



European Polysaccharide
Network Of Excellence

N°29 - APRIL 2015



**“Nature makes polysaccharides,
EPNOE turns them into products”**

editorial

Dear Readers of the EPNOE Newsletter,
The beginning of 2015 was very active for EPNOE.

First of all, all EPNOE Members are congratulating Professor Thomas Rosenau from BOKU University in Vienna, Austria, for being the recipient of the prestigious Anselme Payan award of the American Chemical Society.

In January, the first **training course** organized this year took place in Wageningen, organized by Karin Stana-Kleinschek (U. Maribor), Carmen Boeriu and Jan van Dam (Wageningen University and Research), Zdenka Persin (U. Maribor), Ewa Wesolowska (IBWCh Lodz). Its topic was Polysaccharides in health and personal care.

In the same place, the **1st International EPNOE Junior Scientists Meeting** was organized 19-20 January 2015 by five junior EPNOE researchers, Suse Botelho da Silva (The Netherlands), Martin Gericke (Germany), Jordi Girones (France), Rupert Kargel (Slovenia) and Zdenka Persin (Slovenia). Its topic was Future Perspectives in Polysaccharide Research. Despite the short notice, more than 40 junior scientists met and discussed their results, and their views on the future of polysaccharide science. A book of abstracts (ISBN 978-961-248-473-6) is freely available on EPNOE website (www.epnoe.eu).

Mid-February 2015, **epnoe-at-large** was officially established. This new, free network dedicated to individuals (contrary to EPNOE where members are legal entities) is described in detail in this issue. Already 250 scientists from 35 countries joined.

Before finishing, I wish to remind you the **EPNOE 2015 conference** organized in Warsaw on 19-22 October 2015, under the auspices of EPNOE and the American Chemical Society. I kindly invite you to attend it.

With my best wishes,



Dr. Patrick Navard
Coordinator of EPNOE
Armines/Mines ParisTech/CNRS
CEMEF - Centre for Material
Forming
Sophia-Antipolis
(France)

news

Member's info



New staff:

- At **ARMINES-CEMEF**, France:
Estefania Boix-Lopez and Lucie Chupin joined the Biomass For the Future projet (P. Navard) "Plant-based polymer composites and concrete".
- At **ARMINES-C2MA**, France:
 - Lata Soccalingame (Post-doc), supervisor : Nicolas Le Moigne, Stéphane Corn, Project : BIOSORG, Topic : "Development and durability of new sorghum based biocomposites".
 - Pauline Ponge (M2, INSA Lyon), supervisor : Nicolas Le Moigne, Project : Process'Alg, Topic : "Valorization of biopolymers from microalgae for materials applications".
- At **Jan Dlugosz University**, Poland:
 - Sylwia Ptak, Doctoral thesis "Biocatalyzed synthesis of hydrophobic starch derivatives" (supervisors: prof. Tadeusz Antczak, prof. Janusz Kapusniak).
 - Arkadiusz Zarski, Doctoral thesis "Enzymatic synthesis of starch esters in ionic liquids" (supervisor: prof. Janusz Kapusniak).
 - Magdalena Roczkowska, Doctoral thesis "Biocatalyzed esterification of maltodextrins" (supervisor: prof. Janusz Kapusniak).
 - Sylwia Bielas, Doctoral thesis "New starch-based materials for encapsulation and controlled release of bioactive compounds" (supervisor: prof. Janusz Kapusniak).
 - Magdalena Ptak, Doctoral thesis "Biocatalyzed esterification of pectins with long-chain fatty acids" (supervisor: prof. Janusz Kapusniak).



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EPNOE Member's research

Three **knowledge-transfer and innovation consortia** in Europe established formal links with EPNOE: Polintegra (Poland), Céréales Vallée (France) and the Bioeconomy Cluster (Germany). The agreements specify the following main common activities:

- Exchange of information;
- Organization of meetings;
- Brain-storming sessions;
- Building of common R&D proposals;
- Common participation to stakeholder's events.

Polish Innovation Centre

The Polish Innovation Center called Polish Ponadregionalne Centrum Naukowo-przemysłowe (bio)-polimery Materiały-technologie dla Gospodarki (Polintegra) is linking about 70 major universities and companies in Poland in the area of (bio) polymers, materials and technologies.

BioEconomy Cluster

The BioEconomy Cluster is a German association made up of about 50 companies, research institutes and educational institutions that work in close partnership to build the foundations of a bio-based economy. Their aim is to promote the material and energetic use of biomass in the form of innovative processes used in the production of materials, platform chemicals, products and energy carriers on the basis of renewable non-food resources like beech wood.

