

Advanced Papermaking Initiative

The 21st Annual Report

1 April 2018 to 31 March 2019

04

A year in passing. When we open pathways to change, what are we setting in motion? What are the exciting glimpses of events and people to come?

Director's Note

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The Advanced Papermaking Initiative: Aims, structure, people and their research.

API Composition

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API's faculty members manage not only their academic but also administrative, research and volunteer tasks.

Teaching and Tasks

Cover photo: MFC pulp being churned in a large mixing tank in the high-head lab at PPC.
Credit: Chitra Arcot

Created for API by:
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Small Molecule Biochemicals

06

A sum of our efforts, simple in numbers. And far reaching in influence.

API in Numbers

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Expanding the boundaries of research in forest bioproducts.

Prestigious Chairs

20

Peer-reviewed journal articles, and non-peer reviewed, oral presentations at conferences, posters and patents.

Publications

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Our graduate researchers and post doctoral fellows. Visiting scholars and guest lecturers.

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26

Financial statement for the reporting period.

Finances

THE CONTENT

Dear Readers:

The 21st Annual Report of our Advanced Papermaking Initiative covers activities of the reporting period between April 1, 2018 and March 31, 2019. The financial information about the budget contained in this report supersedes that of the previous reporting period (April 1, 2017 to March 31, 2018).

While a year is a short time span to record events of far-reaching significance, this financial year contains all the fine trappings and beginnings of long-term changes at the Pulp and Paper Centre (PPC).

I'm pleased to welcome Associate Professor Emily D. Cranston as UBC President's Excellence Chair in Forest Bioproducts. Emily's research interests in sustainable nanocomposites and hybrid materials from cellulose and other biopolymers positions her expertise across the faculties of Applied Science and Forestry. Emily stepped into her role at the start of this year.

In early 2020, another world-leading expert will join our forces. Dr. Orlando Rojas has been appointed Canada Excellence Research Chair (CERC) in Forest Bioproducts. The federal government's CERC program (www.cerc.gc.ca/home-accueil-eng.aspx) supports and generously funds Canadian universities to attract top research talent from abroad to Canada.



photometry

Note

June 2019

Other events that steward change were the launch of seminar series in bioproducts and the successful Researcher Day last September for graduates invited from four faculties to give 3-minute talks and present posters. Leadership of the BioProducts Institute shifted to the distinguished hands of Prof. Scott Renneckar at the faculty of Forestry.

Our Energy Reduction in Mechanical Pulping (ERMP) program is completing its Phase 2 stage this year. The program began in 2007, and Prof. James Olson led both Phases 1 and 2 for 12 years as Principal Investigator. James steered and expanded direction to embrace developments in bioproducts and fibre technologies in the Phase 3 proposal, currently under review at NSERC, Ottawa.

Our work centres on research, and everything we achieve is because of the people behind it. In the past year, our research graduates have moved on and out of PPC to jobs in industry while some researchers successfully defended their thesis and obtained their well-deserved doctorate degrees. We've coached many undergraduates in their first coop placements at PPC, and we've hosted a good many visiting scholars and distinguished visitors.

The coming years at PPC hold much promise.

I wish you well.

Sincerely,
Mark

Mark D. Martinez, PhD, P.Eng.
Professor, Chemical and Biological Engineering, UBC
Director, Advanced Papermaking Initiative
Director, Pulp and Paper Centre



25 graduate
students

API in Numbers

14
PhD
students

9
visiting
scholars

21
peer-reviewed
articles

4
professors



7
post
doctoral
fellows

1
patent

5
coop
students

25
conference
presentations

2

API Composition



**All activities, teaching and research
are supported by a multi-million dollar
grant that created the Advanced
Papermaking Initiative.**

The mission of the Advanced Papermaking Initiative (API) is to enhance post-secondary education and research for the pulp and paper industry of British Columbia.

API 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 faculty position at BCIT

Prof. Rodger Beatson.

Professor Peter Englezos, a faculty member and Head of the Department of Chemical and Biological Engineering at UBC, is also a faculty member of API.

This 21st Annual Report provides an overview of the activities of the API-funded faculty for the reporting period of April 1, 2018 to March 31, 2019.

