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European Polysaccharide Network Of Excellence



"Nature makes polysaccharides, EPNOE turns them into products"

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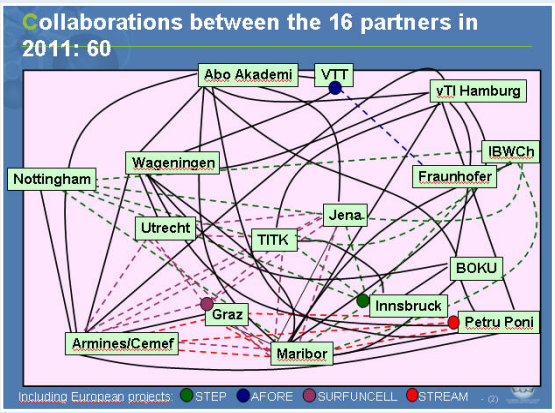
editorial

Dear readers of the EPNOE Newsletter,

At the last governing Board meeting of EPNOE, held in Wageningen on August 29, I made a survey regarding the number of bi- or multi-lateral collaborations that have been running in 2011 between the 16 research/academic members of EPNOE. Such a figure is a very strong indicator of the collective dynamism of a network.

Let's first recall what the state of collaboration was between these members before the start of EPNOE. Over five years, from 2000 till 2004, only five members had a bi-lateral collaboration, plus three collaborations inside Germany due to a federal initiative. During year 2011, at least 60 collaborations were running, not financed by EPNOE but for most of them financed by outside sources from various origins (industrial contracts, EC projects, National initiatives).

It is a tremendous achievement, showing how much EPNOE partners are conducting their research together. It is a very strong point of attraction for companies which can find in this network all the scientific and technological resources they need to overcome blocking points and innovate.



With my best wishes,

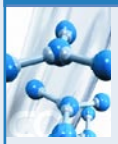
Dr. Patrick Navard
Coordinator of EPNOE
Centre for Material Forming
Sophia-Antipolis
(France)

news

Members' info

New diploma students
Two new diploma students joined the group of Prof. Heinze, University of Jena:
- Anja Friedl, in the field of polysaccharide derivatives/material science
- Robert Hampe, in the field of polysaccharides for medical applications

Forthcoming articles



A statistical analysis of fibre size and shape distribution after compounding in composites reinforced by natural fibres;
N. Le Moigne, M. Van den Oever, T. Budtova ;
Composites Part A, 42(10), 1542-1550 (2011)

Polypropylene/natural fibres composites: analysis of fibre dimensions after compounding and observations of fibre rupture by rheo-optics;
A. Le Duc, B. Vergnes, T. Budtova;
Composites Part A, in press, doi:10.1016/j.compositesa.2011.07.027

Extraction and chemical characterization of Norway spruce inner and outer bark;
J. Krogell, B. Holmbom, A. Pranovich, J. Hemming, S. Willför;
Nord. Pulp. Pap. J., in press

Synthesis of diblock methylcellulose derivatives with regioselective functionalization patterns;
A. Nakagawa, D. Fenn, A. Koschella, Th. Heinze, H. Kamitakahara;
Journal of Polymer Science, Part A, Polymer Chemistry, 2011, DOI: 10.1002/pola.24952

Physical properties of diblock methylcellulose derivatives with regioselective functionalization patterns: first direct evidence that a sequence of 2,3,6-tri-O-methyl-glucopyranosyl units causes thermoreversible gelation of methylcellulose;
A. Nakagawa, D. Fenn, A. Koschella, Th. Heinze, H. Kamitakahara;
Journal of Polymer Science, Part B, Polymer Physics, 2011, DOI: 10.1002/polb.22343

Alkyl β-D-cellulosides: non-reducing cellulose mimics;
M. Meiland, T. Liebert, A. Baumgärtel, U. S. Schubert, Th. Heinze;
Cellulose 2011, DOI: 10.1007/s10570-011-9581-4

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EPNOE Partners' projects

New EC project, "AEROCOINs", started the development of new efficient superinsulating materials for construction sector

Silica aerogels are light nanostructured amorphous materials (Figure 1). Their porosity is higher than 90% with pore sizes in the mesoporous ranges (generally, between 5 and 30 nm). This makes them the most promising insulating materials with the lowest thermal conductivity materials ever measured under ambient conditions ($\lambda < 0.013$ W m-1 K-1). However, their very poor mechanical properties and high cost associated with their production prevent using them intensively in building and construction sectors.

