Effects of geometry and thermal boundary conditions on calender roll thermal deformation

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Uniformity of paper thickness and surface properties is a key factor determining the end-use performance of paper. Nonuniformity of cross direction (CD) caliper profile can be reduced by adjusting the local radius of a calender roll. Consequently,manipulating the CD profile of local roll temperature using arrays of locally adjustable control actuators can smooth the CD profile of local nip load. As for the system being controlled, by far the slowest element to respond to change is the calender roll itself because of its high thermal inertia.

In this study, we developed a simplified model for the transient local deformation of a calender roll in response to a local cross-machine (CD) control action. We then validated the model against the full finite element and finite volume solution of Ian A. Journeaux ("Impinging jet heat transfer and ther-mal deformation for rotating calender rolls," Ph.D. thesis, Mc-Gill University, 1990) for a variety of roll designs and thermal boundary conditions.This model of local roll deformation may be used with confidence to examine the effects of roll geometry and the difference between unheated and heated shell rolls over the range of conditions for which it was obtained and validated.

For a specific calender CD control system it is often necessary to seek a compromise between conflicting objectives: a large roll deformation and fine CD resolution, and fast control response time.The dynamic model of calender rolls was found to be effective in seeking a compromise between those conflicting CD control objectives in order to identify optimal CD control strategy. The very short time this method requires for computation of the dynamic deformation of calender rolls makes this model the appropriate tool for use in improved methods of CD real-time control of calendering.

As the industrial objective is to minimize the time the paper is off-specification, the model of dynamic roll deformation developed here enables mills to determine combinations of roll geometry and thermal conditions that are consistent with achieving this objective. **TJ**

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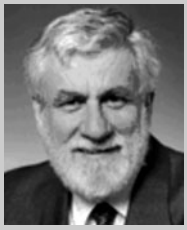

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