Pôle de Compétitivité "Céréales Vallée"

Céréales Vallée is based in Auvergne region in France pooling together about 77 research centers and companies. It aims to improve production efficiency and ensuring the competitiveness of agriculture and cereal chains, to invent new cereal varieties, and to create links between agricultural production, industrial imperatives and consumer needs.

news (continued)

Member's info



Masters & PhD defenses:

- At **University of Natural Resources and Life Sciences Vienna (BOKU)**, Austria:
 - Dr. Karl Michael Klinger has successfully defended his PhD thesis "Current Biorefinery Scenarios: Studies into Ammoxidation of Lignocellulosic Material and Periodate Oxidation of Cellulose" (Supervisors: T. Rosenau, A. Potthast, F. Liebner).

New projects:

- At **University of Natural Resources and Life Sciences Vienna (BOKU)**, Austria:
 - Chromophores and cellulose aging (Austrian Research Promotion Agency FFG, Bridge Pro-gram, 10/2014-12/2017, Project leader: T. Rosenau).

Events:

- **Åbo Akademi, Finland:**
 - Cellulose Technology course, April 21-23, 2015, Åbo Akademi, Finland
http://users.abo.fi/jgustafs/CellTek/CellTech-Flyer_JG_2015.pdf
- **University of Natural Resources and Life Sciences Vienna (BOKU), Austria:**
 - 18th International Symposium on Wood, Fiber and Pulping Chemistry September 9-11, 2015, Vienna, Austria (more info: www.iswfpc2015.at)
- **IBWCh Institute (Poland):** 4th EPNOE International Polysaccharide Conference, 19-22 oct. 2015, Warsaw, Poland.



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EPNOE Member's research

Anselme Payen Award to Professor Thomas Rosenau

In recognition of his outstanding contributions to wood, pulp and fiber chemistry, the Cell Division of the ACS presented the 2014 Anselme Payen Award to Professor Thomas Rosenau. Thomas Rosenau is currently Professor and Chair of Wood, Pulp and Fiber Chemistry at the University of Natural Resources and Life Sciences in Vienna, Austria. He is a Fellow in the International Academy of Wood Science and has received numerous awards for his research in cellulose, wood and lipid chemistry. Author of more than 260 reviewed articles, 350 conference contributions, and 14 patents, Prof. Rosenau is clearly an accomplished scientist. His fundamental research contributions to the areas of chromophore formation, cellulose solvation, hydrogen bonding in cellulose, cellulose-water interactions, and extractive chemistry have led to both innovative discoveries and significant improvements to current industrial processing methods. Developing the CRI (chromophore release and identification) method allowed him to isolate and structurally identify trace chromophores in cellulosic matrices, with important applications in pulp bleaching. An understanding of degradation processes, byproducts, and reactive species formed in media resulted from his work on cellulose solvents and solutions. Lyocell fiber manufacturing is now more stable, and safer due to his contributions. Prof. Rosenau's decade-long collaborative studies with colleagues in Japan, the US and Austria have allowed direct monitoring— for the first time—of the molecular mechanisms responsible for cellulose swelling, dissolution and regeneration. His work in non-cellulose research is equally impressive, leading to a novel vitamin E derivative gaining approval for in-hospital treatment of inflammatory intestinal diseases. Another salient finding was the first direct spectroscopic detection and in-depth study of vitamin E-derived ortho-quinone methide, a key intermediate in vitamin E antioxidant chemistry. These studies led to his design and synthesis of novel spin traps for scavenging radical intermediates under unique and harsh chemical environments.





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Thuringian Award for Applied Research

Ultrasensitive immune mediated rapid test device for emergency medicine based on nanostructured polymer membranes

A crucial issue in emergency medicine is to make decisions fast and at the place, which is beyond the border of lab-based diagnostics. Therefore, mobile test devices for the "point of care" application are of particular interest. The common membrane-based test strips are easy to prepare but suffer from low sensitivity and precision.

An interdisciplinary team of biotechnologists and chemists from Research Center of Medical Technology and Biotechnology (fzmb, Bad Langensalza, Germany) and from the Friedrich Schiller University of Jena was able to develop an highly efficient system (Figure 1). The test device is based on sintered membranes of defined porosity that are coated with a monolayer of a designed biopolymer formed by self-assembling. Antibodies are attached to this modified surface with high reproducibility and excellent coupling efficiency.