Research carried out at UBC's Pulp and Paper Centre (PPC) is industry relevant and focuses on efficient processes that advance the research and partnerships of the Advanced Papermaking Initiative, the Energy Reduction in Mechanical Pulping program and the Pulp and Paper Centre.

Prof. James A. Olson is Dean of the Faculty of Applied Science. James holds a B.A.Sc. in Engineering Physics (1991) and a Ph.D. in Chemical Engineering from the University of British Columbia (1996). His tenure at UBC has been distinguished and progressive in rank and scale of funded projects that he has led as principal investigator from Assistant Professor in 1999 to Director of the Pulp and Paper Centre in 2011, and then in early 2014 as Associate Dean of Research and Partnerships at the Faculty of Applied Science. His research expertise is in the areas of advanced pulp processing, screening, LC refining, fibre and paper properties, and the fluid mechanics of fibre suspensions.



API Core

Prof. Mark Martinez holds a Ph.D. in Chemical Engineering from The University of British Columbia (1995) and a Docent in Paper Technology (1999) from the Royal Institute of Technology, Sweden. He joined the Chemical Engineering Department at UBC in 1999. Mark was appointed Director of the UBC Pulp and Paper Centre at the start of 2014, and has been the Director of the Advanced Papermaking Initiative since 2011. His research focuses on the fluid mechanics of fibre suspensions.

Over the past year, API faculty members supervised a combination of 31 graduate students, research assistants and postdoctoral research fellows. Attributed to them are 21 co-authored scientific, peer reviewed articles, 20 papers and posters at international conference proceedings and 11 graduate and doctoral theses.



Prof. Rodger Beatson holds a B.Sc. Honours (1968) in Chemistry from the University of Exeter, Devon, England. He obtained his Ph.D. in Organic Chemistry from the University of Western Ontario, London, Ontario in 1975. Roger began working for the API in 1999 as faculty member at BCIT, and has been Adjunct Professor in UBC's Faculty of Forestry since 1995. Dr. Beatson's current research interests are dissolving pulp production, the use chemicals to reduce energy consumption in refining and the recovery of hemicellulose from mill residues for use in improving beatability and enhancing paper strength.

e Faculty



Prof. Peter Englezos holds a Ph.D. in Chemical Engineering from the University of Calgary (1990). He served as Coordinator of UBC's Master of Engineering, non-thesis Pulp and Paper Program during 1992-99. Peter was Director of the Advanced Papermaking Initiative between July 2005 and August 2011.

He became the inaugural holder of the Advanced Papermaking Professorship in December 2007. Peter was appointed Head of the Department of Chemical and Biological Engineering in July 2009. His current research interests span engineering wood fibres for novel product development, novel gas separation technologies for hydrogen production and carbon dioxide capture, water desalination and natural gas hydrates.

Faculty



Adjunct Professor Nuwan Sella Kapu has more than fifteen years of experience in the plant sciences and biomass processing. He obtained his Ph.D. in Plant Biology specializing in cell wall biology and biochemistry from the Pennsylvania State University, University Park.

His research areas at UBC focus on developing technologies for bio-products and biorefineries using diverse feedstocks including bamboo.



Barbara Dalpke graduated in 1997 with a degree in Pulp and Paper Engineering from the Technical University in Darmstadt, Germany. She then joined the PhD program in Mechanical Engineering at UBC and upon graduation in 2002 transferred to the Chemical Engineering department as a Postdoctoral Fellow.

Barbara's role is sessional lecturer at UBC and she teaches Pulp and Paper Technology to undergraduate students at the University of Victoria.

Teaching and tasks

Dr. Rodger Beatson instructed 49 students for 3 courses in Chemical and Environmental Technology (CENV) — #3346, 4400 and 4403 — at BCIT covering Paper and Chemicals from Renewable Resources, Research Projects and Process Simulation. Rodger also co-supervised the doctoral research of one PhD candidate. He also reviewed papers for a peer-reviewed journal, *Nordic Pulp and Paper Research Journal* in 2018.

