The characterisation of TMP fibres in MDF

Scientists at the Thünen Institute in Hamburg, Germany, have been working with GreCon of Alfeld to develop an inline system for the characterisation of TMP fibres in MDF; and an offline fibre analysis system. Jan Benthien of the Thünen Institute describes the system

A typical feature of raw materials from renewable resources is their natural quality variations.

To recognise and react to these variations is a big challenge in industrial production. In the case of the wood based panel industry, the size distribution and morphology of the wood particles and fibres is of importance for both production and the resulting panel properties.

Despite the importance of fibre quality for medium density fibreboard (MDF) production, its evaluation continues to be carried out at a technically low level because no adequate measuring devices are available on the market.

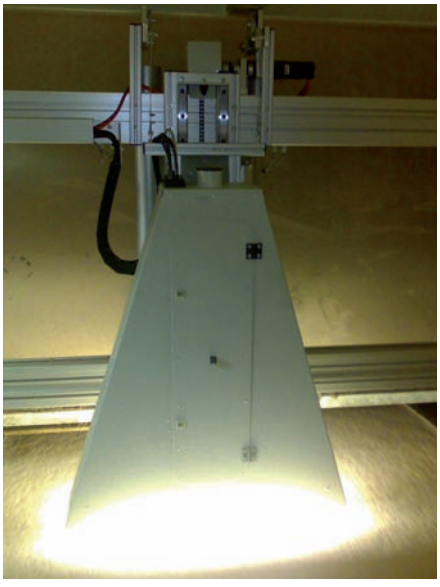
This was the finding of a worldwide survey of MDF factories which was presented at the International Wood Composites Symposium (IWCS) in Seattle, Washington, US, in April 2013 (Benthien et al, 2013a).

According to the results of this study, skilled personnel perform the great majority of fibre quality control simply with touch and visual evaluation.

Fibre quality is also evaluated by using various sieving methods adapted from particleboard production: comparing the finished surface produced with MDF reference samples; and on the basis of the fibre mat density.

Image-based fibre analysis systems from the pulp and paper industry cannot be adapted adequately for the characterisation of thermo mechanical pulp (TMP) used in MDF manufacture.

The GreCon Fiberview



Fiberview in action

Because of the large size spectrum of TMP – the particle size ranges from small dust particles (fibre fragments) to single wood fibres, up to several-centimetre-sized fibre bundles (undefibrated wood particles) – such systems are inapplicable for TMP characterisation. In particular, fibre bundles (shives) tend to block the flow-cell, as our own experiments applying a "Kajaani Fibre Lab" (from Metso Automation, Kajaani, Finland) have shown.

The limited usability of wet fibre suspension-based image analysis measuring systems for the characterisation of TMP also applies for dry image fibre analysis systems.

Testing fibre quality simply by touch

In particular, the need to separate the fibres before image acquisition with manual and time-consuming techniques, as well as the need to sort-out the overlapped fibres imaged, means that otherwise-promising measuring systems, like the FibreShape, QIC-PIC and Camsizer appear to be inadequate for TMP characterisation.

With the aim of solving the limitations of the currently-available measuring systems, the Thünen Institute of Wood Research (Hamburg, Germany), Hamburg University (in particular the Department of Wood Science), the Cognitive Systems Laboratory (KOGS) and Fagus-GreCon Greten GmbH & Co KG (GreCon), commenced development of software for image analysis-based fibre quality control in 2009.

This research project was called Fibre-Vision and was financed by the Fachagentur Nachwachsende Rohstoffe eV (FNR) on behalf of the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) in Germany.

In 2010, an image-based system for the

recognition of large fibres in the MDF production process was developed and tested at the joint research site of the Department of Wood Science and the Thünen Institute of Wood Research in Hamburg-Lohbrügge, with participation by industry partner GreCon.

This successor project, called Fibre-View, was financed by the Aif Projekt GmbH on behalf of the Federal Ministry of Economics and Technology (BMWi).

