



a place of mind

FACULTY OF
APPLIED SCIENCE

ADVANCED PAPERMAKING INITIATIVE (API)

ANNUAL REPORT

for the period April 1, 2012 - March 31, 2013

Prepared for API

Dr. Mark Martinez, Director

Professor in Chemical and Biological Engineering

Your support continues to
make a vast difference to
our students, faculty and
community.

Thank you.

For more information, please contact:

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Introduction

The mission of the Advanced Papermaking Initiative (API) is to enhance postsecondary education and research for the paper industry of British Columbia. The Initiative supported the creation of two faculty positions at UBC (Professors James Olson in Mechanical Engineering and Mark Martinez in Chemical and Biological Engineering) and one at BCIT (Dr. Rodger Beatson). Professor Peter Englezos, a faculty member from the Department of Chemical and Biological Engineering at UBC, is also a member of the API.

This 15th Annual Report describes the activities of the API-funded faculty as well as the Director's for the period 1 April 2012 to 31 March 2013. Leading edge and industrially relevant research is carried out at UBC's Pulp and Paper Centre. I invite you to contact Professors Beatson, Englezos, Martinez and Olson directly to learn more about their exciting research projects.

This year, we have had many activities including the renewal of the second phase of the Mechanical Energy Reduction program for five years. This program, which is led by the API, links industry, government, and three academic institutes to examine novel means of reducing the direct electrical energy consumption in the production of mechanical pulp. In addition, we have been actively attempting to recruit an industrial research chair in the rapidly expanding bio-refining area.

API Structure



Mark Martinez
Director, API

The Initiative is led by a Director, appointed by the Dean, and advised by a Management Committee consisting of API faculty. An industrial Advisory Group provides advice to the Director and Dean on the API's activities in meeting its mandate.

The key personnel are:

Dean, pro tem, <i>Applied Science</i> :	Eric Hall
Director of API:	Mark Martinez

Management Committee:

This committee consists of the faculty associate with the API

Rodger Beatson
Peter Englezos
Mark Martinez
James Olson

Advisory Group:

Ms. Gail Sherson, *FPInnovations*
Prof. Peter Wild, *University of Victoria*
Mr. Jeff Bennett, *Canfor Pulp Ltd.*

API Faculty - Biographies

Rodger Beatson holds a Ph.D. in Organic Chemistry from the University of Western Ontario, London, Ontario. Since graduating he has worked at Consolidated-Bathurst as Group Leader Product Development in the Packaging Division, at Paprican in research positions in mechanical pulping and fibre and paper physics and at Canadian Forest Products as a Senior Research Scientist. In 1999 he joined the API as a Faculty member at BCIT. Rodger has been an Adjunct Professor in the Faculty of Forestry since 1995. Dr. Beatson's current research interests are in identifying the genes that control fibre morphology and lignin content, dissolving pulp, and the use of enzymes and chemicals to reduce energy consumption in refining.

Peter Englezos holds a Ph.D. in Chemical Engineering from the University of Calgary (1990). During his Ph.D. studies, Dr. Englezos was the recipient of an Izaak Walton Killam Memorial Scholarship. In September 1990, he joined the Department of Chemical Engineering at UBC as an Assistant Professor. Dr. Englezos was awarded a UBC Izaak Walton Killam Memorial Faculty Research Fellowship for the period 1997-98. In 1999, he was named Fellow of the Tokyo Electric Power Company Endowed Chair at the Faculty of Science and Technology of Keio University in Japan. He served as Coordinator of the non-thesis Pulp and Paper Master of Engineering Program for the period 1992-1999. Dr. Englezos served as the Director of the API between January 2006 and August 2011. On December 1, 2007 he became the inaugural holder of the Advanced Papermaking Professorship. In July 2009 he was appointed Head of the Department of Chemical and Biological Engineering. Dr. Englezos is a registered Professional Engineer in British Columbia and a member of the Canadian Academy of Engineering (2009). His current research interests are in the fields of papermaking chemistry, natural gas hydrates, thermodynamics, and carbon dioxide capture.

Mark Martinez holds a Ph.D. in Chemical Engineering from the University of British Columbia (1995) and a Ducant in Paper Technology from the Royal Institute of Technology (1999). He joined the Chemical Engineering Department at UBC in 1999 after four years at the Swedish Pulp and Paper Research Institute, where he was group manager for the paper technology group. His research focuses on the fluid mechanics of fibre suspensions, and has been awarded numerous awards including the 2009 BCIC Lieutenant Governors Award for Innovation. He is a registered Professional Engineer in BC.