Dr. Barbara Dalpke delivered MECH 450D “An introduction to Pulp and Paper Technology” to 25 UVIC students (4th year) by video link, and simultaneously also delivered the course as MECH 410A to 7 UBC students (five 4th year and two 3rd year). Both courses are 3-credit electives with 37.5 h of instruction delivered over 14 weeks.

In 2018 Winter term I, Dr. Nuwan Sella Kapu guided 3 Master of Engineering Leadership-Green Bio-products students and 3 MEng students in the laboratory component of GBPR 503. He also served as the UBC supervisor of a MEL-Green Bio-product student who completed an industry practicum with the local company Recycling Alternative to fulfill a 3-credit technical elective. He was also the Chair of the UBC Students session at the PacWest 2018 conference.

Teaching and Tasks

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Prof. Peter Englezos is Head of the department of Chemical and Biological Engineering (CHBE). His lectures covered the thesis course 491, 493, 494, 496 with nine students. He gave guest lectures in CHBE 364/365/366 to cover 125 students and 2 hours, the CHBE course 483- Energy Engineering to 47 students for a one-hour duration.

Peter volunteered a lecture at our non-credit 3-day course at PPC for a 1-hour duration on "Water and Colloid Chemistry in Papermaking".

Peter also sits on the APSC Strategic Planning Committee and the APSC Space Committee.

Prof. Mark Martinez conducted the CHBE 251 course, Transport Phenomena 1 on Fluid Mechanics with 39 hours of instruction provided to 182 students. Mark also gave two lectures at the non-degree course, "Introduction to Pulp and Paper Technology" that had 8 students and held 12 labs for them. Mark was the principal supervisor in the research work of 4 doctoral students, 2 graduates and one professional researcher. Mark co-supervised 2 doctoral students and 2 post doctoral fellows.

As Director of the Pulp and Paper Centre, Mark supervises the work of 3 support staff.



Prof. James A. Olson's appointment as Dean of the Faculty of Applied Science expanded his leadership and research responsibilities meteorically. After 12 years as principal investigator of two Phases in an industry-research led partnership in energy reduction with NSERC, James hands over the proposed Phase 3 of the program to Mark Martinez to take it forward after June 2019.

James serves as Chair, Faculty ARPT Committee, and member of UBC's Senate Library Committee, the Vantage College Steering Committee, the Entrepreneurship at UBC, the WWest Advisory Committee, the President's Roundtable on Opioid Crisis, and the President's Working Group on UBC Rapid Transit Plan.

James's work in academia and research continues to grow. Earlier this year, the BC government approved a new undergraduate program in Biomedical Engineering with the faculties of Applied Science and Medicine. James delivered the keynote address and lectured at our API course, "Introduction to Pulp and Paper Technology" for 3 hours. Dr. Olson supervised the research work of 3 doctoral students.

Prestigious Chairs



Dr. Emily Cranston

President's Excellence Chair in Forest BioProducts

Emily Cranston has joined UBC's Departments of Chemical and Biological Engineering and Wood Science as associate professor. The Canada Research Chair in Bio-based Nanomaterials and the UBC President's Excellence Chair in Forest Bio-products, she was previously an associate professor of Chemical Engineering at McMaster University.

Among Prof. Cranston's primary research aims is to better understand and develop valuable applications for nanocellulose, a sustainable material derived from wood pulp. Flexible, lightweight and exceptionally strong, it has the potential to improve everything from cars and cosmetics to biomedical devices and food.

Source: <https://engineering.ubc.ca/news/2019/01/welcoming-emily-cranston-ubc-presidents-excellence-chair-forest-bio-products-to-apsc>

As the CERC in Forest Bioproducts, Dr. Rojas will establish a world-class research program in genomics, synthetic biology, materials science and engineering. Together with his team and by applying cutting-edge nano- and biotechnologies, he will discover new strategies to isolate and transform biomass components as well as side-streams and residuals from forestry and agriculture, oils and biomolecules.

The work will lead to the generation of new bio-based precursors and advanced materials critical to the future bioeconomy. Prof. Rojas will be the scientific director of the UBC BioProducts Institute, synergizing a distinguished group of professors and researchers across campus who will conduct multi- and cross-disciplinary research that will position UBC at the forefront in the area.