Resulting from these two research projects was the creation of an image analysis system for the recognition of shives on the surface of MDF panels (inline fibre characterisation); a software for the separation of cross-wise overlapping fibres; and a technique for mechanical fibre separation.

This mechanical fibre separation technique is trend-setting for automated offline fibre characterisation and is currently awaiting patent approval.

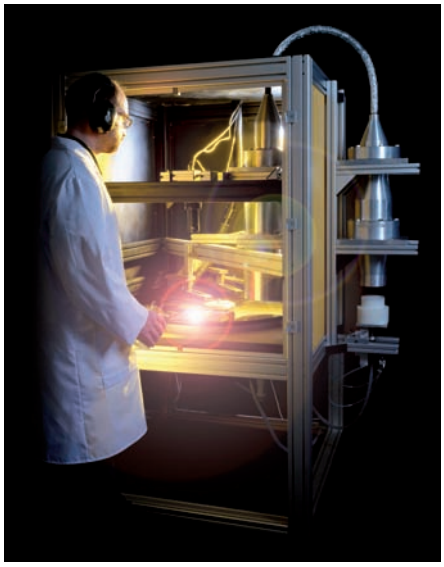
The inline fibre characterisation system was incorporated into the product portfolio of GreCon, and is in successful operation at three German MDF plants (Hasener, 2013a,b).

The offline fibre characterisation system is currently being tested, further developed, and used for the determination of the considerable influence parameters on fibre quality, and of fibre quality on fibreboard properties, in the context of a research project (Fibre-Impact), financed by the FNR on behalf of the BMELV.

This research was conducted by the cooperation partners Thünen Institute of Wood Research, GreCon, Glunz AG (Meppen, Germany), Austrian refiner manufacturer Andritz AG, Hamburg University, KOGS, and the IHD, or Institut für Holztechnologie (Institute for Wood Technology), Dresden.

The aim of this project was to develop a suitable measuring device for the MDF industry which can be used for:

1. Internal quality control: specifying, checking and ensuring the target fibre quality
2. machine service life evaluation: relating the achieved fibre quality to the state of the refiner disc
3. process optimisation: observing the effects on fibre quality during optimisation of steaming and defibration conditions to ensure that panel properties are above the minimum requirements
4. validating agreed performance data of the defibration machinery with regard to the product guarantee: objective information about the achieved fibre composition would be advantageous for both machinery suppliers and plant owners.



Offline fibre analysis in Thünen Institute

Since the first results of the development activities were presented at the IWCS 2011 and the "8th Fussbodenkolloquium" (Flooring Colloquium) in Dresden, functional details and first research results were recently published by Benthien et al (2013a,b) at the IWCS 2013 and at the 'Arbeitskreis Faseranalytik 2013' (Work Group Fibre Analytic) at the Institut für Biokunststoffe und Bioverbundwerkstoffe (IfBB) (Institute of Biogenic Plastics and Bio Composites) at the University of Applied Sciences and Arts in Hannover, Germany.

A more extensive description of the hardware and software developed will be published in the *Journal of the Society of Wood Science and Technology Wood and Fibre Science* (Benthien et al 2014).

A conference contribution, focused especially on software details, is planned for the 22nd International Conference on Pattern Recognition – ICPR 2014 in Stockholm (Sweden).

As well as the publication of research results in the form of a final project report (Thünen Report), two more scientific papers are planned. One of these papers will focus on the interactions of defibration conditions, fibre characteristics and panel properties, while the second paper will show the potential of the measuring device, presenting characteristics of fibres from industrial production.

Firstly, differences in fibres collected in various MDF plants in the world will be shown, while secondly, the spectrum of fibre qualities produced for MDF, with different application examples of one MDF manufacturer, will be shown.

The data acquisition was organised with a recently-finished industrial trial. Within this trial, the offline measuring device that had been developed was operated in an MDF plant for the duration of three grinding disc lifetimes and successfully proved its system stability and usability in practical application.

This article was based on a paper written by J T Benthien, S Heldner, Dr M Ohlmeyer of the Thünen Institute of Wood Research. ■

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