



a place of mind

FACULTY OF
APPLIED SCIENCE

ADVANCED PAPERMAKING INITIATIVE (API)

ANNUAL REPORT

for the period April 1, 2011 - March 31, 2012

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:

Dr. Mark Martinez

API Director

**Professor in Chemical and Biological
Engineering**

Faculty of Applied Science

2360 East Mall

Vancouver, BC V6T 1Z3

Telephone: 604 822 2693

Email: martinez@chbe.ubc.ca

Contents

INTRODUCTION	3
API STRUCTURE	4
BIOGRAPHIES	5
TEACHING	6
RESEARCH	7
SELECTED PUBLICATIONS	8
FINANCES	10

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 14th Annual Report describes the activities of the API-funded faculty as well as the Director's for the period 1 April 2011 to 31 March 2012. 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.

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 approximately 60 final year students. At UBC they co-teach [CHBE 401](#) and at UVic, [Mech 450](#).

This year Professor Englezos delivered [CHBE 243](#), 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. The course consisted of 12 hours of lectures to 76 students.

Professor Beatson delivered three BCIT 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. 17 students attended 27 hours of lectures and 18 hours of labs.

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. 17 students attended 60 hours of labs.

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. 17 students attended 60 hours of tutorials.

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

Over this year, API member have supervised over 20 graduate or undergraduate students, published more than 20 scientific journal publications and produced 2 patents.

API Faculty - Selected Publications

- A. Bagherzadeh, P. Englezos, S. Alavi, J.A. Ripmeester, "Molecular Simulation of Nonequilibrium Methane Hydrate Decomposition", *J Chem Thermodynamics*, 44(1), 13-19, 2012
- A. Elahimehr, J.A. Olson, D.M. Martinez, J. Heymer, "Estimating the area and number of bar crossings between refiner plates", *Nordic Pulp Pap Res. J.*, 27(5): 836-843, 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
- M.O. Alaqqad, C.P.J. Bennington, D.M. Martinez, "The permability of wood chip beds: The effect of compressibility", *Can J. Chem Eng*, 90(5) 1278-1288, 2012
- R.P. Beatson, "Chemicals from Extractives" In Sustainable Production of Fuels, Chemicals, and Fibers from Forest Biomass; Eds. Zhu, J.Y, Pan, X.J. and Zhang, X.: ACS Symposium Series, Volume 1067; Chapt. 11, 279-297, Publ. American Chemical Society: Washington, DC, January, 2012
- X-F. Chang, J.A. Olson, R.P. Beatson, "A Comparison between the Effects of Ozone and Alkaline Peroxide Treatments on TMP Properties and Subsequent Low Consistency Refining" *BioResources* 7(1), 99-111, 2012
- A. Bagherzadeh, I. L. Moudrakovski, P. Englezos, J.A. Ripmeester, "Magnetic Resonance Imaging of Gas Hydrate Formation in a Bed of Silica Sand Particles", *Energy Fuels*, 2011, 25 (7), pp. 3083-309, 2011
- A.M. Kietzig, M.N. Mirvakili, S. Kamal, P. Englezos, S.G. Hatzikiriakos, " Laser-Patterned Super-Hydrophobic Pure Metallic Substrates: Cassie to Wenzel Wetting Transitions," *J. Adhesion Sci.Tech.*, 25 (20), 2789-2809, 2011
- A. Madani, H. Kiiskinen, J.A. Olson, D.M. Martinez, "Fractionation of MFC in a gel and the effect on the elongational properties of paper", *Nordic J. Pulp Pap Res*, 26(3) 306-311, 2011
- A. Madani, H. Kiiskinen, J.A. Olson, D. M. Martinez, "Fractionation of microfibrillated cellulose and its effects on tensile index and elongation of paper", *Nordic Pulp and Paper Research J.* Vol 26, 2011
- J. Heymer, J. A. Olson, R. J. Kerekes, "The role of multiple loading cycles on pulp in refiners" *Nordic Pulp and Paper Research J.*, 2011
- M. Hamelin, S. Delfel, J.A. Olson, C. Ollivier-Gooch, "High performance multi-element foil (MEF) pulp screen rotor – Pilot plant and mill trials", *J. of Pulp and Paper Science*, 36(3-4), 2011