Source:
<https://engineering.ubc.ca/news/2019/04/orlando-rojas-to-join-chbe-as-one-of-two-new-canada-excellence-research-chairs-at-ubc>



Dr. Orlando Rojas

Canada Excellence
Research Chair in
Forest BioProducts

Our Graduate Researchers

PhD Researchers

Adel MohammedRedha

Daniel Paterson

Ehsan Zaman

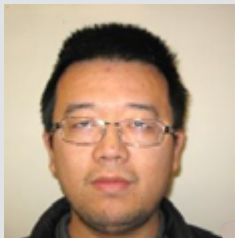
Hatef Rahmani

Hui Tian

Jingqian Chen

Jorge Rubiano Berna

Lee Rippon



Gaoyang Liu



Jordan McKensie



Junnan Chao



Reza Harirforoush

Post doc

Coop Undergrads

Miaoran Li
Ashutosh Kamble
Jwal Prajapati
Peter QiQiao Zhong
ZeZhong Li

Master of Applied Science

Arthur Rostami
Aishwarya Gautam
Faisal Al Qurooni
Farzin Golkhosh
Francois Audard
Justin Roberts
Miguel Villalba
Omid Hajieghrary
Ryan Melnick
Weiyin Li

PhD Researchers

Long Cheng
Masoud Daneshi
Mehr Negar Mirvakili
Mohammad Shanb Ghazani
Nicholas McIntosh
Sudipta Mitra
Xiaohe Liu

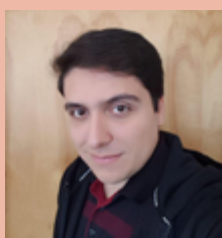
Postdoctoral fellows



Thomas Eaves



Timm Treskatis



Amir Farzad Foroughi

Post doctoral fellows

Amir Farzad Foroughi
Gaoyang Liu
Jordan Mackenzie
Junnan Chao
Reza Harirforoush
Thomas Eaves
Timm Treskatis

Visiting Scholars

and g

Guilin Hu

Hui Cai

Jaehyug Choi

Jinyi Tian

Louis Belgrand

Lubing Shi

Xiaosu Wang

Xinyan Zhang

Yong Yang



Dr. Marcus Fulde



Dr. Xiao Zhang

Dr. Marcus Fulde

Professor, Institute of Microbiology and Epizootics at Freie Universität, Berlin.
Lessons from the neonate mouse: a model system to study microbiota development and bacterial pathogenesis

Dr. Orlando Rojas

Professor, Chair of Materials Platform, Aalto University, Finland.
Biobased Polymers: Material Bank for the Development of Structure, Color and Function



Dr. Orlando Rojas

Dr. Jussi Manninen
Executive Vice President VTT
Technical Research Centre, Finland
Present and future of the Finnish Bioeconomy

uest lecturers



Dr. Katalin Barta
Associate Professor, Stratingh Institute
for Chemistry University of Groningen, The Netherlands,
Sustainable pathways to value added chemicals from renewable resources

Dr. Greg T. Beckham
Group Leader and Senior Engineer
National Renewable Energy Laboratory.
Hybrid Biological and Catalytic Processes to Manufacture and Recycle Plastics



Dr. Kristina Oksman

Dr. Kristiina Oksman
Professor and Director of Composite Center
Luleå University of Technology Laboratory, Sweden
Bionanomaterials and Their Use in Composites



Dr. Tapio Salmi

Dr. Tapio Salmi
Academy Professor, Dept. of Chemistry
Åbo Akademi University, Finland
Refining Biomass to Chemicals - What Can Chemical Reaction Engineering Do?

Dr. Xiao Zhang
Associate Professor, Voiland School of Chemical Engineering and
Bioengineering, WSU, Richland
Oxidative Lignin Valorization to Fuel, Chemicals and Materials

Daneshi M., D. Hewitt, J. MacKenzie, N.J. Balmforth, and D.M. Martinez. 2018. "Obstructed viscoplastic flow in a Hele-Shaw Cell". Submitted to Physical Review Fluids.

