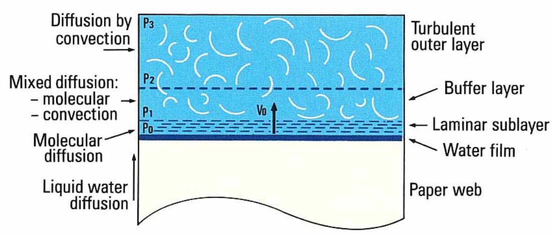


Figure 3 – Vaporized water diffusion in the paper drying process.

INSTALLATION

A pocket ventilation system was installed at Cascades, in Jonquière, in 1988. Cascades' dryer features a primary hood and a secondary hood following the coating machine. Air to be impinged into the pockets is heated through two duct burners, with the downstream duct of the second burner branching off to feed the second hood. The combustion air mixture for both burners is partly provided by air recirculation from the first hood, and the balance is aspirated from the plant mezzanine.

TESTS

Production increased by more than 30%. t should be noted, however, that other changes were made at the same time: the cylinder felts and siphons were replaced and the formation table was altered.

Performance was measured at two different temperatures (298°C and 220°C) while maintaining steam pressure constant inside the cylinders to properly assess the efficiency of the pocket ventilation system.

Normal operating temperature at the time was 290°C.

TESTS RESULTS

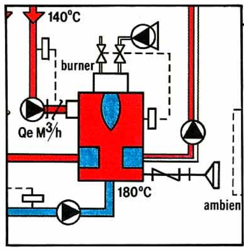
- Weight………..350 g/sq.m
- Paper width………3.472 m
- Moisture level at drying hood inlet(dryness)…..40%
- Moisture level at drying hood outlet (dryness)...94%

These results tend to indicate that rising the temperature from 220 to 290°C would increase machine speed by about 10%. This represents a reasonable assessment of the contribution of pocket ventilation towards machine speed increase.

The fact that this system is more energy efficient at normal operating speed is another important factor. Turning one unit of water from the paper web into steam required 5% less energy (steam and direct gas pocket ventilation system).

	VP 220°C	VP 290°C	
Machine speed m/min	**134**	**148**	**+10%**
RATIO : Total energy provided / Water vaporized			
Btu/lb water	**2 025**	**1 932**	**-5%**
KW/kg water	**1,30**	**1,24**	
Air released From the hood – lb (hot air)	**357 000**	**348 000**	**-2,6%**
Water flushed Out - lb (water)	**35 000**	**41 000**	**+14,2%**

(VP = Pocket ventilation)



CROSS MACHINE PROFILE CONTROL

Cross machine profile control can be achieved through pocket ventilation systems by dividing the cross ducts into compartments that can be turned on and off individually. Air can therefore be impinged exactly where the moisture profile has to be corrected (See figure 4).

It should be noted that this technology is an improvement over the infrared profile correction technique. Besides the fact that pocket ventilation improves paper drying, it also needs a lower investment.

SUMMARY 0F POCKET VENTILATION BENEFITS

- Higher production.
- Cost-efficiency due to direct gas technology.
- Stable and uniform air moisture inside the hoods.
- Cross machine moisture profile control.
- Lower condensation risks.
- Operating flexibility.
- Longer lasting felts.
- Paper web stabilisation on the cylinders.

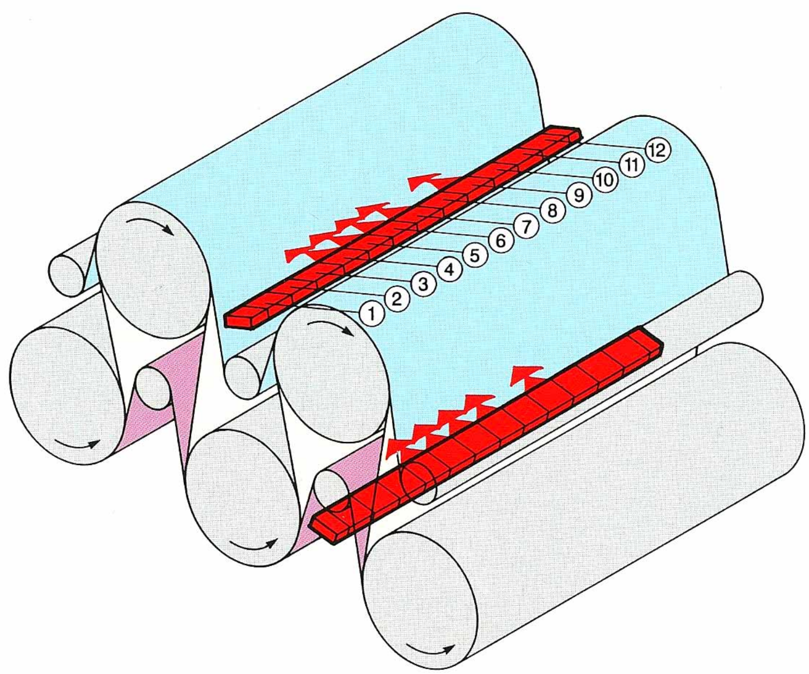


Figure 4 – Cross machine profile correction through selective impingement.

For more information, contact

DATECH GROUP

Gaz Métropolitain

DEVELOPMENT AND
TECHNOLOGICAL
ASSISTANCE DIVISION
Phone: (514) 598-3779