Model based flatness control

Strip flatness is an important quality criterion and likewise one of the most impacting process variables to recovery and productivity when rolling flat products.

The challenge:

Deficiencies in flatness quality are often contributed to inadequate or even missing dynamic process conditioning functionality of the control system or conservatively tuned, respectively too slow control loops. Control loops always have to satisfy the criterion of stability for all working points. Conventional control loops have to be tuned for the highest responsiveness of the process and thus often compromise all other working points. Furthermore, a control system which is purely based on measurements won't generally reach the optimum working point.

Our solution:

The model based flatness control system *SBox* of *milltec* comprehensively fulfils the requirement considering the current rolling situation and process dynamics.

Numerous physical and self learning process models observe the process and provide the flatness controller with detailed information about the process states. The exact knowledge of the controlled process allows highest control dynamics independently from product properties and process states. This applies in particular to new products, which often challenge or overstrain conventional control systems.

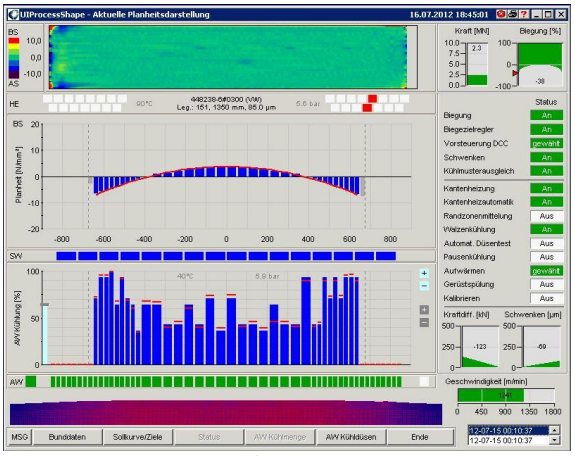

Figure 1 *SBox* main HMI

The *SBox* for example includes a high resolution physical model computing the axial, radial and circumferential surface temperature field of the work rolls nearly in real time. This temperature field is particularly needed for the determination and consideration of the dynamics and directivity of the zone cooling. Furthermore, this model serves as basis for thermal conditioning of the work rolls.

The physical models of the *SBox* not only provide the control loops with detailed process information. Also the operators and process engineers benefit from the detailed insight into the process beyond measurements.

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***SBox* - The model based flatness controller**

Another highlight of the *SBox* is the possible interaction with the gauge control system for maximising recovery.

In combination with a *milltec Setup*, the *SBox* is able to optimise the bending preset of the next coil by active thermal conditioning of the work rolls while rolling the predecessor coil.

Another technological option being available when combining *SBox* with *Setup* is the dynamic intermediate cooling:

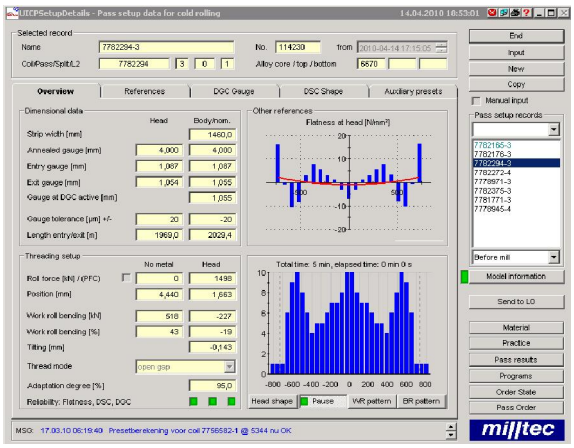

Figure 2 Intermediate cooling pattern for predicted flatness

Different to conventional intermediate cooling strategies with only a fixed coolant pattern, for each coil individual work roll coolant pattern are calculated and cyclically updated by the *Setup* function based on the forecasted flatness at the strip head of the following pass.

Due to the adaptation of the roll coolant pattern to the flatness requirements, the average coil change time significantly decreases and the flatness after product changes improves.

Summary:

Strip flatness is one the most contributing factors to recovery and productivity when rolling flat products.

A control system which takes this responsibility into account should combine:

- Intelligent strategies with dynamic process conditioning and
- Highest possible dynamics in all conditions.

The *milltec SBox* combines these criteria with:

- Numerous physical and self learning process models,
- Process observation for sensitivity calculation and mill state tracking,
- Intelligent control strategies using process observation results,
- Intelligent strategy modules for dynamic conditioning the process.

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