Fernandez F., D.M. Martinez, and J.A. Olson. 2018. "Low consistency reject refining of mechanical pulp for energy savings". Nordic Pulp and Paper Resources Journal. 33(1):21-27.

Forughi, A.F., S. Green, A. Kong, and B. Stoeber. 2018. "Through air drying of paper—The effect of dryer fabric". Drying Technology. October 2018. doi.10.1080/07373937.2018.1509082

Forughi, A.F., S. Green and B. Stoeber. 2018. Effect of dryer fabric structure on the performance of contact paper drying. Drying Technology. September 2018. pp. 854-863. doi.10.1080/07373937.2018.1469141

Jahningiri P., D. M. Martinez, and C. Hoehr. 2018. "Pressure rise in medical cyclotron liquid targets: Transient analysis". Applied Radiation and Isotopes. 136:87-100.

McIntosh N., Y.Sharma, A.B. Phillion, J.A. Olson, and D.M. Martinez. 2018. "Estimating the transverse dimensions of cellulose fibres in wood and paper using 2D and 3D microscopy techniques". Cellulose. 26(3)2099-2108.

Paterson D., D.M. Martinez, T.S. Eaves, N.J. Balmforth, and D.R. Hewitt. 2018. "Flow driven compaction of a fibrous porous medium". In review Physical Review Fluids.

Rubiano Berna J.E., D.M. Martinez and J.A. Olson. 2018. "A comminution parameterization model of low consistency refining". Power Technology. 328:289-299.

Rubiano Berna J.E., D.M. Martinez, and J.A. Olson. 2019. "Power-gap relationships in low consistency refining." Nordic Pulp and Paper Research Journal. 34(1):36-45.

Rubiano Berna J.E., C. Sandberg, M. Martinez, and J.A. Olson. 2019. "Theoretical analysis of LC-refining – pressure screening systems in TMP". Nordic Pulp and Paper Research Journal. 34(1):46-58.

Tian H., Q. Lu, R.B. Gopaluni, V.M. Zavala, and J.A. Olson. 2019. "An economic model predictive control framework for mechanical pulping processes." Journal of Control Engineering Practice. 85:100-09.

Treskatis T., A. Roustaei, I. Frigaard, and A.Wachs. "Practical guidelines for fast, efficient and robust simulations of yield-stress flows without regularisation: A study of accelerated proximal gradient and augmented Lagrangian methods". Journal of Non-Newtonian Fluid Mechanics. 2018:(262) 149-164. doi./10.1016/j.jnnfm.2018.05.002



Tsai Y, Q. Lu, L. Rippon L, S. Lim, A. Tulsyan, and B. Gopaluni. 2018. "Pattern and Knowledge Extraction using Process Data Analytics: A Tutorial". IFAC-Papers OnLine. 1;51(18):13-8.

Uittenbosch T., K. Buckley, T.J. Ruth, D.M. Martinez, and C. Hoehr, 2018. "A forced convection gas target for the production of $[^{11}\text{C}]\text{CH}_4$ ". Applied Radiation and Isotopes. 140:1-4.

Yuan Z, W. Wei, G. Li, and NUS Kapu. 2019. "High titer ethanol production from combined alkaline/alkaline hydrogen peroxide treated bamboo at high solid loading". Waste and Biomass Valorization. 1-11.

Yuan Z, Y. Wen, NUS Kapu, and R. Beatson. 2018. Evaluation of an organo-based biorefinery process to fractionate wheat straw into ethanol and co-products. Industrial Crops and Products. 121:294-302.

Zacchia N., D.M. Martinez, and C Hoehr. 2019. "Radiolysis reduction in liquid solution targets for the production of $^{89}\text{-Zr}$ ". Submitted to Applied Radiation and Isotopes.

Zacchia N., K. Buckley, G.M. Martinez, T.J. Ruth, D.M. Martinez, and C Hoehr. "Understanding isotope production from cyclotron targets: The effect of adsorption on the target body". Physics in Medicine and Biology. 63;195009.

Zacchia N., T. Uittenbosch, K. Buckley, T.J. Ruth, D.M. Martinez, and C Hoehr. 2019. "Modelling chemical kinetics in a ^{11}C target system. Submitted to Nuclear Instruments and Methods Physics Research Section B.