The company Senova Weimar GmbH developed "Dediocard Cardio", a device based on this principle, as high quality rapid test for heart attack (Figure 2). Further test devices based on these nanostructured porous polymer membranes are developed for the quick detection of Ebola virus or botulinus toxin.

The cooperation between organic chemistry, polymer chemistry, biotechnology, and medical technology began with the development of polymer membranes and bears a large synergetic potential together with lots of interesting applications in the future.

The Prize is endowed with € 35.000,- and will be awarded on March 09, 2015 by the Thuringian Minister for Economy, Science, and Digital Society.

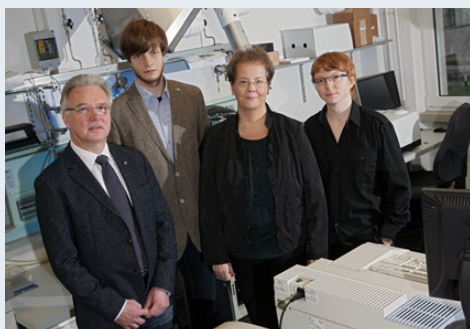


Figure 1: Awardees of the Thuringian Award for Applied Research (from the left): Prof. Thomas Heinze (FSU Jena), Dr. Friedrich Schulz (FSU Jena), Katrin Frankenfeld (fzmb), Christian Rautenberg (fzmb).



Figure 2. "Dediocard Cardio" rapid test for detection of heart attack based on nanostructured polymer membranes.

This article was proposed by Dr. Andreas Koschella, Friedrich-Schiller-Universität Jena, Germany



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EPNOE Member's research

Functional Cellulose Microspheres

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Future Biorefinery, FuBio, was a 5 year program starting in 2009 in Finland aiming at new values chains from wood biomass. Latter half of the program, FuBio Cellulose, had three scientific and technical goals; sustainable processes for cellulose stable fibres, new processes for cellulose-based water chemicals, and new products for regenerated cellulose.

One product intensively studied in FuBio Cellulose was cellulose microspheres (Figure). They are by the definition spherical particles with cellulose as a main component providing structural integrity. Other components, such as cellulose derivatives with functional groups, can be blended in to give additional functions. Other way to introduce the functional groups is to chemically modify the spheres heterogeneously [1].

Spherical shape can be produced by several techniques, such as dispersion, dropping or atomisation [2]. The choice of the technique greatly affects the size; dispersion technique produces spheres roughly from 10 to several 100 micrometers, whereas dropping and atomisation techniques from several 100 to few thousand micrometers.

In FuBio Cellulose we studied the release of model drugs from the millimeter-sized cellulose microspheres prepared by dropping technique (Figure, rightmost sample) [3, 4]. Spheres were oxidised to study the drug release from the swelling matrix under physiological condition simulating human gastrointestinal track. Results indicated that the release of the drug is uniform and their dosage is highly uniform, enabling personalised dosing for various different types of patients.



Figure: Cellulose beads from micro- to millimeter scale. Figure from [2]

References:

1. Trygg, J.; Fardim, P.; Yildir, E.; Kolakovic, R. & Sandler, N., *Cellulose*, 2014, 21, 1945-1955.
2. Gericke, M.; Trygg, J. & Fardim, P. *Chemical Reviews*, 2013, 113, 4812-4836.
3. Yildir, E.; et al., *International Journal of Pharmaceutics*, 2013, 456, 417-423.
4. Trygg, J.; Fardim, P.; Yildir, E.; Kolakovic, R. & Sandler, N., *Macromolecular Materials and Engineering*, 2014, 299.

This article was proposed by Dr. Jani Trygg, Åbo Akademi University, Finland



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EPNOE BIC Member's research

Sappi, having manufacturing facilities and Technology Centres at three continents, is a global supplier to the pulp- and paper industry, specialised in manufacturing (chemical) pulp and high-quality paper and board.

Cellulose, acquired from biomass, will play a pivotal role in the development of the so-called bio-based economy, an economy largely based on natural and sustainable raw materials.

Using proprietary technology, Sappi is able to separate Cellulose Nano Fibrils (CNF) from this biomass with characteristics that include:

- Excellent barrier-properties for coatings and paints;
- Strong rheology-modifier applicable in a variety of applications that include cement and concrete, paints and coatings, as well as food and pharma.

