HIGH TECH COMPETENCE FOR HIGH TECH PAPER AND FIBER PRODUCTS: The Institute for Paper, Pulp and Fiber Technology at Graz University of Technology

Since its foundation in 1947 the Institute for Paper, Pulp and Fiber Technology (IPZ) at the Graz University of Technology (TU Graz) is the the only academic institution in the area of paper technology in Austria representing this field in the area of university education and academic research. With its staff of 23 people the institute also offers high quality services in the field of paper and pulp testing and in the calibration of testing instruments.

Student Excursion to Sweden (Södra)

Education:

Based on a broad scientific engineering education– ideally obtained during a Bachelor of Science degree in "Chemical and Process Engineering" (Verfahrenstechnik) at TU Graz – the Institute for Paper, Pulp and Fiber Technology (IPZ) is one of the few places in Europe and the only one in Austria offering a Master of Science de- and the equipment involved in pulp and paper production and converting. This theoretical education is complemented by a number of laboratory courses and several of industry excursions to paper and pulp producers and to converters. In the field of elective subjects the students can choose from a variety of topics – taught by industry professionals – to deepen their education in areas as e.g.

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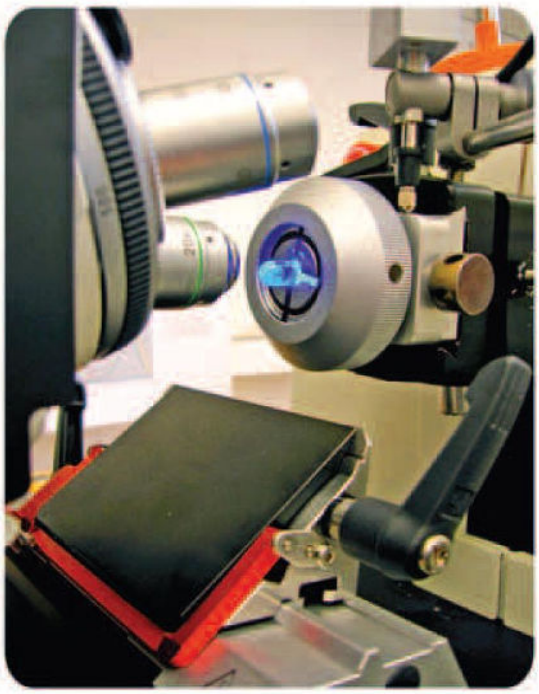
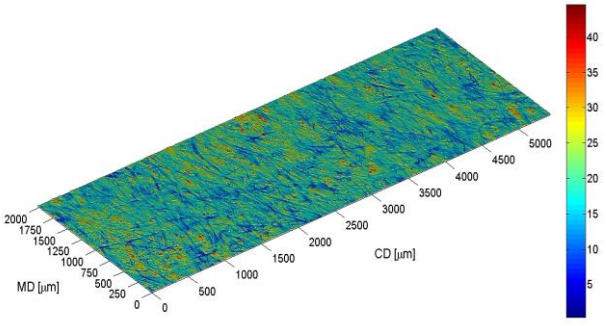
modeling and simulation, minerals, lignocellulosic biorefineries, environmental technology and so on.
A six month diploma thesis – usually carried out in the pulp and paper industry – marks the end of the studies. Interested graduates have the possibility to continue their education and to obtain a Ph.D. degree.
For graduates from other disciplines or for technicians with some years of industry experience interested in deepening their theoretical knowledge the institute also offers a three-semester course in "Paper and Pulp Technology", which leads to the title "Certified Academic Paper Engineer".



