

# Newsletter

ÅBO AKADEMI  
PROCESS CHEMISTRY GROUP  
Centre of Excellence

## Åbo Akademi Process Chemistry Group

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### New interactions between PCG and industry

*The process industry is competing on a global level and therefore needs people who are educated for working in global environments.*

Industry is built on knowledge - not only technical knowledge - but also knowledge about social needs and expectations. The technical knowledge is the key element of high-tech industry, in which process industry also belongs. Technological knowledge must be continually renewed and adapted to changing needs in society, such as changes in product markets, and also to new demands relating to e.g. environmental protection. Competing processes and products may pop-up and change the operational conditions of an industrial company almost overnight. Only the most adaptable and fittest companies survive.

To compete and survive, the process industry needs technological flexibility and adaptability. This again is built on deep, mechanistic and phenomenological knowledge of technical processes and products, a knowledge achieved by solid scientific work. This is what the Process Chemistry Group provides. PCG offers high-class basic technical education to students who will transfer this technological know-how to industry and academia at large.

To be able to perform long-term strategic research to create the knowledge base for process industry, PCG needs new sources of funding. We have already received new funding for strategic research from Academy of Finland and Åbo Akademi University. Our funding is presently, however, directed mainly at a wide variety of specific short-term projects. During the recent annual seminar new ways of financing strategic research were discussed with the Scientific Advisory Board. We

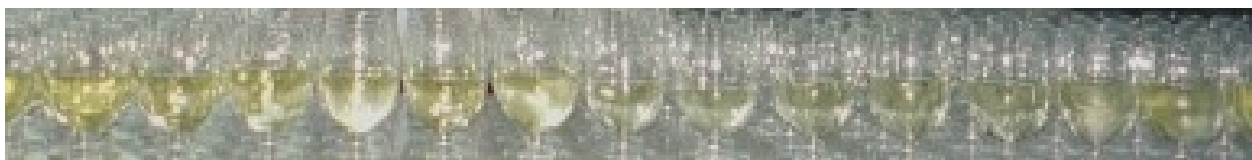


*Academy Prof. Bjarne Holmbom is the leader of the Wood & Papermaking Chemistry team within PCG.*

hope that industry, Tekes (National Technology Agency) and the Academy of Finland could jointly increase funding for our strategic research.

The process industry is competing on a global level and therefore needs people who are educated for working in global environments. We must do all we can to promote research and education which involves global networking. This is one of the reasons why the Faculty of Chemical Engineering at Åbo Akademi University is offering a Master's programme in Chemical Engineering in English, beginning in the fall of 2002. Ten to fifteen motivated and talented students with a B.Sc. degree will be invited to study in the programme. We are dedicated to providing them with an excellent, personal education for an international career after the M.Sc. degree either in Finland or abroad. We hope that the readers of this newsletter can be helpful in making potential students aware of our new Master programme. The 2-year programme could directly benefit industry by providing further education to already employed young chemical engineers with a B.Sc. degree.

**Academy Prof. Bjarne Holmbom**  
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*The Annual Process Chemistry Group Seminar was arranged August 14 at Åbo Akademi University. About 150 PCG associates participated in the scientific sessions and social events.*

With the sun shining in a cloudless sky, the PCG Annual Seminar took place for the third time in the middle of the cultural heart of Finland. In the shadow of the 12th-century cathedral **Gustav Björkstrand**, Rector of Åbo Akademi University, declared the Annual Seminar opened in the Gadolinia building, named after the famous Finnish chemist Johan Gadolin (1760-1852), Gadoliniums (Gd) namesake.

About 150 PCG associates were gathered to enjoy the scientific output of the seminar. After a short review of the PCG activities in year 2000, the seminar continued with presentations by the four teams within PCG. Four professors of the Faculty of Chemical Engineering at Åbo Akademi University are in charge of the teams, which focus on chemistry-oriented chemical engineering.