CNF is consisting of both amorphous and crystalline parts. After removal of the amorphous fraction, Cellulose Nano Crystals (CNC) can be obtained. These CNC-particles do show some surprising characteristics that include:

- Stiffness comparable to Alumina;
- Strength comparable to Kevlar and
- A strength to weight ratio that is 8 times better than of steel.

Sappi has developed bench-scale technology that produce CNF that is (compared to competitive samples) superior in size-distribution against lower costs than can be achieved with technologies currently available.

Scaling-up that technology through pilot-developments will ultimately enable Sappi to move into new and adjacent business fields based on renewable raw materials.

Scientists from Edinburgh Napier University and Sappi have developed a low cost way to turn wood into a wonder material that could be used to build greener cars, thicken foods and even treat wounds.

It means Sappi will be able to produce the lightweight material on a commercially viable basis – and without producing large volumes of chemical waste water associated with existing techniques. The energy-saving process will be used in a new nanocellulose producing pilot plant to be erected by Sappi.

“Nanocellulose, extracted from wood fibres, has a number of unique optical, barrier and strength properties,” said project coordinator Math Jennekens, R&D Director at Sappi Europe. “Unlike other lightweight, high-strength materials based on fossil fuels it is completely sustainable, making it very desirable as a new material for various industrial and transport applications.”

The versatile material has previously been produced by intensively processing wood pulp to release ultra-small, or ‘nano’ cellulose fibers – each so small that 2,000 could fit inside the width of a single strand of human hair.

But the Sappi - Edinburgh Napier University research team say they have been able to drastically reduce the amount of energy needed to power the process, as well as the need for expensive chemicals.

“What is significant about our process is the use of unique chemistry which has allowed us to very easily break down the wood pulp fibers into nanocellulose,” said Professor Rob English, who led the research with his Edinburgh Napier colleague, Dr. Rhodri Williams.



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EPNOE BIC Member's research (continued)

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"There is no expensive chemistry required and, most significantly, the chemicals used can be easily recycled and reused without generating large quantities of waste water.

"It produces a dry powder that can be readily redispersed in water and leaves the nanocellulose unmodified – effectively making its surface a chemical "blank canvas" and so more easily combined with other materials.

"The ability to bring all these attributes together have so far eluded materials scientists working in the field. It is very exciting."

Nanocellulose produced at the proposed Sappi plant could be used in a wide range of industrial and everyday products and devices because of the way they can improve the properties of materials they are combined with, said Professor English.

"It could be used to thicken water-based products such as paints, foods and concrete," he said. "Or when it's used in plastics to make a composite it can replace glass fibers, which is very attractive in the production of the next generation of lighter, fuel-efficient vehicles.

"Because of its low oxygen permeability it could also be a possible replacement for plastic films in packaging. Then there are also applications for it in containing films in lithium batteries and touch screen displays. And as cellulose is inherently bio-compatible and bio-absorbable, there is considerable potential in biomedical applications such as wound dressings and regenerative medicine."

Andrea Rossi, Group Head Technology, Sappi Limited, said a pilot production plant was being planned for "towards the end of 2015. This pilot plant" he continued " will move Sappi into new adjacent business fields based on renewable raw materials to produce innovative performance materials and help in delivering on Sappi's strategy to seek growth opportunities in adjacent and new markets."

Professor English added: "Commercial interest in nanocellulose is growing at a phenomenal rate following predictions of a possible 35 million tonnes per year market by the 2020s. And so the key challenge now is very much in business development and understanding the value offered by nanocellulose in our target markets."

According to Andrea Rossi, the pilot plant will test the manufacturing of dry re-dispersible Cellulose NanoFibrils (CNF). Using this proprietary break-through technology, Sappi will ultimately be able to manufacture CNF with unique morphology, specifically modified for either hydrophobic or hydrophilic applications. Products produced will be optimally suitable for conversion in lighter and stronger fibre-reinforced composites and plastics, in food and pharmaceutical applications, and in rheology modifiers as well as in barrier and other paper and coating applications.

Andrea Rossi indicated that using the products manufactured in the pilot-scale plant, Sappi will seek co-development with multiple partners to incorporate CNF into a large variety of product applications to optimise performance and to create unique characteristics.