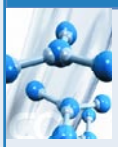
The main objective of AEROCOINs project is to create brand new superinsulating materials, mechanically strong and price-affordable, by combining silica-based sol-gel chemistry and using polysaccharides for aerogels reinforcement.

The project is coordinated by TECNALIA RESEARCH and INNOVATION (Spain); project partners are technology centers and universities: CEP and CEMEF from Mines ParisTech (France), EMPA (Switzerland), VTT (Finland), ZAE Bayern (Germany), Technical University of Lodz (Poland) and companies: PCAS (France), Acciona Infraestructuras (Spain) and SEPAREX (France).

Figure 1. Silica aerogel made by CEP/Mines ParisTech

news (continued)

Forthcoming articles



Pure, transparent-melting starch esters: Synthesis and Characterization;
T. Liebert, M. C. V. Nagel, T. Jordan, A. Heft, B. Grünler, Th. Heinze;
Macromolecular Rapid Communications 32 (2011) 1312-1318.

Expedient, accurate methods for the determination of the degree of substitution of cellulose carboxylic esters: Application of Uv-vis spectroscopy (dye solvatochromism) and FTIR;
R. Casarano, L. C. Fidale, C. M. Lucheti, Th. Heinze, O. A. El Seoud;
Carbohydrate Polymers 83 (2011) 1285-1292 .

Stable Cellulose Nanospheres for Cellular Uptake;
T. Liebert, M. Kostag, J. Wotschadlo, Th. Heinze;
Macromolecular Bioscience 11 (2011) 1387-1392.

Tailoring the Degree of Polymerization of Low Molecular Weight Cellulose;
M. Meiland, T. Liebert, Th. Heinze;
Macromolecular Materials and Engineering 296 (2011) 802-809.

Meltable Dextran Esters As Biocompatible and Functional Coating Materials;
T. Liebert, J. Wotschadlo, P. Laudeley, Th. Heinze;
Biomacromolecules 12 (2011) 3107-3113.

Proteinähnliche Oligomerisierung von Kohlenhydraten;
Th. Heinze, M. Nikolajski, St. Daus, T. M. D. Besong, N. Michaelis, P. Berlin, G. A. Morris, A. J. Rowe, St. E. Harding;
Angewandte Chemie 123 (2011) 8761-8763.

Protein-like Oligomerization of Carbohydrates;
Th. Heinze, M. Nikolajski, St. Daus, T. M. D. Besong, N. Michaelis, P. Berlin, G. A. Morris, A. J. Rowe, St. E. Harding;
Angewandte Chemie, International Edition 50 (2011) 8602-8604.

The dissolution of cellulose in NaOH-based aqueous system by two-step process;
H. Qi, Q. Yang, L. Zhang, T. Liebert, Th. Heinze;
Cellulose 18 (2011) 237-245.

EPNOE Partners' research

Improvement of strength and stiffness of paper with chemically modified micro-fibrillated celluloses

The economy of paper industry is characterized by constant competition and cost pressure. Therefore, an important goal is the use of fibers, fillers, and additives as efficiently as possible in order to produce paper of the desired qualities. With respect to the fiber raw material, cost savings can be achieved if the elementary fiber structures essential for the paper strengths emphasise effectively. For increasing the bondable fiber surface it seems to be possible to induce external and internal fibrillation, on one hand. On the other, the application of micro-fibrillated cellulose during sheet formation is an alternative approach to improve the paper quality.

In a cooperation project (grant number: IGF 15707 BR, BMWi/AiF) of Papiertechnische Stiftung Germany and our group at the Friedrich Schiller University of Jena, the influence of micro-fibrillated cellulose of different qualities on the increase of strength and stiffness of low weight packing paper was studied. The mechanical homogenization degree and the specific surface of the incorporated micro-fibrils are most important for the effectiveness on the increase of the strength of paper without losing volume. Various micro-fibrillated cellulose samples were studied and it turned out that a chemical modification is a promising approach to improve the properties regarding paper quality. In particular a heterogeneous surface acetylation of the micro-fibrillated cellulose under strict aqueous conditions could be established. By an optimized procedure, almost no change of the micro-fibrillated structure occurred as could be shown by SEM studies (Fig. 1). The products obtained significantly increase the efficiency of micro-fibrillated cellulose in the field of paper making. In concluding, a significant amount of raw material can be saved by an optimal combination of chemical modified micro-fibrillated cellulose and paper-typical additives. The process technology development is relatively simple. However, appropriate quantity of micro-fibrillated cellulose on industrial scale is still missing.