The *Combustion & Materials Chemistry* team was presented by Prof. **Mikko Hupa** and Dr. **Heimo Ylänen** (Bioactive glass: Inorganic chemistry for tissue engineering), *Kinetics & Catalysis* by Prof. **Tapio Salmi** and Prof. **Dmitry Murzin** (From reaction mechanism to reaction design), *Process Analytical Chemistry* by Prof. **Ari Ivaska** and Dr. **Tomasz Sokalski** (Modelling

membrane potentials in realtime and space domains) and *Wood & Papermaking Chemistry* by Academy Prof. **Bjarne Holmbom** and Dr. **Kenneth Sundberg** (Anionic groups in papermaking fibres - recent progress). In the 'Young scientists' session' 12 posters, out of a total of 42, were presented orally. The seminar was closed with comments by members of the Advisory Board: Prof. **J.W.Niemantsverdriet**, Prof. **Albert Renken**, Dr. **Jyrki Kettunen** and Dr. **Mika Aalto**. Some of Prof. Niemantsverdriet's and his Dutch Ph.D. students' view concerning a top research institute's qualifications are listed below.

The PCG Annual Seminar continued later in the evening with a pleasant get-together in the Aboa Vetus & Ars Nova museum and a banquet at the nearby Student Union building designed in 1936 by the well known Finnish functionalist Erik Bryggman.

Some qualifications of a top research institute  
- view by Dutch Ph.D. students (Niemantsverdriet)

- Research leaders of international caliber
- Excellent infrastructure
- Highly motivated students
- The best international postdocs in key disciplines
- Close connections to industries
- Financial support from a variety of sources
- Publications in high impact journals
- Ph.D. degrees, partially on the basis of refereed articles
- Scientific awards on all levels
- Invited lecturers, contributed talks and posters

Text and photos: Tom Lindfors



Prof. Niemantsverdriet summing up his view of an ideal Ph.D. student.



The PCG Group enjoy the get-together in the Aboa Vetus & Ars Nova museum. Members of the PCG Advisory and Executive Boards gathered for a portrait (left-hand picture): J.W.Niemantsverdriet, Albert Renken, Karl Ahlblad, Ari Ivaska and Mika Aalto (from left).



# Clean technology based on heterogeneous catalysis

by Tapio Salmi



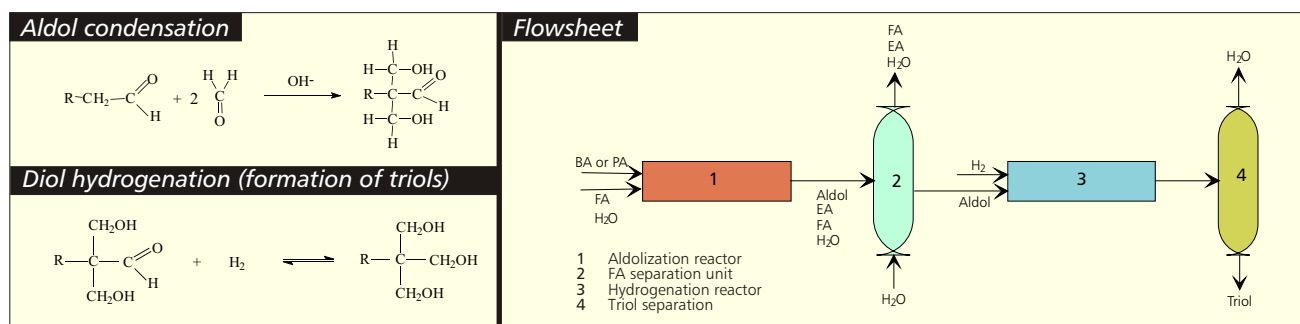
*Clean technology based on heterogeneous catalysis has been developed for the production of triols. The new process concept is already patented in many countries.*

Diols and triols are key intermediates in the industrial production of lubricants, surface coatings and synthetic resins. Equimolar amounts of sodium formate ions (*i.e.* formic acid) are formed in the traditional reaction route which is based on alkali-catalyzed aldolization followed by the Cannizzaro reaction. This is a serious drawback because formate is an environmentally hazardous compound, with a low market value, and has to be separated from the product mixture.

An alternative synthesis route for diols and triols based on heterogeneous catalysts is thus desirable. It is known that the synthesis can be

stopped at the aldol stage by using mild bases such as tertiary amines as catalysts instead of NaOH. The carbonyl group of the aldol can then be hydrogenated to diol or triol. The formation of co-products is avoided as described by the reaction scheme below.

