N°6 - MARCH 2008

European Polysaccharide Network Of Excellence



"Nature produces polysaccharides, EPNOE turns them into materials"

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editorial

The world of polysaccharides is booming, with more and more interest in the tremendous possibilities that these natural polymers can offer. EPNOE is part of this adventure on several fronts. I wish to mention two this month; academia-industry relations and education. On February 8, about 60 scientists and managers of 46 European companies gathered in Paris to meet EPNOE scientists. It was the first meeting of the EPNOE Business and Industry Club, a structure which will build solid bridges between academia and industry through a multidisciplinary and collaborative R&D and education platform. All company members agreed on the success of a very well organised and informative day, mixing oral presentations and free discussions in front of posters, not to mention excellent food. Education is one, if not the major, condition for a successful growth of scientific and technical activities in the field of renewable polymers. Our field must be in a position to attract the best students, despite a decrease in interest of young European citizens for science. EPNOE is meeting this challenge by building attractive educational tools, combining the advantages of being part of the only organised international network on natural polymers and having a strong relation with industry. Our main actions are the organisation of a Marie Curie Training Network dedicated to post-graduate PhD and post-doctoral researchers (STEP project coordinated by Professor Thomas Bechtold of Innsbruck university) and the building of an Erasmus Intensive Program for under-graduate students (coordinated by Professor Anton Huber from Graz university). When fully operational, these two actions will provide a number of enthusiastic researchers who will make a significant contribution to European polysaccharide science and ensure that our industries remain competitive in the face of increasing worldwide competition.

Dr. Patrick Navard
Coordinator of EPNOE
Centre for Material Forming
Ecole des Mines de Paris / CNRS
(France)

news

Conferences

Conference of the German Agency for Renewable Resources (Fachagentur Nachwachsende Rohstoffe, FNR)

- Date: 29 May 2008
- Place: Friedrich Schiller University of Jena (Germany)
- Information: tim.liebert@uni-jena.de

In June 2005 the German Agency for Renewable Resources (Fachagentur Nachwachsende Rohstoffe, FNR) launched a call for projects focused on the use of plant ingredients as feedstock for new materials. Six projects were granted (amount ca 6 Mio. Euro). A project dealing with the search for new activating and dissolving media for cellulose was established at the Center of Excellence for Polysaccharide Research of the University of Jena. The conference held in Jena is a first gathering of the project leaders, co-workers and interested audience to discuss the results obtained up to now.

16th International Papermaking Conference PROGRESS'08 «Efficiency of papermaking and paper converting processes» organised by the Association of Polish Papermakers

- Date: 24-26 September 2008
- Place: Qubus Hotel, Cracow, Poland
- Information: http://www.spp.pl/events.php

Training

New Post-Master one-year education program on Bioplastics, including polysaccharides

- Date: starting October 2008
- Place: Ecole des Mines, Sophia-Antipolis (France)
- Information: www.bioplastics.cemef.ensmp.fr

Dedicated to post-graduate students looking for a specialisation in bioplastics, this course includes a six-month training period in industry. Teaching will be performed by Ecole des Mines staff and a large share of academic scientists from Nottingham, Wageningen and Pau, industrial scientists from 16 companies from 11 countries and representatives from French ministry of Ecology, School of Economics and European Bioplastics.

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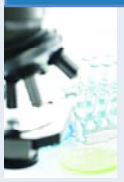
Training



An annual course (Current Topics in Carbohydrate Biotechnology) for scientists

- Date: 10 -11 April 2008
- Place: Notthingham (UK)
- Information: www.bioup.com/html/cb_2008.html

The science and biotechnology of large carbohydrate molecules and their derivatives is of major importance in the Life and Ecological Sciences and in several branches of industry, because of the attributes of these large, environmentally friendly (and largely biomedically non-toxic) molecules. This course provides an overview of the diverse properties of carbohydrates, how they are produced and characterised and how their properties can be adapted for particular needs.

