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Research area: Process aims
Paper and paperboard production // stock preparation

Key words:
Computer Assisted Paper Design, simulation, optimization, validation

Title:
Validation and calibration of models used for the prediction of pulp and paper properties under industrial scale conditions

Background/Problem area

Numerical models describing fundamental relationships between material or process parameters and the resulting paper properties are one of the focal points of PTS research in the area of ”Computer Assisted Paper Design“ (CAPD). PTS scientists have recently completed the development of several elements for the numerical modelling of stock preparation processes and the prediction of laboratory sheet properties.

The models are based on pilot plant scale experiments at PTS Heidenau. Despite the use of parameters and conditions similar to those in paper mills, a model cannot simulate all of the disturbing influences typical of real processes. As a matter of fact, each numerical model derived under ideal conditions will deviate more or less from the real process behaviour. For this reason suitable methods for model validation and calibration are needed. However, there are practically no standard procedures available, and the issues are largely unexplored due to their complexity.

Objectives/Research results

The research project is intended to develop a general validation procedure for CAPD-related numerical models under industrial scale conditions. Models are validated to make sure they are properly adjusted to a given task and represent the real process with adequate accuracy. This does not necessarily mean that they must exactly match the process in all points; in many cases it is sufficient that the model follows the same trends.

Within the research project the CAPD modules “Refining”, “Mixing” and “Sheet forming/sheet properties” were used to forecast the effect of refining parameters on paper properties from known pulp characteristics. For several pulp mills the following steps were carried out:

- Determination of relevant stock and process parameters on site
- Drawing up the structural model of the refiner arrangement at the mill
- Using the latter model calculations were carried out and calculation results were compared to measured values of the real process.

The results show that in most cases the relationships between refining parameters and the resulting pulp and sheet properties are adequately reflected by the CAPD models currently available. The next steps will consider calibration functions to overcome remaining differences between the real process and model calculations. The final aim is a continuous methodology covering all stages of module development: from the on-site acquisition of stock and mill data to model generation, verification and the factually correct calibration of complex models.

Application/Economic benefits

Currently an increasing demand for simulation models used to predict paper properties can be recognized. But up to now software tools concerning this matter are not commercially available. A thorough validation of the existing CAPD models developed at PTS guarantees their applicability in paper mills. Furthermore the results of the research project will provide a high degree of model reliability which is a prerequisite for risk minimization and for the acceptance by customers. Numerical models qualified to describe classical paper manufacturing processes allow an efficient design of paper properties especially with regard to the following tasks:

- prediction of paper properties for a given set of raw material properties and process parameters

- assessment of changes in paper properties because of varying raw material characteristics

- systematic selection of raw materials to meet the defined paper specification and

- adaptation of process parameters to compensate for raw material variations.

The developed techniques for model validation and calibration can be applied as well to future models using a data structure identical to the existing models. Thus the implementation of new simulation models and their application in practice can be carried out very quickly.

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Remarks

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