

Polyurethanes Technical Conference 2014

**Dallas, Texas, USA
22-24 September 2014**

ISBN: 978-1-63439-966-1

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2014) by the American Chemistry Council
All rights reserved.

Printed by Curran Associates, Inc. (2015)

For permission requests, please contact the American Chemistry Council
at the address below.

American Chemistry Council
1300 Wilson Boulevard
Arlington, Virginia 22209

Phone: (703) 741-5000
Fax: (703) 741-6050

www.americanchemistry.com

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

Papers

Blowing Agents

Chemistry and Renewables

Coatings and Adhesives

Construction

Elastomers

Environment, Health and Safety:General

Environment, Health and Safety:SPF

Flame Retardants and Combustibility

Flexible Foams

Processing and Composites I

Processing and Composites II

Sprayed Polyurethanes

Pre-Conference Workshop:
Introduction to Environmental, Health and Safety Issues Relative to Diisocyanates 1

Blowing Agents

Forane® 1233zd - Continued Improvement in Resin Shelf Stability with this Low GWP Liquid, Non-flammable Blowing Agent 105

Joseph Costa, *Arkema, Inc.*

Ben Chen, *Arkema, Inc.*

Laurent Abbas, *Arkema, Inc.*

Sri Seshadri, *Arkema, Inc.*

Methylal: An Environmentally Friendly Blowing Agent Newly Introduced in North America 118

Michel Beaujean, *Lambiotte S.A.*

Cold Chain Industry: Energy Efficiency Solutions - Solstice LBA / Cyclopentane Blend Performance 135

James Bowman, *Honeywell*

John Szymanski, *Honeywell*

Salvador Mejia Gomez, *Bayer de Mexico S.A. de C.V.*

Formacel® 1100: a HFO with Unique Characteristics for Polyurethane Foam Applications 144

Gary Loh, *DuPont*

Konstantinos Kontomaris, *Dupont*

Saadat Ata, *Dupont*

Vaneeta Grover, *Dupont*

Technical Comparisons of Foams Using Various Blowing Agent Blends Containing HCFC141b, HFC 245fa, Solstice® LBA and Hydrocarbons in Domestic Appliances 162

Abhijit Borgohain, *UOP India Pvt Ltd*

Wilfred Selwyn T, *UOP India Pvt Ltd*

SP Chidambaram, *UOP India Pvt Ltd*

Pranav Mehta, *UOP India Pvt Ltd*

Chemistry and Renewables

Biopolyols Containing Lignin for PU Applications 172

Minh Tan Ton-That, *National Research Council Canada*

Tri-Dung Ngo, *National Research Council Canada*

Damien Maillard, *National Research Council Canada*

Performance of EMEROX® Renewable Polyols and INFIGREEN® Recycled Polyols in Resilient MDI Molded Flexible Polyurethane Foams 177

Michael Brooks, *Emery Oleochemicals, LLC*

Ashley Maloney, *Emery Oleochemicals, LLC*

Steve Turner, *Emery Oleochemicals, LLC*

Jeff Barnhorst, *Emery Oleochemicals, LLC*

Bryan King, *Emery Oleochemicals, LLC*

Ibrahim Sendjarevic, *Troy Polymers, Inc.*

Simulation of Urethane Thermoset Polymerization - Redefining Rigid Foam Formulations 189

Galen Suppes, *University of Missouri*

Yingyue Li, *University of Missouri*

Rima Ghoreishi, *University of Missouri*

Yusheng Zhao, *University of Missouri*

The Catalytic Reaction Mechanisms of Isocyanurate Formation Catalyzed by Potassium Catalyst Elucidated by Computational Chemistry 197

Satoshi Murayama, *Nippon Polyurethane Industry Co., Ltd.*

Determination of Aldehydes in Amine Catalysts 205

Bhajendra Barman, *Huntsman Advanced Technology Center*

Coatings and Adhesives

Novel Polyurethane Coatings Obtained with Polycarbonate Diol for Pipelines with Improved Mechanical Properties and Hydrolysis Resistance 213

Jose Jofre-Reche, *University of Alicante*

Andres Yanez-Pacios, *University of Alicante*

Jose Miguel Martin-Martinez, *University of Alicante*

Manuel Colera, *UBE Chemical Europe*

Victor Costa, *UBE Chemical Europe*

Novel CO₂-based Polycarbonate Polyols for High Performance Polyurethane Hot Melt Adhesives 223

