INTRODUCTION TO THE JOHANNES LINNEBORN PRIZE AND THE 2016 WINNER LAUDATION

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The Johannes Linneborn Prize was established in 1994 on behalf of the European Commission by Dr. Wolfgang Palz to honor a European individual for an exceptional life-time contribution to the field of sustainable energy from biomass. In exceptional cases the award can be granted to a non-European. It is not a reward for scientific excellence only but also technical and managerial merits are appreciated. This prestigious award was connected to the name of Johannes Linneborn, a German biomass pioneer and businessman and the manufacturer of more than 500,000 Imbert small-scale wood gasifiers used to fuel cars, when fossil liquid fuels were scarce. His ideal was a world in which mankind lives in harmony with nature with optimal exploiting of biomass for energy and materials.

From a long list of excellent candidates the Prize Committee selected as winner of the Linneborn Prize 2016:

Professor Jack (John) Saddler
Endowed Professor of Forest Products Biotechnology / Bioenergy
Faculty of Forestry
University of British Columbia
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The prize is awarded to him for his outstanding, pioneering and innovative work and leadership for over 38 years in research and promotion of the pretreatment, fractionation and hydrolysis of Biomass to provide the front-end of a Biorefinery. Aiming at a full and economically valid exploitation of lingo-cellulosic feedstock's as sustainable and renewable sources for the production of energy carriers and materials/ chemicals he delivered very important contributions to the solutions of a wide range of scientific, technical and policy related issues. Over many years he proved to be an excellent scientist, inspiring teacher and author of many influential reports and publications. He was a much valuated advisor for biomass industries, for governments and international organizations all over the globe. Jack Saddler participated in a wide range of international studies where he often took the lead.

Jack Saddler was born in Scotland where he studied Microbiology and Biochemistry and received his BSc (Hons) at the university of Edinburgh and his PhD at the university of Glasgow (1978) Subsequently he joined the National Research Council (NRC) of Canada (Ottawa) where he developed their biomass-to-ethanol program. In 1982 he joined the newly privatized Canadian Forest Products lab, (now the Forintek division of FP Innovations) where he became the manager of the Biotechnology and Chemistry group. In 1981 he was appointed adjunct Professor in the Department of Biology at the University of Ottawa. In 1989 he was invited for Executive Interchange with the Federal Government, and assigned to the Science Directorate of the Canadian Forest Service in charge of Biotechnology and Industry partnerships. In 1990 he was awarded the Endowed Chair of Forest Products Biotechnology/Bio energy at the University of British Columbia. (NSERC-Industry chair). There he trained almost a hundred graduate students and post-docs. He served as the Head of Department of Wood Science from 1998-2000 and became Dean of the Faculty of Forestry from 2000-2010. Until recently Jack Saddler was Task leader of the International Energy Agency Bioenergy Task 39, "Liquid Biofuels" were his work had an important international impact.

The scientific work of Jack Saddler proved highly productive over many years. He published about 400 papers, many of which remarkably highly cited and influential, next to several books and patents. Only a very condensed description can be given here.

The most important theme in his work on Biomass is the necessary move from a hydrocarbon (coal, oil, natural gas) based economy to a more sustainable, carbohydrate (fuels and chemicals from biomass) based future. Specially the utilization of forest products and residues was in focus, concentrating on the initial steps of biomass deconstruction, fractionation and hydrolyses. The aim is to turn the lignocelluloses constituents (cellulose, hemicelluloses and lignin) into resources accessible for further biochemical and micro biological conversion towards liquid fuel components, platform chemicals and high value products. This is by no means an easy task. Over many millions of years nature has developed a wide range of molecular, nano, micro and macro sized systems to improve the robustness of the plant materials and increase resistance to attack by micro organisms and their enzymes. The pretreatment of the biomass was considered by Jack Saddler as essential for the future success of the Biorefinery concept. In the subsequent multi-step processes the influence of the pretreatment is of paramount importance.