Serial sectioning technique for 3D paper analysis

Services:

The IPZ also operates the "Institute for Testing and Research for Paper, Pulp and Fiber Technology" which holds an accreditation according to ISO/IEC 17 025. In this framework testing of raw materials and paper and fiber products according to international standards is performed for a variety of customers. An overview of possible tests and prices is available under www.ipz.tugraz.at/Dienstleistungen.
Besides standard tests also unique testing routines developed in research projects are available as e.g. 3D coating thickness distribution maps, fiber cross sectional properties in the dry state, single fiber flexibility, single fiber damage due to refining, advanced image analytical routines for printability evaluation, refractive index maps of paper surfaces, local compressibility



Local coating thickness distribution on a WFC paper sample

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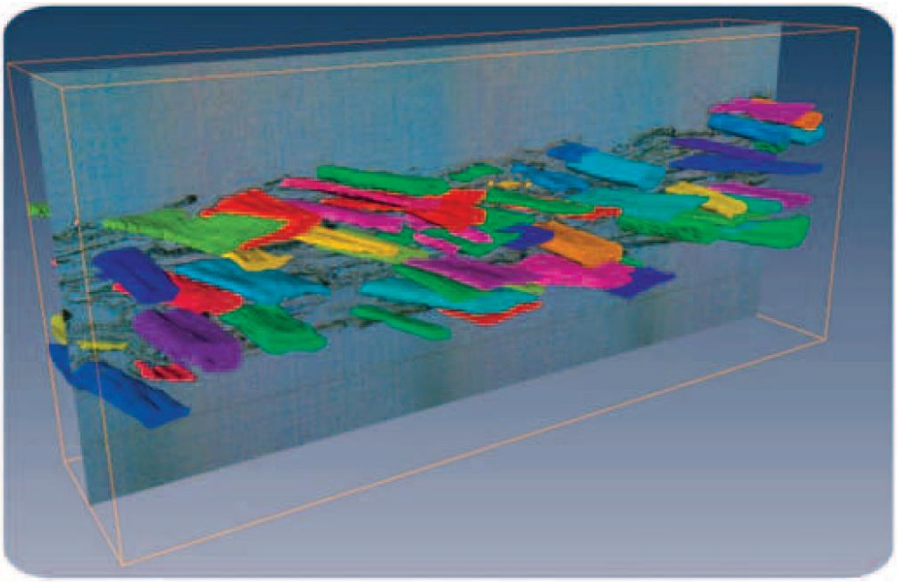

3D reconstruction of fibers in paper

maps etc. The examination of laboratory instruments represents an additional area of activities. Also in the frame of the accreditation according to ISO/IEC 17025 pulp, paper and board testing instruments are checked regarding their compliance to international standards.

These routine checks are performed on site at the customer and detailed reports concerning the performance of the instruments are issued, which are used in the certification of the quality management system of the customer.

The institute is independent from testing equipment suppliers and besides the check of the equipment also detailed advice concerning all questions regarding testing equipment is offered.

In general service is of high importance for the staff of institute since experience has shown that advice offered to the paper and pulp in-

Characterisation of fiber-fiber bonds in paper

Besides single fiber strength and number of fiber-fiber bonds, bonding area and specific bonding strength are responsible for the mechanical properties of a fibrous network. A new method for measuring the size of the bonded area based on microtome serial sectioning and image analysis has been developed, which simultaneously also allows the characterization of fiber morphological parameters in the region of the bond. Further activities are focused on the determination of specific bonding strength and its improvement by various modifications of the fiber surface.

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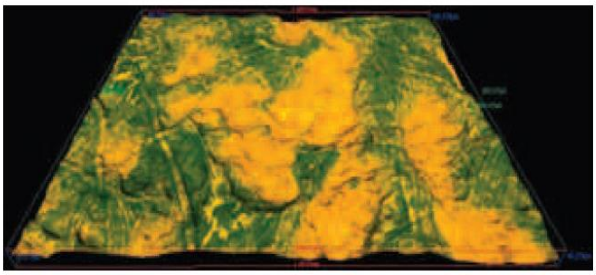

Flexographic printing ink (green) on a 3D visualisation of paper surface topography

dustry in solving current problems often is the basis for a long lasting and trustful cooperation.