Zaman E., A. Vakil, D.M. Martinez, and J.A. Olson. 2018. "An integral criterion for turbulence suppression in swirling flows". Canadian Journal of Chemical Engineering. 9999: 1-10.

Zhang W. H., R. Christensen, R. Lutes, X. Liu, J. Zhang, D.M. Martinez, H. Pande, B. Marcoccia, and Y Ni. 2018. "Using cupriethylenediamine (CED) solution to decrease cellulose fibre network strength for removal of pulp fibre plugs." Accepted by Canadian Journal of Chemical Engineering.

conference p

Daniel Paterson, T.S. Eaves, N.J. Balmforth, and D.M. Martinez. 2018. "Compressional dynamics of fibrous porous media I: from the coffee press to industrial machinery", 71st Annual meeting of APS Division of Fluid Dynamics. Atlanta, Georgia, USA.

Ehsan Zaman.^{*} PACWest. 2018. "A Numerical Study on Developing a Hydrocyclone-Specific Turbulence Model". Supervisors M. Martinez and JA Olson. Jasper, Alberta, Canada. 30 May to 2 June, 2018.

Hui Tian. PACWest 2018. "Moving Horizon Estimator Design for Mechanical Pulping Process". Supervisor, Prof. B. Gopaluni. Jasper, Alberta, Canada. 30 May to 2 June, 2018.

Jingqian Chen, D.M. Martinez, X Chang, and H.L. Trajano. 2018. "Hemicellulose Oligomer Molar Mass Evolution and Kinetics of Softwood Hydrolysis by Population Balance Model", 41st Symposium on Biotechnology for Fuels and Chemicals. Seattle, USA.

Jingqian Chen, N. Sella Kapu, Z. Yuan, X Chang, R. Beatson, D.M. Martinez and H.L. Trajano. 2018. "Capturing the complexity of hemicellulose hydrolysis". CSChE Confernece, Toronto, Canada.

Jorge Enrique Rubiano Berna, C. Sandberg, M. Martinez, J.A. Olson. 2018. "Theoretical study of systems composed of low consistency refining and pressure screening." 31st International Mechanical Pulping Conference, May 27-30. Trondheim, Norway.

Yuan Z., Jose G. Dimayacyac, and R. Beatson, "Reducing energy consumption in thermomechanical pulp production using chlorine dioxide." AIChE Annual Meeting, October 25 -November 2. Pittsburgh, Pennsylvania, USA. This paper was also presented at the AIChE Pacific North West Student Regional Conference April 13-14, 2018 in Bozeman, Montana. Awarded the second prize.

Yuan Z., Jose G. Dimayacyac, and R. Beatson. 2018. "Effect of chlorine dioxide treatment on the properties of thermomechanical pulp," 31st International Mechanical Pulping Conference, May 27-30. Trondheim, Norway,

Lee Rippon.^{*} 2018. Advanced Tools for Data Analytics Workshop at Advanced Control of Chemical Processes (ADCHEM). July 24. Shengyang, China.

Lee Rippon.^{*} 2019. AIChE Spring Meeting. 2019. Short course instructor at the Advanced Tools for Process Data Analytics. March 31. New Orleans, Louisiana, USA.

Mark D. Martinez. Pan Pacific Conference with the Appita Fibre Value Chain Conference. 2018. 4-7 December. Rotorua, New Zealand.

"Processing Opportunities Created through Rheology: New MFC Methodology"

"Looking at Dewatering from a Different Light: Insights from Consolidation Theory".

Masoud Daneshi, D.M. Martinez, N.J. Balmforth, D.R. Hewitt, and J.A. MacKenzie. 2018. "Experiments on obstructed viscoplastic flow in a thin slot", Annual European Rheology Conference. Sorrento, Italy.

presentations

Mehr Negar Mirvakili and P. Englezos. XXIX InterAmerican Congress of Chemical Engineering. 2018. Poster. "Effect of Surface Wettability on Optical Properties of Casted Microfibrillated Cellulose Films". October 28-31. Toronto.