The authors want to thank the Federal Ministry of Economics and Technology for their financial support (project IGF 15707 BR).

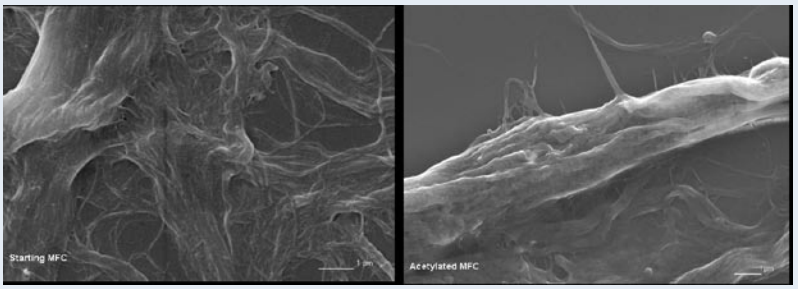


Figure 1: Scanning electron micrograph imagines of micro-fibrillated cellulose before and after surface acetylation.

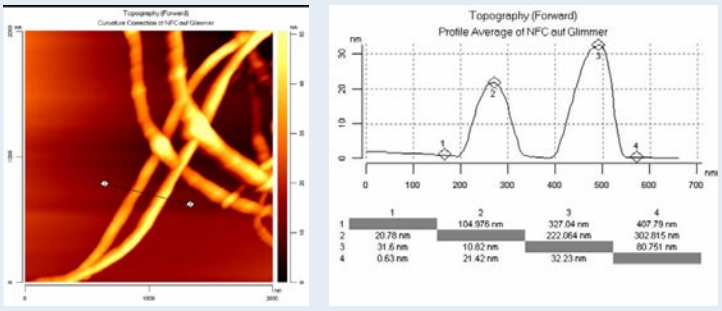


Figure 2. Atomic force micrograph imagine of single micro-fibrillated cellulose fibre.

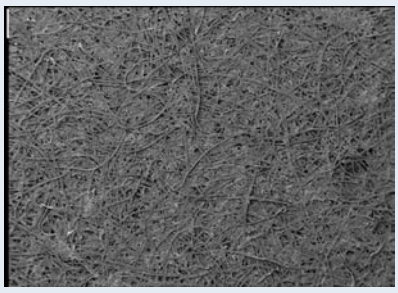


Figure 3: SEM imagine of paper sheet with incorporated acetylated micro-fibrillated cellulose.

Thomas Heinze (1), Katrin Petzold-Welcke (1), Tiemo Arndt (2), Klaus Erhard (2)
(1) Friedrich Schiller University of Jena, Germany (2) PTS, Germany

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EPNOE Education

Intensive Programme (IP) 2011 "Sustainable Utilization of Renewable Resources"

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An Intensive Programme (IP) is a European Commission education project. The IP "'Sustainable Utilization of Renewable Resources" is a teaching course which gathered PhD students and Post-docs for two weeks, July 4-16, 2011, in Graz, Austria. It was organized by the University of Graz, and supported by EPNOE.

The IP 2011 'Sustainable Utilization of Renewable Resources' focused on the recent knowledge on the geographically dependent production and utilization of renewable resources in general and with a major focus on polysaccharides in particular. The ecology and economy of various applied processing approaches were covered as well as the growing fear of a competition between agro-based energy and demand for nutrition. Ecological footprints and Life Cycle Analysis approaches and methods were discussed. Communities, regional organizations and enterprises were visited to demonstrate and argue the pros & cons of their local approaches to sustainable processing and use of appropriate technologies.

16 students out of the 42 international attendants have been sent by EPNOE partners. 12 out of the 27 international teachers and instructors were from EPNOE partner institutions.(Abo Akademi in Finland, BOKU Vienna, in Austria, Armines, Sophia Antipolis from France, Petru Ponu, Iasi from Romania, Utrecht University from the Netherlands and University of Graz, Austria.