COST Seminar (Towards Understanding Wood, Fibre, and Paper - deeper knowledge through modern analytical tools) for academic and industrial experts

- Date: 19-21 May 2008
- Place: Turku/Abo (Finland)
- Information: www.abo.fi/fak/tkf/spk/

The seminar will include invited internationally recognized key-note lecturers, outstanding presentations from COST Actions E41 and E50, a poster session with short presentations, and contacts with industrial representatives.

Members' info

Award:
Martin Patel, assistant professor in the Department of Science, Technology and Society at the University of Utrecht (Netherlands) won the 'Personal Contribution to Bioplastics' prize during the second Bioplastics Award that took place in Cologne (Germany) on December 5, 2007 for the work he has been doing over the past 15 years in the techno-economic analysis of energy saving and emission reductions achievable through new and existing industrial biotechnologies.

Reorganisation:
The former Federal Research Centre for Forestry and Forest Products (BFH) has merged together with part of the Federal Research Centre for Agriculture (Braunschweig) and the remains of the Federal Research Centre for Fisheries (Hamburg and Rostock) into the newly formed Federal Research Institute for Rural Areas, Forestry and Fisheries, also named «Johann Heinrich von Thuenen Institute» or vTI. The headquarter of vTI is now located in Braunschweig (Bundesallee 50, D-38116 Braunschweig).

New equipment:
University of Maribor (Slovenia) recently purchased new equipment - quartz crystal microbalance with dissipation unit (QCM-D, Q-Sense) which is a very sensitive technique and can be used to characterize the formation of thin films (nm) such as proteins, polymers and cells onto surfaces, in liquid.

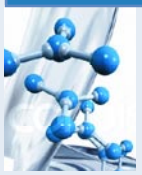
Retirement:
John Mitchell recently retired from a full time position at the University of Nottingham and has been re-employed on a part-time basis. While Professor Sandra Hill has replaced him as Head of the Food Structure Group, his role in EPNOE will increasingly be undertaken by Tim Foster.

New PhD students:
Diploma students: Kristin Schumann «Regioselective Cellulose Ethers»

Holger Wondraczek, «Photoactive Polysaccharide Derivatives», University of Jena (Germany).

Ales Doliska, «Adsorption study of xylans, mannans and their derivatives onto polymer surfaces» (textile fibres, films) in collaboration with the University of Graz, vTI and Aabo Akademi University.

Forthcoming articles



Treatment in Swelling Solutions Modifying Cellulose Fiber Reactivity - Part 1: Accessibility and Sorption; *A. Jaturapiree, A.Ehrhardt, S. Groner, H. B. Oeztuerk, B. Siroka, T. Bechtold* - Macromolecular Symposia

Treatment in Swelling Solutions Modifying Cellulose Fiber Reactivity - Part 2: Accessibility and Sorption; *H.M. Bui, M. Lenninger, A. P. Manian, M. Abu-Rous, C. B. Schimper, K. C. Schuster,T. Bechtold* - Macromolecular Symposia

Novel biocomposites with feather keratin; *K. Wrzesniewska - Tosik, D. Wawro, M. Ratajska, W. Steplewski* - Fibres &Textiles in Eastern Europe

A nonwovens coated by chitosan with potential anti-microbial behaviour – preliminary results; *M.H. Struszczyk, K. Brzoza-Malczewska, M. Szalczynska* - Fibres &Textiles in Eastern Europe

An environment-friendly method to prepare microcrystalline cellulose; *H. Stupinska, E. Iller, Z. Zimek, D. Wawro, D. Ciechanska, E. Kopania, J. Palenik, S. Milczarek, W. Steplewski, G. Krzyzanowska* -Fibres &Textiles in Eastern Europe

Water-soluble 3-O-(2-methoxyethyl)cellulose: Synthesis and Characterization; *Th.Heinze, A. Koschella* - Carbohydrate Research