Mohammad ShanbGhazani.^{*} Annual European Rheology Conference (AERC). 2018. Sorrento, Italy. April 17-20. Poster. "Continuous Fractionation of Particles in a Visco-plastic Fluid". Best Poster Award. Nick Zacchia, D.M. Martinez, and C. Hoehr, 2018. "Reduction of radiolysis in liquid targets for radiometal production: What not to do", 16th International Workshop on Targetry and Target Chemistry (WTTC17), Coimbra, Portugal.

B. DeMuner, Mohammad ShanbGhanzi, J. Kadla and D.M. Martinez. 2018. "Proof of Concept of gell fractionation of eucalyptus Kraft MFC", TAPPI International Conference on Nanotechnology for Renewable Materials. Madison Wisconsin, USA.

Nick Zacchia, T. Uittenbosch, K. Buckely, D.M. Martinez and C. Hoehr. 2018. "[11C]CH₄ from Gas Targets: The effects of forced convection and adsorption on the target walls", 16th International Workshop on Targetry and Target Chemistry (WTTC17), Coimbra, Portugal.

Peter Englezos. "Surface Engineering of Lignocellulosic Films". 2018. Okanagan School of Engineering, November 26. Kelowna, British Columbia, Canada.

Peter Englezos. 2019. "Gas Hydrate Based Gas Separation: CO₂ Capture and Storage". March 14. IIT Madras, India.

R. Ciccione, A.B. Phillion, Farzin Golkosh, and D.M. Martinez. 2018. "3D Image based deformation in softwood pulp: Effect of refining intensity". Progress in Paper Physics, Lodz, Poland.

Reza Harirforoush, J.A. Olson, and P. Wild. PACWest Conference. June 2018. "The Effect of Recirculation mode on bar forces in Low Consistency Refining". Best Student Award. Jasper, Alberta, Canada.

Thomas .S. Eaves, Daniel Paterson, N.J. Balmforth, and D.M. Martinez. 2018 " Compressional dynamics of fibrous porous media II: gelling and Freeness. 71st Annual meeting of APS Division of Fluid Dynamics, Atlanta, Georgia, USA.

Timm Treskatis.^{*} "Hyperbolic Conservation Laws and Mathematical Fluid Dynamics". Poster. October 1- 5, 2018. Würzburg, Germany.

Timm Treskatis.^{*} IWR School "Advances in Mathematical Optimization". 2018. October 8-12. Heidelberg, Germany.

Timm Treskatis.^{*} SIAM Conference on Computational Science and Engineering. 2019. February 25-March 1. Spokane WA, USA.

^{*}Collaborators and supervisors to be attributed.
Underlined names reflect presenters.

Patent

Lu Q, Rippon Lee D, Gopaluni RB, Forbes MG, Loewen PD, Backstrom JU, and Dumont GA, inventors; Honeywell Limited, assignee. *Closed-loop model parameter identification techniques for industrial model-based process controllers*. United States patent application US 15/636,419. March 22, 2018.

Theses

Amir Farzad Foroughi

"Paper Drying: Experimental Studies on the Influence of Dryer Fabric". PhD Thesis. 2018. <http://hdl.handle.net/2429/66544>

Jorge Enrique Rubiano Berna

"On Low Consistency Refining of Mechanical Pulps". PhD Thesis. 2018. University of British Columbia.

Miguel Esteban Villalba Chehab

"Characterization of Screw Feeder Compression and its Effect on Wood Chip Cellulose Accessibility", MASc Thesis. 2018.

Other graduate researchers also successfully defended their thesis during this reporting period:

Ehsan Zaman - PhD

Mehr Negar Mirvakili - PhD

Aishwarya Gautam - MASc

Faisal Al Qurooni - MASc

Justin Roberts - MASc

Noteworthy Accomplishments

Community Outreach

API Course

INTRODUCTION to PULP and PAPER TECHNOLOGY

A three-day course sponsored by the Advanced Papermaking Initiative (API) at the University of British Columbia

Who should attend:
This introductory-level course is suitable for current engineering students, including coop, along with recently hired engineers working in BC pulp and paper mills and supporting industries. Suitable for both technical and non-technical individuals who want to understand basics of BC's natural resource, chemical and mechanical pulping, bleaching, recovery, papermaking, and paper grades and properties.

