

# Model Based Control Solutions

## For Glass Gob Temperature Control

By combining BASF Exactus® pyrometers with ACSI advanced control methods, customers are able to implement cost-effective solutions that tightly control the glass gob temperature.



### Gob Temperature

A consistent glass gob temperature is a critical part of the forming process. Traditional mass flow temperature (MFT) alone is blind to temperature variations beyond the 9 point grid. By controlling gob temperature with a Model Based Control (MBC) strategy, unprecedented process stability and repeatability can be achieved.

### Temperature Measurement

The Exactus pyrometer, with 1ms response, collects about 40 readings per gob and supplies the average or peak gob temperature to the control system. Accurate to  $\pm 2^{\circ}\text{C}$  and drifting  $< 0.1^{\circ}\text{C}/\text{year}$ , Exactus pyrometers enable superior process control that conventional pyrometers cannot match.

### Model Based Control

ACSI's technology interprets all the variables that affect gob temperature. By understanding the interrelationships among inputs, it removes the complications that would normally be difficult for operators to resolve. The MBC:

- Thinks of the forehearth as a unit, not individual zones, allowing the zones to work together rather than fight each other
- Prioritizes temperature readings to determine the most important
- Predicts control actions required to drive the glass temperature to setpoint quickly without overshoot
- Models feed forward inputs and update control actions to quickly stabilize temperature variation

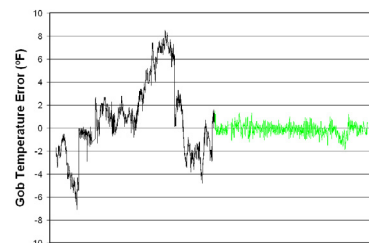
*Combining Gob Temperature with Model Based Control provides unparalleled process stability and repeatability. This combination can lead to as much as a 2% yield improvement.*

### Benefits & Results Achieved

- **Rapid Return on Investment**
- **Reduced Defects:** Seal surface and split finish defects reduced by nearly half.
- **Faster Job Changes:** Two thirds reduction in gob stabilization time after job change has been achieved. The recovery time improvement is shown in Figure 2.
- **Reduced Gob Temperature Variation:** More than a 7X reduction in gob temperature variation is shown in Figure 1.



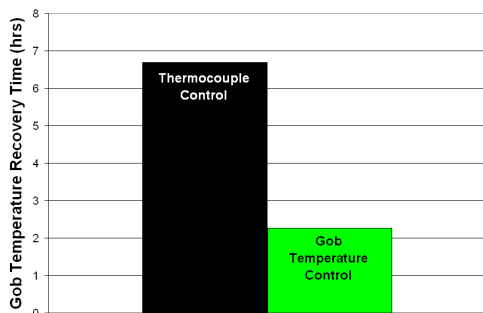
Superior process temperature stability with Model Based Gob Temperature Control leads to reductions in specific defects. Note the dramatic stability improvement in Figure 1 below.



**Figure 1** displays the job temperature error during a 16-day period with:

1. PID control (black)
2. Model Based Control with job temperature (GT) as process variable (green)

**A two thirds reduction in job change recovery time can be achieved with Model Based Job Temperature Control. The drastic recovery time improvement is shown in Figure 2 below.**



**Figure 2** displays an average of the time required for job temperatures to stabilize after a job change.

1. Thermocouple Control (black)
2. Job Temperature Control (green)

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BF-9466 02/19