

CONTROLLING CD WARP IN CORRUGATED BOARD

It is generally agreed that post CD warp is caused by tension created in the board due to unbalanced shrinkage resulting from differing moisture contents in top and bottom linerboards. We propose to control CD warp by measuring the moisture of the top and bottom linerboards leaving the preheaters with our unique DELTA T moisture sensor. The DELTA T uses a patented mathematical model and temperature sensors to infer moisture. Using these two (top and bottom linerboards) moisture content values, we calculate their ratio and adjust it to a value that produces minimum warp. The ratio is adjusted by altering the preheater % wrap, and/or adjusting moisturizers. Figure (1) illustrates how we would plot warp data for corresponding moisture ratios to find the ratio range that minimized % warp.

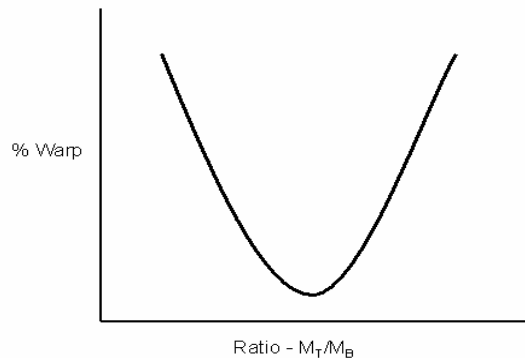


Figure (1) - % Warp vs. Moisture Ratio

This control method would tend to optimize the system with respect to minimizing warp for the available control range of your heater wrap and moisturizers. No long, drawn out calibration would be necessary. Once set up, its operation would be simple and operator-friendly. It could be easily integrated into an existing control system.

We have been in the business of monitoring and controlling the moisture content of products from industrial dryers and ovens throughout the US, Canada and South America since late 1986. Our patented moisture sensor is unique in that it can determine moisture content using temperature sensors. No other manufacturer is able to do this. This allows us to sense the moisture in the hot, dirty and space-limited environments of industrial operations. Others have used conventional moisture sensors on retractable rods that run in and out across the sheet of paper, but these have not been successful because they are expensive and maintenance-prone. Most, if not all, have been shut down. Others systems propose the use of temperature as a substitute for moisture, however, temperature alone does not correlate well with moisture. Our patented mathematical model relates moisture content (MC) and drying rate to a temperature difference (ΔT) and the speed or production rate (S) with excellent correlation.

$$MC = K_1(\Delta T)^P - K_2/S^Q$$

The temperature difference would be obtained by the infra-red temperature sensors as shown by figure (2). Control could be effected using a minimum of (4) sensors.

We would use nine a minimum of (4) small (2 inch) infra-red, non-contact temperature probes for each double-facer. Two temperature sensors would be needed following each pre-heater. The remaining sensors shown on figure (2) would probably not be needed; however, they could be used for information purposes. From the data derived, we would calculate the ratio of the moisture contents for the top and bottom linerboard prior to it entering the double-facer.

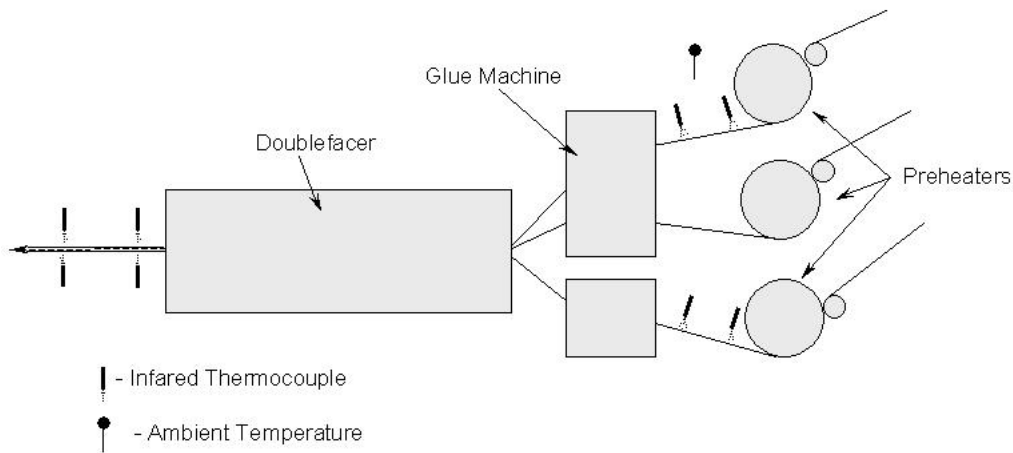


Figure (2) - Sensor Locations

Once the ratio of moisture contents are continuously available, the ratio range that minimizes % warp at the stacker is determined. This ratio would be maintained by manipulating the % wrap and/or the moisturizers, in spite of changes in the moisture content of the entering linerboard. Line speed and basis weight of the linerboard would be taken into consideration by the control system.