Syntheses and Comparison of 2,6-Di-O-methyl Celluloses Both from Natural and Synthetic Celluloses; *H. Kamitakahara, A. Koschella, Y. Mikawa, F. Nakatsubo, Th. Heinze, D. Klemm* - Macromolecular Bioscience

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Zoom on EPNOE Partners' research

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Modification and derivatisation of cellulose in novel solvents

The market for renewable biopolymers like cellulose is constantly growing and a great part of the worldwide cellulose production is used for fibre spinning. The Thuringian Institute of Textile and Plastics Research (TITK) uses a traditional NMMO solvent process as well as developing new spinning processes based on ionic liquids (IL) as solvents. Aside from fibre spinning TITK is dealing with the chemical modification of polysaccharides and their subse-quent up-scaling. Utilizing a well equipped pilot plant (figure 1), synthesis of advanced poly-saccharide derivatives for special applications in kg-scale is feasible. There is growing interest in the ability to produce water soluble cellulose derivatives with a regioselective distribution of substituents as model substances, with the potential for new applications, for example 6-O-trityl cellulose (figure 2), tosyl cellulose (figure 3), and trimethylsilyl cellulose (figure 4) .

Figure 1: Autoclaves in the pilot plant of TITK applied for up-scaling of laboratory synthesis.

A heterogeneous approach is usually favoured for the preparation of the derivatives because this procedure is already widely used in industry. However, there are some derivatives only accessible by homogenous conversion of cellulose. TITK have been able to develop homoge-neous reaction systems for this purpose, based on solutions of cellulose in N,N-dimethylaceteamide (DMAc)/LiCl, which is an approved reaction medium for esterification, etherification and many other reactions. The use of ionic liquids as a reaction medium is also being developed. However, further scientific research is needed to clarify many unanswered questions concerning, for example, purity requirements, recycling of solvent, feasibility of a variety of synthesis reactions or unwelcome side reaction.

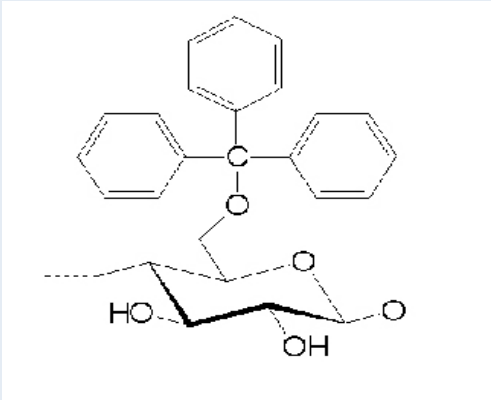

Figure 2: 6-O-Trityl Cellulose

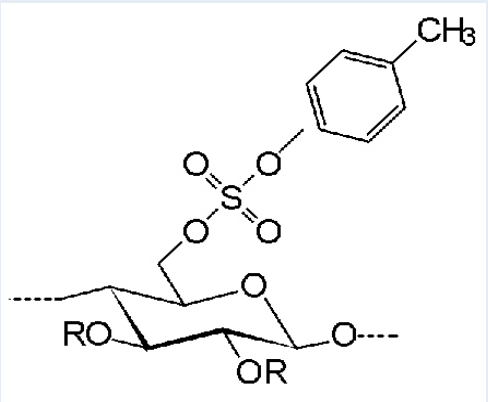

Figure 3: Tosyl Cellulose

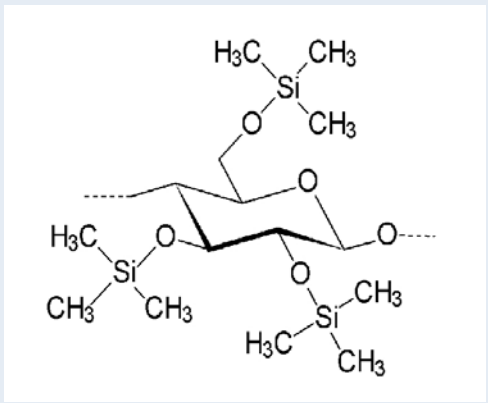

Figure 4: Trimethylsilyl Cellulose

Dr. Frank Meister
Thuringian Institute of Textile and Plastics research - Division of Native Polymers and Chemistry (Germany)