Description:
This hands-on course will consist of lectures during the mornings, and lab exercises in the afternoons to re-emphasize material and enhance understanding of process.

The course will provide an overview of:

- Natural Resources
- Mechanical Pulping history, theory and comparisons with chemical pulping
- Kraft Pulping, Bleaching and Recovery
- Pulp processing equipment, theory and operation of pulp screening, cleaning and low consistency refining
- Papermaking theory of forming, pressing and drying
- Chemical additives in the wet end of the paper machine
- Future bio-products and the transformation to a sustainable bio-economy
- Low Consistency Refining

May 1 to 3, 2018
Cost of 3-day course is \$600/person.
Register at www.ppc.ubc.ca/API/Course

THE UNIVERSITY OF BRITISH COLUMBIA



The 3-day course is a volunteer endeavour jointly by faculty members of API and from APSC. For the 19th year of its existence, this course provided a strong foundational base in theory and laboratory work to highly motivated personnel in the pulp and paper industry.

The feedback was positive and given by all of the course attendees. "This is a well-managed course with top notch professors who know the industry inside out."

Suggestions to expand the course and offer something online are in consideration.

Support staff at PPC were also highly involved in many of the course aspects. Reanna Seifert, lab technician, and George Soong who holds advanced degrees in Wood Science managed laboratory work and demonstrations. Chitra Arcot managed the project and organized the event.

The PACWest conference at Jasper, 30 May to June 2, 2018, featured six of our presenters, Ehsan Zaman, Reza Harirforoush, Taraneh Kordi, Jingqian Chen, Hui Tian, and MehrNegar Mirvakili, with their research. Dr. Nuwan Sella Kapu facilitated this dedicated UBC session.

We continue to offer fun papermaking events every month at the Ronald McDonald House in Vancouver. We also contributed quarter tonne of handsheets to the Berwick Child Development Centre at UBC. Children use the large sheets for artwork in their therapy sessions.

	Period Total	PG YTD
Transfer in from End Stab	-369,522.00	-369,522.00
Sub Total	-369,522.00	-369,522.00
Budget Balance Carry Forward	9,881.12	0
Budget pool-Expense	369,522.00	0
Total available	379,403.12	
Description	Period Total	PG YTD
TEACHING		
Salaries-Tenure Stream Faculty	4,500.00	4,500.00
Salaries-Other Term Faculty	12,406.86	12,406.86
Salaries- Employee benefits-Main	1,133.87	1,133.87
	<i>Subtotal</i>	18,040.73
COMMUNITY OUTREACH		
Field trips & conferences-Other transportation	2150.48	
Field trips & conference-Meals	3,342.39	
Field trips & conferences-Accommodation	1246.73	
Conferences - registration	670.89	
	<i>Subtotal</i>	7,410.49
API COURSE AND MEETINGS		
Office (supplies, print orders, course manuals, creative services, gifts, prizes, swag)	1231.33	
Food and Catering	1855.74	
Technical supplies and services	1431.26	
	<i>Subtotal</i>	4,518.33
RESEARCH AND PROFESSIONAL		
Prof fees- corp/NR outside CAN	225,499.11	
Prof fees – Individuals T4A	84,609.91	
Membership fees	533.66	
	<i>Subtotal</i>	310,642.68
Total		340,612.23
Total Expenses:	379,403.12	340,612.23
Balance Available		38,790.89

Financial Statement

**For the Reporting Period of
April 1, 2018 to March 31,
2019**

The Advanced Papermaking Initiative Advisory Board met on June 25, 2019 to approve the budget, review proposals and activities of the API. At the meeting, one of the motions was minuted to be recorded in this Annual Report.

A motion was passed in favour of the budget and the proposal for the Chair to pursue the Retention program with UBC's Mechanical Department, and for removing the Attraction program off further discussion. Paul Bicho and Davis Chiu seconded this motion and all members voted unanimously in favour of the motion, The Board will reconvene to review details of the program prepared by the Chair, Prof. Mark Martinez.



Thermochemical