This article was proposed by Math Jennekens, Director R&D, Sappi Europe, the Netherlands



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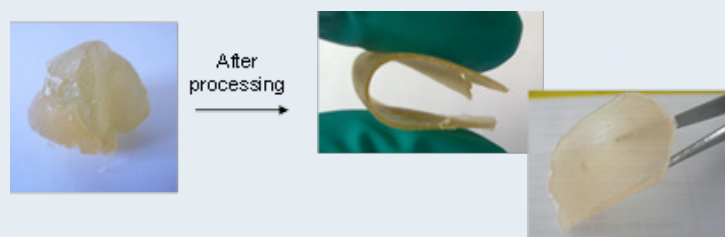


EPNOE Affiliated Member's research

Biohybrid materials based on Polysaccharide, Ionic Liquid and Poly(Ionic Liquid)

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Etienne Fleury and Aurélie Charlot
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With the aim to generate biohybrid conductive ionogels, we exploit the synergistic interactions between polysaccharides chains and imidazolium based components, namely ionic liquids (IL) or poly(ionic liquid) (PIL). The polysaccharides involved in this work are galactomannans (guar, locust bean gums) and xanthan gums which present unique attributes in terms of abundance, non-toxicity, thermal stability and accessibility to high molecular weight chains. We demonstrated that imidazolium-based IL are: 1) efficient and non-degrading solvents of these polysaccharides, 2) efficient reaction media enabling the preparation of functionalized and reactive derivatives [1], 3) efficient dispersing media to prepare composite with inorganic fillers, and 4) structuring and doping agents to afford strongly conductive physical gels that can be easily processed under the form of films (see Figure below) [2]. Now, efforts are concomitantly devoted to more sophisticated materials through i) the preparation of ternary blends containing precisely-defined RAFT-made PIL homopolymers and copolymers [3] and ii) the synthesis of grafted copolymers constituted of both polysaccharide and PIL segments by "grafting onto" and/or "grafting from" strategy. The morphology of the biohybrids is systematically studied by means of synchrotron scattering measurements. The final rheological, thermal and conductive properties are analyzed as a function of structural parameters.



Guar / IL ionogels

Guar / IL films

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[3] B. Zhang et al., submitted.

This article was proposed by Prof. Etienne Fleury, IMP, INSA de LYON, France



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EPNOE new Affiliated member presentation

Jan Dlugosz University in Czestochowa (Poland)

Jan Dlugosz University in Czestochowa (JDU) is a public university, with history that traces back to 1971. JDU is flourishing at all its levels. For over 40 years, since its beginnings, it has become recognised and has got a consolidated position among the most important institutions of higher education in Poland. At present the University community is created by nearly 8,200 students and over 700 academic staff members. The University offers almost 30 different fields of study, which is its great achievement, and students may choose from almost 100 specialities and specialisations. The JDU offers studies at all levels, starting with the undergraduate degree which can be followed by the postgraduate degree, and ending with a doctor's degree, including engineering studies. The Institute of Chemistry, Environmental Protection and Biotechnology is a part of the Faculty of Mathematics and Natural Sciences, one of five faculties at JDU.

The Faculty of Mathematics and Natural Sciences conducts scientific research and educates students in the fields of science, nature and technology. The Faculty possesses professional and modern laboratories which are equipped with the new generation measuring and exploratory apparatus. The results of the research conducted by the Faculty's academic teachers are cited in the most important research journals and are highly evaluated at international symposia or conferences. The Faculty has the right to confer a doctor's degree in the fields of Physical and Chemical Sciences. Research grants and projects result in many implementations in industry.

The research activities of Institute of Chemistry, Environmental Protection and Biotechnology are focused both on natural polymers (starch, pectin, maltodextrins and others) and on biobased synthetic polymers like polylactid and polyalkanoates. The activities of the Institute revolve around the synthesis and characterization of new biodegradable materials for application in agriculture, packaging industry, medicine and pharmacy, mainly for constructing biodegradable polymeric material used for packaging of organic waste and agricultural and horticultural films, bioresorbable polymeric scaffolds with shape memory behaviour as well as systems for the controlled release of biologically active substances, pesticides and pharmaceuticals. The polysaccharide research at Institute is mainly related to starch chemistry and technology and concerns chemical, physical and enzymatic modification of starch for food (dietary fibre, prebiotics, dietary supplements) and non-food (hydrophobically modified starch as packaging material, biomaterials of new generation from cereals and milling processing, microcapsules for controlled release).