The researchers of the PCG Kinetics and Catalysis team have recently developed in co-operation with Neste Chemicals (Dynea) a two-step process based on heterogeneous catalysts for the production of triols. The process uses propion- or butyraldehyde and formaldehyde as raw materials. In the aldol condensation step, anionic ion-exchangers are used as catalysts. In the second step, the aldol is hydrogenated over a metal catalyst. A conceptual flowsheet of the new process is shown below. This project has recently resulted in two doctoral theses by Valentina Serra-Holm (2000) and Tiina-Kaisa Rantakylä (2001).



## PCG News

Maritta Kymäläinen's Doctoral Thesis "Fate of Nitrogen in the Recovery Cycle of a Kraft Pulp Mill" was named the Best Thesis work in Finland in 2000-2001. The prize was awarded by the Chemical Engineering Society of Finland on October 4, 2001.

The Council of the Faculty of Chemical Engineering of the Budapest University of Technology and Economics has awarded Prof. *Ari Ivaska* the *Géza Zemplén Medal* for 'his outstanding and most valuable support of the teaching and research activity of the Faculty'.

The European Commission has appointed the Åbo Akademi Process Chemistry Group to be a *Marie Curie Training Site* from the beginning of the year 2002. Marie Curie Training Sites will support short stays (3 months-1 year) by young researchers pursuing doctoral studies. The salary and travelling expenses of the research fellows will be paid by the European Commission. ÅA PCG has provisionally been granted 96 fellowship months for the following four years. ([www.cordis.lu/improving/home.html](http://www.cordis.lu/improving/home.html))

Prof. Mikko Hupa was the chairman of the International Chemical Recovery Conference in Whistler, B.C., Canada. The conference was co-sponsored by the North-American organizations TAPPI and PAPTAC and focused on technology and research in the recovery of cooking chemicals in pulp mills. Around 350 people from all pulp and paper industry countries participated in the very successful four-day conference.

## Visitors

Dr. Svetlana Bratskaya, Institute of Chemistry, Far East Department of the Russian Academy of Sciences, Russia, 3-30.9.2001

Dr. Pedro Fardim, Universidade Estual de Campinas, Brazil, from 1.3.2000

Prof. Qin Menghua, Shandong Institute of Light Industry, China, from 1.5.2001

Prof. Orlando L. Sanchez-Munoz, Instituto Superior Politecnico "Jose A. Echeverria" (ISPJAE), Ciudad de la Habana, Cuba, 1-30.6.2001

Dr. Li Niu, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, China, from 1.2.1999

Dr. Tomasz Sokalski, Warsaw University, Poland, from 1.2.2000

## Recent Doctoral Theses

Jörgen Bergman: "Aspects on the Amounts of Stable Flourine in the Synthesis of <sup>18</sup>F-labelled Radiopharmaceuticals"

Maritta Kymäläinen: "Fate of Nitrogen in the Chemical Recovery Cycle of a Kraft Pulp Mill"

Tiina-Kaisa Rantakylä: "Development of production technology for triols through catalytic hydrogenation"

Maria Zevenhoven-Onderwater: "Ash-Forming Matters in Biomass Fuels"

Please check our website for M.Sc. and Licentiate Theses: [www.abo.fi/instut/pcg](http://www.abo.fi/instut/pcg)

## PCG Scientific and Industrial Advisory Boards

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## PCG Facts and Mission

The Åbo Akademi Process Chemistry Group (ÅA-PCG) studies physico-chemical processes at the molecular level in environments of industrial importance, in order to meet the needs of tomorrow's process and product development. Our particular focus on the understanding of complex process chemistry we call

### *Molecular Process Technology*

The Group consists of four research teams at the Chemical Engineering Faculty of Åbo Akademi University: *Combustion & Materials Chemistry* (Prof. Hupa), *Kinetics & Catalysis* (Prof. Salmi), *Process Analytical Chemistry* (Prof. Ivaska) and *Wood & Papermaking Chemistry* (Academy Prof. Holmbom). In the year 2000, about 170 people (including 32 senior researchers) took part in the PCG activities within 92 research projects with a total funding of approximately 4.5 Million .

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