Research institute:
PTS Munich
Hessstr. 134
80797 Munich, Germany

Internet: www.ptspaper.de

Head of the research institute:
Dr. P.W. Rizzi
Project leader:
Dipl.-Ing. G. Kamml
Tel: +49 (89) 121 46 – 409
Fax: +49 (89) 121 46 – 36
E-mail: G.Kamml@ptspaper.de

Research area: process aims
paper and board production / paper manufacturing

Keywords:
Simulation, Water Circuit, forecast accuracy

Title:
Improvement of forecast accuracy by dynamic simulation for paper process optimization

Background/Problem area

Water circuits in paper mills are characterized by high dynamic process conditions. Because of high amounts of process water circulated and high efforts for fresh water preparation and effluent treatment dynamic simulation models are a useful tool in process optimization and for decision making in water circuits. The development of simulation models is based on detailed on-site measurements and fundamental knowledge of water circuit arrangements in paper mills. In the case of organically grown paper mills usually not all necessary parameters for modeling and model calibration can be determined and have to be estimated based on key values and general process knowledge. The reliability of proposed measures for process optimization is on the other hand directly depending on the performance of dynamically models used for simulation. None of the process simulators currently available automatically supports evaluation of the forecast accuracy of the simulation model in respect of the estimated parameters. As even the impact of single parameters on time-dependent processes are various and complex, manual methods therefore are not sufficient.

Objectives/Research results

With assistance of dynamic simulation tools multiply linked water circuits in paper mills can be fully illustrated. Essential parameters for calibration of dynamic simulation models are often not accessible within the real process and have to be estimated with measurable auxiliary parameters or determined by coupled volume flows or changing levels in chests before or after. By help of a so-called validation assistant, the process of parameter estimation should be assisted by a software tool, which can guarantee high sophisticated simulation models, useful for reliable statements for process optimization and investment decisions.
In a first step a dynamic simulation model for a paper mill water circuit has been built. Real time process data from the paper mill was collected during a one week on-site examination. Additionally analytical measurements have been performed to characterize the process. A tool for scenario management and data collection for the simulation model has been developed. Multiple parameters can be changed and results can be logged for every parameter set.

A Matlab based tool for comparison of simulation results and optimizing parameters has been development. In the current state the validation assistant is available in a stand alone version and in a linked version with the simulation tool IDEAS. Both versions are capable to compare original data from mill examination with data generated by a simulation model. The accuracy of the model is evaluated, based on the calculation of different evaluation parameters. The impact of model calibration parameters on the behavior of the model can be shown.
The linked version can also be used to send back a new set of calibration values to the simulation model. Different optimization strategies are currently tested to find optimized calibration parameters. At the current moment, process data and data from a simulation model of a second paper mill is used to test the validation assistant. A further task with help of the second model is to further improve the parameters used for validation of the model and test the optimization functionality.

Application/Economic benefits

High accurate simulation models will provide a better understanding of process conditions and process rules. Paper mills will be able to develop optimized operation characteristics for short time changing process conditions and can get support for long term investment decisions. Especially for small and media sized enterprises with relatively low production capacities, but high specialized products, it is important to operate their paper mills in optimized process conditions. The possibility of evaluation of model accuracy will help paper mills, to rely on simulation results and help to increase the acceptance of simulation in the paper industry.
Dynamic simulation models will also support a further reduction of effluent volumes in paper production and therefore help to reduce costs of waste water treatment and effluent discharge. By process optimization of typical paper mills working on already low specific effluent volume flows of 3 l/kg a dynamic simulation model can help to develop measures to reduce dynamic problems of overflows and change process conditions. Possible reductions of effluent volume flows by up to 30% can be expected.

Project period: 1st November 2003 – 30th October 2005

Remarks

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