Research:

The main challenge in papermaking is to achieve a uniform distribution of the highly inhomogeneous raw materials in the final product. High resolution measurement routines and modelling of paper and fiber structures and production processes therefore are some of the keys in the development of improved and novel paper products at optimized costs. At the IPZ an interdisciplinary team of paper and process engineers, mechanical engineers, image analysis specialists and mathematicians work on these topics and a few are presented in the following: High resolution analysis of the 3D material structure of paper Knowledge of the spatial arrangement of the main components (fibers, fillers…) in paper products is the basis for a deeper understanding of paper and board properties. A detailed analysis of a 3D-paper structure requires a high spatial resolution and a sufficient sample size. A serial sectioning technique has been developed which allows the digitization of paper samples up to a size of 1 cm2 at a resolution of 0.6 x 0.6 x 1 µm3. The result is a sequence of images which are further processed using specially developed image analysis algorithms. A three dimensional coating layer analysis tool allows the characterisation of coating layer structures. Other tools allow the in situ characterisation of fiber morphological parameters such as fiber width, fiber wall thickness and degree of collapse of the fibers. Furthermore, three dimensional reconstructions of single fibers in the paper network are possible. Ongoing work is focused on the prediction of paper properties based on the measured data as well as the development of new evaluation routines for paper and other materials. Image analytical evaluation of papermaking fibers and fiber suspensions.

Automated image analysis routines have been developed to characterise the morphological parameters of pulp fibers in suspension on a single fiber basis. Besides standard parameters (fiber length, width, curl etc.) several new parameters like single fiber flexibility, fibrillation, degree of damage of the S1 fiber wall and drag coefficient of fibers in suspension are measured in highly diluted fiber suspensions.

Another focus is set on the image analytical characterisation of fiber suspensions at a consistency of 0.5 to 1.5% which corresponds to the consistency normally used on industrial paper

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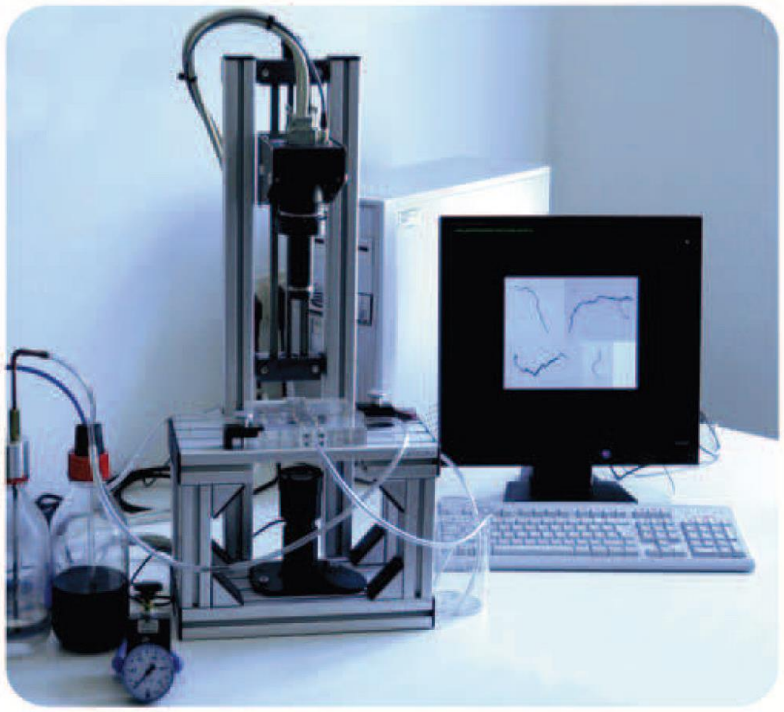
machines. The main parameter of interest is the degree of fiber flocculation in the suspension under various flow conditions. Correlations of fiber morphological parameters to the degree of flocculation and the influence of chemical additives on fiber flocculation are also evaluated.

Modelling the printability behavior of paper based on local measurements Research is aimed at predicting the evenness of the printing ink layer transferred to paper.

Uneven printing ink transfer and acceptance caused by inhomogeneities in the paper structure lead to a mottled appearance of the print. Multivariate statistical modelling is used to determine which of the local paper properties (e.g. surface topography, liquid penetration, chemical composition, pore structure) is mainly responsible for uneven ink transfer and the resulting poor print quality.



Measurement system for single fiber flexibility

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