The major features of IP 2011 were:

(1) Two weeks of lectures, discussions, guided tours at regional small scale, industrial and research units and presentations on selected topics;

(2) the teaching of new concepts such as 'non-linear dynamics' for improved explanatory potential for biological processes; presentations and discussion on recent aspects of life cycle analyses and ecological footprints and modelling of technological processes and waste water treatment;

(3) good balance between theory (LCA, ecological footprint, modelling) and practice (guided tours at Bioenergy Mureck, electronic waste management Saubermacher and finepaper production SAPPI Gratkorn);

(4) Attending students which successfully passed the final exam have been awarded with a certificate of 7 ECTS for their regular study programmes at home institutions.

All 16 EPNOE partner-institutions students passed the final exam successfully and have been awarded with the certificate of 7 ECTS for their regular study programmes at home institutions.

Anton Huber, University of Graz, IP director

EPNOE Partners' research

Re(de)fining uses for Brewing by-products

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In the production of beer, for every tonne of malted barley added to the process, up to 0.3 tonnes of plant biomass are underutilized. Traditionally this by-product is used as a high protein animal feed, composted or with consolidated brewing in some parts of the world, ends up in landfill. This material, brewer's spent grain (BSG) is rich in carbohydrates (55-60%), proteins (20%), lipids (5-10%) and dietary phenolics (20-25%). These residual components have the potential to be utilized in a number of new value-chains, such as chemical precursors, plant proteins for human and animal nutrition, functional food ingredients such as prebiotics, emulsifiers, foam stabilizers, natural antioxidants, antimicrobial agents, binding agents, biocomposites for packaging, and feedstock for microbial bioconversions, for example to flavours or biofuel. One main problem however is the instability of BSG as it contains~85% water and is prone to rancidity due to the lipids. Prolonged treatment times can also lead to microbial colonization of BSG.

As part of a European Community-funded project REPRO (Reducing Food Processing Wastes, 2006-2008), VTT scientists developed an enzymatic fractionation process (Fig 1) to sequentially remove peptide-rich and carbohydrate-rich components from BSG, taking laboratory trials through to pilot-scale operations, aimed at maximizing the recovery of these materials and providing also a stable, high-value residue (Fig 2).

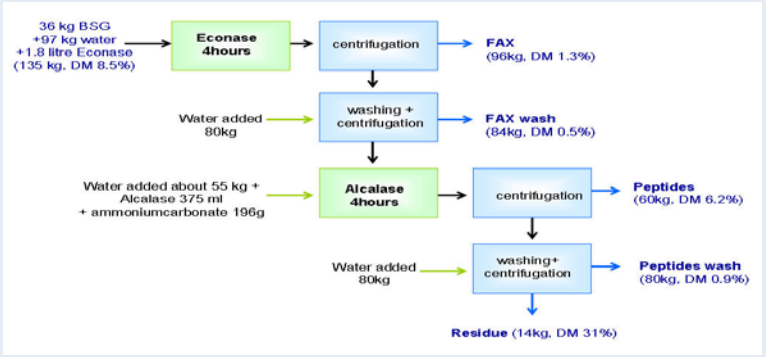

Figure 1. The two-stage enzymatic fractionation processes to remove carbohydrate and peptide components from BSG.

The process involves short enzyme contact times, released 43% of the carbohydrate fraction (rich in glucose, xylose and arabinose-containing oligosaccharides) and 94% of the available protein (rich in proline and glutamine). Due to astute enzyme selection, the carbohydrate fraction also contains the important bioactive component, ferulic acid, still esterified to the oligosaccharides. The insoluble residue is thus virtually free of protein, containing lignin and cellulose and a smaller portion of hemicellulose. In vitro studies of lignin fraction indicated that lignin had no inhibitory effects on the growth of probiotic bacteria and that the alkaline extracted lignin contained health promoting plant lignin precursors of the mammalian lignans.

Figure 2. Freeze-dried BSG (top) and the recovered fractions after enzyme treatments.

The two step process is relatively simple and could be installed in situ. Economic and technological viability can be improved as new enzyme preparations become commercially available. Similar processes may be established to treat other agro-industrial by-products, such as fruits and vegetables, in order to develop new value-chain refineries in existing facilities.