Anna Cherian, *Novomer Inc.*

Christopher Fordice, *Novomer Inc.*

Kim Jaskula, *Novomer Inc.*

Michael Nagridge, *Novomer Inc.*

Simon Waddington, *Novomer Inc.*

Wayne Willkomm, *Novomer Inc.*

Bio-Based Succinic Acid Polyester Polyols: Sustainable Building Blocks for Performance Driven TPUs, PUDs and Coatings 239

William Coggio, *Bio Amber*

Spray Urethane Coatings with VORAPEL™ Hydrophobic Polyols 252

Avery Watkins, *Dow*

Mikhail Gelfer, *Dow*

Beth Nichols, *Dow*

Enrique Millan, *Dow*

Construction

Aromatic Polyester Polyols with Pre and Post-Consumer Content and Renewable Materials with Third Party Certification 259

Les Yamato, *Huntsman International*

David Sheih, *Huntsman International*

Sachchida Singh, *Huntsman International*

Paul Coleman, *Huntsman International*

Richard Donald, *Huntsman International*

The Influence of Code and Regulatory Requirements on Building Envelope Design and Polyurethanes Markets 267

Michael Fischer, *Kellen Company*

Elastomers

Micronized PPE in Thermoplastic Polyurethanes 275

Edward Peters, *SABIC Innovative Plastics*

Development of a Novel Thermoplastic Polyurethane Via Low Free Monomer Technology 284

Zhenya Zhu, *Chemtura Corporation*

George Brereton, *Chemtura Corporation*

Ronald Emanuel, *Chemtura Corporation*

Kevin Jackson, *Chemtura Corporation*

Cyril Migdal, *Chemtura Corporation*

Development of High Performance Polyether Based Elastomers 300

Rui Xie, *Dow*

Laura Grier, *Dow*

Ben Buckley, *Dow*

Nita Xu, *Dow*

Gareth Faulkner, *Dow*

Andrew Davies, *Dow*

Investigation of Hydrolytic Stability of Thermoplastic Polyurethanes Based on Biosuccinium™ Sustainable Succinic Acid Containing Polyester Polyols 311

Lawrence Theunissen, *Reverdia*

Richard Janssen, *Reverdia*

Thermoplastic Polyurethanes from Renewable Long Chain Diacids 327

Allyson Beuhler, *Elevance Renewable Sciences, Inc.*

Environment, Health and Safety: General

The Advancing Tide of Interest in Polymer Hazard and Risk 340

Paul Ashford, *Anthesis-Caleb*

Product Disclosure: Opportunities and Challenges for the Polyurethanes Industry 347

James Hoff, *TEGNOS Research, Inc.*

Environment, Health and Safety: SPF

CPI Ventilation Research Project for Estimating Re-Entry Times for Trade Workers Following Application of Three Generic Spray Polyurethane Foam Formulations 358

Rick Wood, *Air Products*

Spray Polyurethane Foam Monitoring and Re-Occupancy of High Pressure Open Cell Applications to New Residential Constructions 373

William Robert, *BASF Corporation*

Richard Wood, *Air Products and Chemicals, Inc.*

Jim Anderson, *BASF Corporation*

Impact of Process Parameters on Emissions From SPF 382

Manfred Genz Udo Schilling, *BASF Polyurethanes GmbH*

Jurij Krasnow, *BASF Polyurethanes GmbH*

Mark Bockhoff, *BASF Polyurethanes GmbH*

Rene Jansen, *BASF Polyurethanes Benelux B.V.*

Flame Retardants and Combustibility

Flame Retardant Usage and Other Factors Affecting Burn Characteristics of Polyurethane Rigid Foams 400

David Modray, *Foam Supplies, Inc.*

New Developmental Flame Retardants for the Rigid Foam Industry 414

Kali Suryadevara, *ICL America, Inc.*

Jeffrey Stowell, *ICL America, Inc.*

Barbara Williams, *ICL America, Inc.*

Jens Leopold, *ICL-IP Europe BV*

New Sustainable all-MDI Flexible Molded Foam Technology Meeting Flammability Requirements for the Furniture Industry 426

David Honkomp, *Dow*

Flexible Foams

Aliphatic Polyester Polyols with Recycled Content for Viscoelastic Foam 434

Richard Beatty, *INVISTA TerateÆ Polyols*

Vahid Sendijarevic, *Troy Polymers, Inc.*

Influencing the Cell Structure of Flexible Polyurethane Foams by Additives 456

Ruediger Landers, *Evonik Industries AG*

Harald Modro, *Evonik Industries AG*

Roland Hubel, *Evonik Industries AG*

Impact of Water Source on Performance of Flexible Polyurethane Foam 468

Robert Bondar, *BASF Corporation*

Novel Reactive Catalyst System for Polyurethane Foams with Improved Durability and Reduced Amine Emission 481