API Faculty - Selected Publications

N. Daraboina, J.A. Ripmeester, V. Walker, P. Englezos, "Natural Gas Hydrate Formation and Decomposition in the Presence of Kinetic Inhibitors. III: Structural and compositional changes", *Energy and Fuels*, 25, 4398-4404, 2011

N. Daraboina, P. Linga, J.A. Ripmeester, V. Walker, P. Englezos, "Natural Gas Hydrate Formation and Decomposition in the Presence of Kinetic Inhibitors. II: Stirred reactor experiments" *Energy and Fuels*, 25, 4384-4391, 2011

N. Daraboina, J.A. Ripmeester, V. Walker, P. Englezos, "Natural Gas Hydrate Formation and Decomposition in the Presence of Kinetic Inhibitors. I: High Pressure Calorimetry", *Energy and Fuels*, 25, 4392-4397, 2011

S. Delfel, J.A. Olson, D.M. Martinez, A. Regairaz, C.F. Ollivier-Gooch, "Influence of cylinder design and other factors on capacity and power consumption in a pressure screen", *Appita J.* 64(1):55-61, 2011

S. Hormozi, D.M. Martinez, I.A. Frigaard, "Stable core annular flows with viscoelastic fluids using the viscoplastic lubrication technique", *J.Non-Newtonian Fluid Mech*, 166(23-24), 1356-1368, 2011

S.M. Taghavi, T Seon, K. Weigle-Burchard, D.M. Martinez, I.A. Frigaard, "Stationary residual layers in buoyant Newtonian displacement flows", *Phys Fluids*, 23, 044105, 2011

T.J. Rainey, W.O.S. Doherty, N. Kelson, D. M. Martinez, "Pressure Filtration of Australian Baggase Pulp", *Transp. Por. Med.* 86(3) 737-751, 2011

X-F Chang, C. Bridges, D. Vu, D. Kuan, L. Kuang, J.A. Olson, A. Luukonen, R.P. Beatson, "Saving Electrical Energy by Alkaline Peroxide Pretreatment of TMP Prior to Low Consistency Refining" *Pulp and Paper Canada* 112(4), 21-27, July/August, 2011 [Winner Douglas Attack Award for best paper presented on mechanical pulping, PAPTAC Annual Meeting, Montreal, 2010].

Y. Sang, M.E. McQuaid, P. Englezos, "Optimization of Chemical Use for Highly Filled Mechanical Grade Papers with Precipitated Calcium Carbonate", *Bioresources*, 6(1), 656-671, 2011

Y. Sang, N. Al-Saifi, P. Englezos, "Understanding the Precipitated Calcium Carbonate Flocculation Mechanism Induced by Starch through Population Balance Modeling", *Advanced Materials Research*, 236-238 Pages 1250-1255 Part 1-3, 2011

Finances

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

(1 April 2011 - 31 March 2012)

2011-2012 Budget	\$235,633.00
Opening Balance (from 2010-2011)	\$22,269.52
Available Budget 2012-2013	<u><u>\$257,902.52</u></u>
TEACHING	
Faculty	-
Scholarships	-
RESEARCH	
Equipment, service & supplies	-
COMMUNITY OUTREACH	
Travel (Conferences)	\$679.09
Travel (General Expenses)	\$172.67
Seminars	-
Misc. Charges	\$-
	<u>\$851.76</u>
DEAN'S OFFICE	
API administration	<u>\$83,033.01</u>
OFFICE EXPENSES	<u>\$143.31</u>
CHBE, MECH and BCIT API Faculty Appointments	\$150,826.79
Misc. Charges	\$187.41
	<u>\$151,678.55</u>
TOTAL EXPENDITURES (2011-2012)	<u><u>\$235,042.28</u></u>
Uncommitted Balance (2012-2013)	<u>\$22,860.24</u>