Craig B. Faulds, Pirkko Forssell, Piritta Niemi, Kaisa Poutanen & Johanna Buchert

EPNOE Poster Prize

16th European Carbohydrate Symposium, 3-7 July 2011 Sorrento (Naples, Italy)

Last July, 700 scientists met in Sorrento on the occasion of the 16th European Carbohydrate Symposium. The scientific context was highly attractive, covering chemical, biological, biophysical and biotechnological aspects of carbohydrates. The Symposium offered to the participants more than 150 oral communications, 28 Invited lectures, 10 Plenary lectures, two Awarded plenary lectures as well as almost 400 Poster contributions. In this frame, the poster prize from EPNOE was conferred to a young and brilliant PhD student, Dr. Nathalie Claisse, for her poster: "Depolymerization of Cellulose in Ionic Liquid Media" reporting state of art research in valorizing polysaccharides and exploring ionic liquid media and enzymes to produce cellodextrins. This work is developed in the group of Chemistry and Biotechnology of Oligosaccharides led by Dr Sébastien Fort at the Centre de Recherche sur les Macromolécules Végétales (CERMAV-CNRS Grenoble, France) with the financial support of CNRS and ERAS Labo (www.eras-labo.com).

Nathalie Claisse's views :

"Eurocarb was the first conference I've ever attended, and it was for me well-organized. It was interesting to meet researchers from different countries, and have updates on the current research done. As a young researcher, I was quite impressed to see personally the scientists that I'm reading for my own research !
It was also a good opportunity for me to get more familiar with other fields of carbohydrate researches than mine. It is surprising how rich is this topic!

Concerning the EPNOE poster award, I was really thrilled and proud to receive it! My career project is to work as a researcher for an innovative company: I'm really interested in applied research and I see this award as a potential help for future contacts with the companies and the research centers involved in EPNOE. My poster deals with the first part of my Ph.D work: depolymerising cellulose in green media to produce valuable cellodextrins using ionic liquid and enzyme. Valorizing polysaccharides is of great interest nowadays and it absolutely fits the EPNOE topics of research. "

Nathalie Claisse in front of her poster at the 16th European Carbohydrate Symposium.

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EPNOE Conference

2nd EPNOE International Polysaccharide Conference

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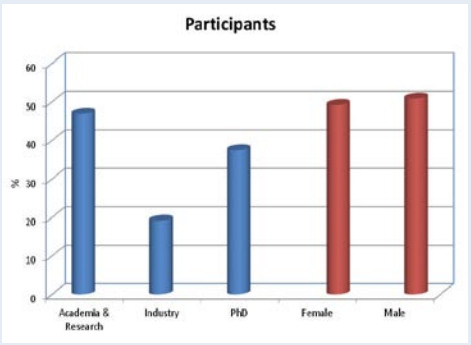
The second EPNOE conference was successfully organized in Wageningen, The Netherlands from 29th August to 2nd September 2011. Multidisciplinary scientific expertise from industry, academia and research was gathered for exchange of information and knowledge transfer around the defined conference themes related to "Polysaccharides as source of advanced and sustainable products".

Much interest was shown for the preconference course that was organized on 28th August 2011 especially for young scientist in the field of polysaccharide science that was addressing the different aspects related to "Tools in polysaccharide engineering". More than 70 PhD students and young professionals from academia and industry attended the course that presented the available tools for investigation of polysaccharide structures and properties, as well as the state of the art of various scientific disciplines that are essential to innovation in polysaccharide application development.

The 2nd EPNOE conference was attended by over 250 scientists from 31 countries. The welcome and opening address by the various speakers underlined the relevance of the polysaccharide science for modern society and called for pro-active participation and extra-disciplinary exchange of information. The five days conference was organized with both plenary sessions with presentations of world renown experts and parallel sessions focussed on the predefined actual scientific topics and specializations relevant for polysaccharide scientific innovation (biofuels and chemicals; characterization; biosynthesis; health; modification and processing; food and feed; and materials). Besides, a special session was dedicated to industrial innovation and its drivers including the concerns for social responsible enterprise.



Highlights of the conference were – besides the new perspectives for polysaccharides as versatile materials with intriguing properties and uses – the latest developments that were presented of technologies in polysaccharide-related disciplines including chemistry, enzymology, biotechnology, chemical engineering, mechanics, materials science, microbiology, physics and life cycle assessment. The concluding session with the Elsevier paper price and EPNOE awarding poster price for young scientists was evidence of the high quality of the science at the conference.

The main mission of this second EPNOE conference was to bring together and target the often widely separated fields of materials, food, and pharmacy/medicine, and to organise knowledge transfer through communication about polysaccharide science with exchange of information and ideas on basic and applied research for the development of innovative products composed and derived of polysaccharides. It can be concluded that the 2nd EPNOE conference was in many aspects a great success. Many will be looking forward for the 3rd conference in 2013 in Nice.

Jan van Dam, Carmen Boeriu