He and his coworkers initially concentrated on two pretreatment strategies: steam pretreatment and organosolv (using solvents like ethanol, butanol …etc.). However it became clear that biomass raw materials such as agricultural residues, hardwood, softwood etc. differ much in their susceptibility to bioconversion. Although steam explosion/pretreatment was already known and widely used in the pulp and paper industry, in the research of Jack Saddler (over three decades) several basic facts were revealed. These were among others related to the fundamental chemistry and its effects on molecular level, micro and macrostructures of the lignocelluloses materials. For example the potential and especially the limits of the one parameter description factor for pretreatment ("H" factor and later the severity factor "Ro") was studied but had to be refined in relation to the Biorefinery concept where hemicelluloses is also

considered a valuable sugar source, suffering degradation at higher severities. Especially for softwood this was important. Solutions were found by Saddler et al using catalytic materials like SO2 and others. In recent further optimization, product recovery of cellulose, hemicelluloses and lignin in suitable form were much improved and application to densified materials (pellets) was demonstrated which is important for economy of scale.

Apart from the pretreatment field Jack's work on carbohydrate active enzymes releasing monomer sugars from pretreated biomass attracted a lot of attention because of scientific, technological and economical intrest.

He showed with a wide range of enzyme systems (including cellulases, hemicellulases and amylases from different micro organisms (bacteria and fungi) that realistic lignocellulosic substrates are required for a proper picture rather than purified commercial substrates. The subsequent fermentation producing alcohols on basis of multiple types of sugars was also a challenge for which practical solutions were found by Jack and his team. Moreover the presence of obnoxious compounds both "naturally" occurring and process derived (like furfurals, organic acid, phenolics etc.) cannot be avoided and also this problem was solved in a practical way among others with high cell densities.

While Jack Saddler used the experience of the pulp and paper sector, new inventions and insights were fed back to this sector. An example is the use of purified and highly specific xylanases for the selective modification of dissolving/chemical pulps, which was a highly successful invention by Jack and the patent was used commercially. Also in the wastewater treatment of bleach Kraft mill effluent he provided help with highly advanced analytical tools and effective biological solutions.

Realizing a Biorefinery will depend much on the production of high value components in the products spectrum and Jack and his team developed several examples such as polyurethane foam from organosolv lignin and crystalline nanocellulose (CNC) preferentially using residual byproducts.

On top of these research and development activities Jack Saddler played an active role in techno economic modeling and policy aspects of Bioenergy. His activities associated with the IEA Bioenergy Implementation Agreement lasted for more than 20 years and also for other global organizations like the World bank and FAO he provided services in the form of authoritative and high impact reports and/or advices. In these activities he generally promoted a more cautious and balanced approach taking into account the logistical, technical and policy challenges that had to be faced before fully commercial processes can be realized. Professor Saddler was often recruited as reviewer of national programs and projects on Biomass in numerous countries (US, Scandinavia, Australia, Japan, EU etc) not only because of his abilities in science and technologies but also because of his knowledge on commercialization, policy issues, biomass availability, marketing/trading and competing options.

In Canada Jack Saddler had important societal impact via advice for Bio-industry and governments at the highest levels. In response to the catastrophe of the mountain pine beetle outbreak, that created an enormous and accumulating surplus of standing deadwood, Jack developed and propagated concepts (biofuels, biochemicals, expansion of chips and pellets industries, export of pellets to Europe, etc) to provide additional means for restoration, replanting and future use of forests.

Jack Saddler received several prestigious awards and recognitions such as the Charles D. Scott award for contributions to Biotechnology for Biofuels and Chemicals, the leadership award for Life Sciences British Columbia and the IUFRO's Scientific Achievement award. Jack Saddler is a Fellow of the Royal Society of Canada.

Professor Saddler, your activities brought the Biorefinery several important steps closer to realization, directly and indirectly via your research, education of young talent and promotion and advising activities with worldwide impact. You really deserve the prestigious European Linneborn Award. We are sure that the whole international Biomass community will join us in our congratulations on this high distinction.