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EPNOE new Affiliated member presentation

Karlstad University, Sweden

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Karlstad University in Karlstad, Sweden is now an affiliated member of EPNOE and we appreciate it that we have been accepted as such a member from January 1, 2015. For us belonging to a small university located far away from continental Europe we need many external contacts to keep us updated on the latest cellulose and hemicellulose research and we hope that we will benefit a lot from this cluster group. We have been active during a long time in cellulose, viscose and cellulose derivatives research and the present research focus on modern and more environmentally friendly "viscose processes" including research to make it more interesting to integrate a dissolving pulp mill and a textile fiber plant. We have a lab where we can produce dissolving pulp and later bleach it to full brightness and we can produce viscose solutions and we can spin the solution to different types of textile fibers. Testing of fabric made from our textile fibers will be analyzed at our university or at the Swedish School of Textiles at Borås, Sweden. Karlstad University has since 2002 hosted international biannual Workshops on Cellulose, Regenerated Cellulose and Cellulose Derivatives and we have had between 60-90 participants each time and our visitors have come from about 10 countries. The next workshop is planned for November 2016.

Head of the group at Karlstad University is Professor Ulf Germgård and you can contact me on ulf.germgard@kau.se

This article was proposed by Prof. Ulf Germgård, Karlstad University, Sweden



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Establishment of a new, free network dedicated to the polysaccharide community: epnoe-at-large

One of the missions of EPNOE is to favour information exchange in the polysaccharide community. To this end, EPNOE decided to establish a new network called epnoe-at-large.

epnoe-at-large is an email-based knowledge transfer platform linking together students, scientists and researchers from academia, research centers, consulting firms or industrial companies and innovators working with and/or interested in polysaccharide science and polysaccharide-related products.

- Who can join epnoe-at-large?

Any individual student, scientist, researcher and innovator from all over the world who is interested in polysaccharide science or polysaccharide-based materials is invited to join epnoe-at-large. Joining epnoe-at-large is free and it does not require nor entail any commitment with the EPNOE organisation. However, membership is not confidential and the list of members will be given on the epnoe-at-large web site which will be publicly open. Ending a membership is immediate after informing EPNOE.

- How will epnoe-at-large work?

In order to avoid complicated log in-log out to a web site, all relevant information provided by a member will be distributed to all the other members. To avoid sending undesired or illegal messages, spams and out-of-the-scope advertisements, an epnoe-at-large commission composed of the President and the four Vice-presidents of EPNOE association will edit and filter messages. To avoid a too large number of mails, the various pieces of information will be gathered in block messages sent once every two weeks. epnoe-at-large is thus an e-mail-based network and a specialized information exchange portal for carbohydrate experts.

In addition to information exchange, other communication activities could be performed in future depending on suggestions and active interest of members. The epnoe-at-large web site could be the site to post (e-)courses given by university professors and lecturers on topics of interest for polysaccharide science, with the aim to collect a large body of teaching materials. The epnoe-at-large community could also launch series of short monographs on specific topics relevant for polysaccharide science. Any initiative by a member will be submitted to the epnoe-at-large expert community.

- Why joining epnoe-at-large

To name a few: to keep up-to-date with the latest research; to get in touch with the leading researchers in the field; to be identified by the community; to share your latest results with the rest of polysaccharide community; to post questions to specialist audience; to search for a student or a staff member; to discover career opportunities; to get information about courses, workshops, conferences, projects, calls for proposals ...

On a voluntary basis, epnoe-at-large members will have the opportunity to place one page describing their expertise in the public epnoe-at-large web site.

- How to join epnoe-at-large

To join, please send an e-mail to contact@epnoe.eu.



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EPNOE Member's Scientific Publications

ARMINES-CEMEF, France:

T. BUDTOVA et P. NAVARD

"Temperature dependence of the viscosity of cellulose solutions", Nord. Pulp Paper Res. J., 30(1), 99-104 (2015)

W. WANG, F. LI, J. YU, T. BUDTOVA et P. NAVARD

"Thermal behavior of hydroxyethylcellulose and cellulose solutions in NaOH-water, Nord". Pulp Paper Res. J., 30(1), 20-25 (2015)

J. OBRADOVIC, P. FARDIM, L. LASSILA et P. NAVARD

"High pressure treatment of DMAc/LiCl swollen softwood pulp", BioResources, 10 (2), 2143-2155 (2015)

ARMINES-C2MA, France:

- L. Soccalingame, A. Bourmaud, D. Perrin, J.C. Benezet, A. Bergeret, Reprocessing of wood flour reinforced polypropylene composites: impact of particle size and coupling agent on composite and particle properties, Polymer Degradation and Stability, 113, 72-85 (2015)

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