James A. Olson holds a B.A.Sc. in Engineering Physics (1991) and a Ph.D. in Chemical Engineering from the University of British Columbia (1996). He worked at the Pulp and Paper Research Institute of Canada from 1995 to 1999 to lead a research project on fibre fractionation and contaminant control. He joined the Mechanical Engineering Department in July 1999 as an Assistant Professor. He was appointed as the Director of the UBC Pulp and Paper Centre in 2011. His research is in the areas of advanced pulp processing, screening, LC refining, fibre and paper properties, and the fluid mechanics of fibre suspensions. In recognition of his research he has been awarded two NSERC Synergy awards for industry collaboration, 2 I.H. Weldon awards for best papers in 2001 and 2010, the 2007 & 2009 Van den Akker medal from the Fundamental Research Committee, and the 2009 BCIC Lieutenant Governors Award for Innovation, as well as, several best paper awards including the Wayne Carr Memorial, the Douglas Attack and the John S. Bates best paper awards. He is a registered Professional Engineer in BC.

API Faculty - Teaching

The API presents a number of courses at three different post-secondary institutes in BC. At both UBC and UVic, Professors Olson and Martinez deliver 2 fourth-year elective courses to Mechanical and Chemical Engineering students. In total, Olson and Martinez delivered 72 hours of lectures to 61 final year students. At UBC they co-teach [CHBE 401](#) and at UVic, [Mech 450](#).

This year Professor Englezos delivered [CHBE 243](#) consisting of 12 hours of lectures to 151 students. The course is an introduction to *Chemical and Biological Engineering Process and Technology* with a focus on processes used in chemical and biological industries which emphasize underlying physical, chemical and biological principles. He also delivered two 1.5 hour lectures in CHBE 362 on Laboratory Data Analysis and Model Parameter Estimation to the department's third-year students.

Professor Beatson delivered three BCIT diploma courses in the past year:

Paper and Chemicals from Renewable Resources: A lecture and laboratory course that covered the production of pulp, paper, extractives, dissolving pulps, biopolymers and ethanol from wood.

Research Projects: Four student groups were guided in a laboratory based research projects. The research topics were: production of polymers films from hemlock hemicelluloses, dissolving grade pulp from hemlock kraft pulp, optimization of refining and starch addition for increasing paper tensile strength and bacterial leaching of copper from ore.

Process Simulation: In this course, students worked with computer simulations of chemical processes (CADSim) to develop an understanding of the impact of manipulating process variables on the products from the process. Processes studied were: Brownstock washing, papermaking and fractional distillation.

API Faculty - Research

The research contributions of the API faculty members are quite broad. API faculty members currently conduct research in the following areas:

- Mechanical pulping
- Stock preparation
- Papermaking and papermaking chemistry
- Chemical pulping
- Novel materials

The major activity of this year was the renewal of the Mechanical Pulping Energy Reduction Program. This is a consortium linking 10 industrial partners with three academic institutes (UBC, UVic, UofT) by leveraging federal government resources (NSERC CRD program).

Over this year, API members have supervised over 20 graduate or undergraduate students, published more than 15 scientific journal publications and produced two patents.

API Faculty - Selected Publications

- A. Capron, X. Feng Chang, H. Hall, B. Ellis, R.P. Beatson, T. Berleth, "Identification of quantitative trait loci controlling fibre length and lignin content in *Arabidopsis thaliana* stems", *Journal of Experimental Botany* 64(1), 185-197, 2013
- A. Nikbakht, A. Madani, J.A. Olson, D.M. Martinez, "Observation of turbulent transition of a papermaking fibre suspension in Hagen-Poiseuille flow", *Pulp and Paper Fundamental Research Symposium*, Cambridge, 2013
- A. Oko, D.M. Martinez, A. Swerin, "Infiltration and dimensional scaling of inject droplets on thick isotropic porous media", *Pulp and Paper Fundamental Research Symposium*, Cambridge, 2013
- N. Rajabinisab, J.A. Olson, J. Heymer, D.M. Martinez, "Understanding of No-load Power in Low Consistency Refiners", *CJChE*, 2013
- S. Towfighi, D.P. Romilly, J.A. Olson, "Elevated Temperature Material Characteristics of AISI 304L Stainless Steel", *Journal of Materials at High Temperatures*, 30(2) pg 1-6, 2013
- A. Elahimehr, J.A. Olson, D.M. Martinez, J. Heymer, "Estimating the area and number of bar crossings between refiner plates", *NPPRJ*, Vol 27, No.5, 2012
- A. Bagherzadeh, P. Englezos, S. Alavi, J.A. Ripmeester, "Molecular Simulation of Non-equilibrium Methane Hydrate Decomposition", *J Chem Thermodynamics*, 44(1), 13-19, 2012
- D. Gorski, A. Luukkonen, M. Sabourin, J.A. Olson, "Two-stage low consistency refining of mechanical pulp", *APPITA J*, 65(3), 2012
- D. Gorski, K. Mörseburg, J.A. Olson, A. Luukkonen, "Fibre and fines quality development in pilot scale high and low consistency refining of ATMP", *NPPRJ* 27 (12) 872-881, 2012
- D. Zhong, P. Englezos, "Methane Separation from Coal Mine Methane Gas by Tetra-n-butyl Ammonium Bromide Semi-clathrate Hydrate Formation", *Energy and Fuels*, 2012
- Madani, D.M. Martinez, I.A. Frigaard, J.A. Olson, "The Stability of Spiral Poiseuille Flows of Newtonian and Bingham Fluids in an Annular Gap", *J. Non-Newtonian Fluid Mechanics*, 193, pg 3-10, 2012
- M.O. Alaqqad, C.P.J. Bennington, D.M. Martinez, "An estimate of the axial dispersion during flow through a compressible wood-chip bed", *Can J. Chem Eng*, 90(6):1602-1611, 2012

