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Research area: Process aims

Process measuring and control technology

Key words:

THz TD measurements, dynamic effects, penetration

TITLE:

Development of a method for the online monitoring of the dynamic behaviour of liquid interfaces in manufacturing and coating processes

Background/Problem area

The refining of raw materials by impregnation and coating as well as the manufacture of composite materials from liquid and solid origin are defining trends of modern materials technology. This applies to industries such as textile, paper, leather, wood and plastic industry. In addition to the development of products and production processes the provision of appropriate measurement methods for the design and manufacturing is vital, to ensure the quality of the products. Understanding the dynamics of penetration of liquids into substrates plays a central role and is the subject of extensive laboratory work.

Finishing agents do influence and determine the product properties. Liquid materials are often overdosed to achieve a specified concentration at the surface. Elsewhere, an overdose is associated not only with excessive use of materials, but leads directly to a reject production. Currently, existing measurement methods do not give adequate insight into the immediate process of finishing, whose relevant processes are completed soon after the application of material and their effects can usually be ascertained only on the finished product. Furthermore, there are often no or only very limited opportunities to examine the finished product partly or as a whole in terms of the quality of the impregnation using non-destructive methods.

The Terahertz TDS technique offers a non-destructive and contactless method to monitor the processes described online with high resolution in the z-direction.

Objectives/Research results

The aim of the project is the development of an online-enabled measurement method for tracking the dynamic processes during the penetration of liquids into solid, sheet-like materials such as paper, textile or nonwoven, as well as related materials, such as wood and wood materials. From the detection of the nature and progress of the liquid interface in the second or sub second range after applying conclusions shall be drawn on optimal production parameters for a more uniform production.

Technical results

- Setup of a suitable terahertz system
- Design and testing of static and dynamic impregnation unit
- Development of a method for the determination of the mean depth of penetration of liquids into solid materials as well as methods to characterize the kind and shape of liquid layer front.
- Adjustment of the measuring system and mathematical methods to practical relevant disturbances
- Statements about the robustness of the THz measurements related to environmental conditions

Scientific results

- Comparison and possible adjustment of different online and offline methods in terms of measuring penetration effects
- Development of a mathematical based model of the behaviour of liquids in solid materials and compounds
- Enhancing the understanding of the THz Time Domain measurement
- Creation of a concept for selection of appropriate solid and liquid materials for specific applications

Application/Economic benefits

The research results are especially useful in the fields of process technology, production, measuring, monitoring and automation, as well as in the industries of the production and processing of sheet like materials using coating or impregnation techniques.

With a direct visualization of the process, a stable impregnation, finishing and coating can be maintained. This leads to a better utilization of high-quality coating systems. The optimization of process parameters on the basis of on-line measurements allows a consistent product quality with minimal use of finishing agents. This leads to a reduction of material use and savings of energy for the preparation of impregnation, finishing and coating materials and specially for the drying.

By providing an on-line measurement method, the need for relatively complex analysis of material cross sections is reduced. The method can shorten the time necessary for development cycles.

Period of time: 01.01.2014 – 31.12.2015

Remarks

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