Description of EPNOE research

Fundamental Theme 5: Nano- and micro-scaled surface modifications of polysaccharide matrices using soluble and functionalized polysaccharides

The field of surface and interface science and technology is an interdisciplinary subject and is at the forefront of an increasing number of scientific and technological activities; for example nanotechnology and catalysis, information technology, materials science and bio-medicine. The technological use of surfaces and surface processes gains more and more importance every year. Non-soluble polysaccharides (1), especially oriented ones, exhibit beside their high-value structure huge surface areas and different surface accessibility to different chemical groups. These properties offer materials development fields ranging from surface modified cellulose fibres enabling sustainable and environmental friendly processing routes, to surfaces with selective interaction possibilities, surfaces providing a controlled release of active substances, compound materials exhibiting specific and tuneable interaction properties as well as sensor elements and biocompatible medical devices. Their processing happens exclusively in heterogeneous reaction systems causing therefore a dominant role of the surface area and interface processes.

The effect of polysaccharides adsorption on fibre properties as well as the importance of hemicellulose structure, molar mass, and charge has been investigated stating a positive effect of hemicelluloses on mechanical properties (2, 3), synergy with cationic compounds (4) and sorption capability (5). Those studies were focused on the mechanical properties of fibres and demonstrate that significant changes can be achieved. The physical interaction and chemical reaction of the less ordered amorphous structure with function bearing compounds, soluble natural and derivatized polysaccharides and polymers, pigments, nano-particles and drugs is not yet well understood and barely used technologically. However, this knowledge is essential when not only bulk products, but high value materials are prepared. The basic understanding for the development of specifically surface modified cellulose materials (fibres, non wovens, membranes) for technical, medical and hygienic applications and the know-how about new techniques to produce those high value compounds will be developed in this multi-EPNOE partner project.

Fundamental Theme 5 targets:

Preparation of large surface area cellulose materials. A matrix of very high surface area, and with excellent mechanical properties, will be prepared from oriented cellulose materials. These surfaces will be modified in order to introduce new properties in technical applications, specific chemical, physical or mechanical properties, selective interaction properties, storage and release capacities for drugs or antimicrobial properties (6).

Surface activation

The way to obtain these specific cellulose surface properties comprises surface activation of the cellulose matrix followed by the irreversible adsorption or chemical binding of soluble polysaccharides. Cellulose surfaces are activated using physical (radiation, plasma treatment) and chemical ways (controlled oxidation, photochemical). A comparison between the reactivity (sorption capacity) of these activated surfaces is performed for the selection of the best possible procedure (combination of different activation methods).

Surface modification

Polysaccharides of different kinds as hemicelluloses, glucoseaminoglucanes, starches as well as their derivatives will be used for the modification of surface properties, the tuning of the hydrophilic / hydrophobic character and the introduction of specific functionalities and interaction properties. The compounds functionalization will preferably be made in homogeneous derivatization processes.

EPNOE Partners involved and their tasks:

University of Graz: Coordination, Functionalization of soluble cellulose, surface characterisation, interaction studies
University of Jena: Functionalized derivatives of cellulose and hemicellulose; *vTI (Hamburg)*: Preparation, chemical and physical characterization of different xylans, sorption and desertion experiments; *Abo Akademi University*: Isolation and sorption experiments of mannans onto cellulose-rich materials; *Petru Poni (Iasi)*: Chemical and physical modification and characterisation of solid cellulose materials; *University of Maribor*: Adsorption / desorption processes, chemical and physical surface characterisation.

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