API Faculty - Selected Publications

M.O. Alaqad, C.P.J. Bennington, D.M. Martinez, "The permeability of wood chip beds: The effect of compressibility", *Can J. Chem Eng* 90(5) 1278-1288, 2012

P. Linga, N. Daraboina, J. A. Ripmeester, P. Englezos, "Enhanced rate of gas hydrate formation in a fixed bed column filled with sand compared to a stirred vessel", *Chem Eng Sci*, 68, 617-623, 2012.

R. Gooding, J.A. Olson, C. Hayarte, F. Labbe, "Enhanced pulp screen performance from increased slot precision and accuracy", *ATIP* 66(3), October 2012.

S. Moradi, P. Englezos, S. G. Hatzikiriakos, "Contact Angle Hysteresis: Surface Morphology Effects," *J. Adhesion Sci.Tech*, 2012

S.M. Taghavi, K. Alba, T. Seon, K. Wielage-Burchard, D.M. Martinez, I.A. Frigaard, "Miscible displacement flows in near-horizontal ducts at low Atwood number", *J. Fluid Mech.* 696 175-214, 2012

Y. Sang, M.E. McQuaid, P. Englezos, "Pre-flocculation of precipitated calcium carbonate filler by cationic starch for highly filled mechanical grade paper", *Bioresources*, 7(1), 354-373, 2012.

Community Outreach

API organized various presentations and round table discussions on May 30, 2012 at the Fairmont Jasper Park Lodge within the 2012 PacWest Conference. Approximately 40 guests were in attendance.

Dr. Mark Martinez acted as a Moderator, with the following invited speakers and topics:

Jean-Pierre Bousquet, Metso Paper

“Conversion of existing TMP plants to ISS (Inter Stage Screening) technology”

Per Engstrand, MIUN, Sweden

“Mechanical Pulping Research at Mid Sweden University”

Robert Lanouette, UQTR

“Refining energy reduction program at the Lignocellulosic material research centre”

James Olson, PPC Director, UBC

“UBC Pulp and Paper Centre energy conservation research”

Marc Sabourin, Andritz

“Andritz perspectives on reducing energy consumption in thermomechanical pulping”

Christer Sandberg, Holmen Paper, Sweden

“Energy Efficient TMP - Demonstration Project at Braviken Paper Mill”

Finances

The financial statement for Year XV is given in the table below.

(1 April 2012 - 31 March 2013)

2012-2013 Budget	\$235,635.00
Opening Balance (from 2011-2012)	\$22,860.24
Available Budget 2012-2013	<u>\$258,495.24</u>
TEACHING	
Faculty	-
Scholarships	-
RESEARCH	
Equipment, service & supplies	-
COMMUNITY OUTREACH	
Travel (Conferences)	\$2,487.03
Travel (General Expenses)	\$1,087.43
Seminars	-
Misc. Charges	\$439.65
	<u>\$4,014.11</u>
DEAN'S OFFICE	
API administration	<u>\$62,420.00</u>
OFFICE EXPENSES	<u>\$2,841.73</u>
CHBE, MECH and BCIT API Faculty Appointments	<u>\$154,105.77</u>
TOTAL EXPENDITURES (2012-2013)	<u>\$223,381.61</u>
Uncommitted Balance (2013-2014)	<u>\$35,113.63</u>