REAL-TIME SIMULATION OF A FEEDFORWARD CONTROL PROCESS ADAPTATION AT THE MANUFACTURING OF FIBERBOARDS

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The industrial manufacturing of wood-based panels has become a highly technological process, where all parameters have to be perfectly adjusted for products of constant and high quality. However, variations caused by differing wood characteristics, such as anatomy, relative amount of constituents or different pre-treatment, as well as variations of single process parameters can cause out of control events. These undesired events can be diminished by monitoring and controlling the entire manufacturing process using gauges, databases and multivariate statistical techniques.

In this work, the process of manufacturing fiberboards was adapted, using the internal bond strength (IB) of boards as the dependent variable. Particularly, the adaptation of process variables was realized by feedforward control and multivariate regression techniques using Partial Least Squares Regression (PLSR). The MNRMSECV (Mean Normalized Root Mean Squared Error of Cross Validation) of predicted IB values using all process variables was 5.6 %. In order to improve this initially calibrated PLSR model, a variable selection was carried out using Interval PLS, where the most important independent variables were selected. Hence, the MNRMSECV of predicted IB values could be decreased by more than 50 % to 2.5 %, using only the selected variables. This improved model was used to predict IB values with new real-time data. Furthermore, calibrated PLSR models were validated using the real IB values from destructive laboratory tests and recalibrated, if necessary (feedback control).

For the feedforward control, a target IB value of 1.7 N/mm² was defined. Thereafter, values of controllable model variables were changed within predefined limits (max ± 1 s), in order to minimize the deviation of the predicted IB value from the target IB value. As a result, predicted IB values of 1.7 N/mm² could be consistently gained, using PLSR models with adapted process variables. Additionally, this minimization function could also be applied to multiple predicted variables, like the bending strength or thickness swelling of boards. Conclusively, raw material and energy inputs can be reduced due to narrower margins of safety by using real-time feedforward control process adaptation.