Hiroshi Fujiwara, *TOSOH Corporation*

Yoshinori Shirakura, *TOSOH Corporation*

Yoshihiro Takahashi, *TOSOH Corporation*

Takao Suzuki, *TOSOH Corporation*

Hiroyuki Kiso, *TOSOH Corporation*

Investigation of Low Density All-MDI HR Foams for Thin Designed Automobile Seating 494

Keita Ishibashi, *Nippon Polyurethane Industry Co., Ltd.*

Hiroyuki Orito, *Nippon Polyurethane Industry Co., Ltd.*

Yoshihisa Okiyama, *Nippon Polyurethane Industry Co., Ltd.*

Naoya Yoshii, *Nippon Polyurethane Industry Co., Ltd.*

Toshihide Yamamoto, *Tosoh Corporation*

Processing and Composites I

Polyurethane Composites: A Versatile Thermo-set Polymer Matrix for A Broad Range of Applications. Mechanical Analysis on Pultruded Laminates. 507

Guido Bramante, *Dow*

Luigi Bertucelli, *Dow*

Andrea Benvenuti, *Dow*

Kevin Meyer, *Dow*

InterWet Provides The Solution To Replace Metal With Polyurethane Composite In Heavy-Duty Parts 523

Max Taverna, *Retired (Cannon SpA)*

Maurizio Corti, *Cannon Afros*

Francesco Abba, *Cannon Afros*

Integrated Footwear Design with Polyurethanes 532

Karsten Stuebener, *KLÖCKNER DESMA Schuhmaschinen GmbH*
Bjorn Dormann, *KLÖCKNER DESMA Schuhmaschinen GmbH*

Processing and Composites II

JFlex: New Slabstock Foaming Technology 539

James Shoup, *Hennecke Inc.*

Different Storage Systems for Blowing Agents 548

Daniel Busse, *PURPLAN Inc.*

Manni 2.0, A Retrofitting Kit For The Production Of Discontinuous Insulated Panels With Vacuum-Assisted Technology 553

Cristiano Ligabo, *Manni Presse*
Max Taverna, *Retired (Cannon SpA)*
Piero Corradi, *Cannon SpA*

Individual and Customized Polyurethane Processing of Modern Footwear 568

Bjoern Dormann, *KLÖCKNER DESMA Schuhmaschinen GmbH*
Karsten Stuebener, *KLÖCKNER DESMA Schuhmaschinen GmbH*

Sprayed Polyurethanes

Formacel® 1100: Spray Polyurethane Foam Application Development 583

Ernest Wysong, *DuPont*
Vaneeta Grover, *DuPont*
Alexander Marchione, *DuPont*
Pavan Naicker, *DuPont*

Use of Simulation to Engineer Rigid Foams with Reduced Residual Isocyanates 601

Galen Suppes, *University of Missouri*
Harith Al-Moameri, *University of Missouri*
Rima Ghoreishi, *University of Missouri*
Yusheng Zhao, *University of Missouri*

MEETING THE NEED FOR SUSTAINABLE BUILDING DESIGN: Final Results from SPFA's Industry-Wide LCA and EPD Project for Spray Polyurethane Foam Insulation and Roofing 611

Richard Duncan, *Spray Polyurethane Foam Alliance*
George Pavlovich, *Safety/Environmental Consultant, formerly of Bayer MaterialScience LLC*
Sean Tian, *Bayer MaterialScience LLC*

Results of Latest Field Evaluations of Solstice® Liquid Blowing Agent Spray Foam 638

Mary Bogdan, *Honeywell*
David Williams, *Honeywell*

Poster Abstracts

CASE

Chemistry and Fundamentals

Emissions/Catalysts/Renewable Materials

Modeling and Simulation

Process and Equipment

Rigid and Spray Foams/Blowing Agents

Testing and Safety

CASE

Development of a Novel Thermoplastic Polyurethane Via Low Free Monomer Technology 650

Zhenya Zhu, *Chemtura Corporation*

George Brereton, *Chemtura Corporation*

Ronald Emanuel, *Chemtura Corporation*

Kevin Jackson, *Chemtura Corporation*

Cyril Migdal, *Chemtura Corporation*

Development of Water-Soluble, Metal-Based Catalysts for Polyurethane Coating Applications 651

Brandon Parks, *Reaxis Inc.*

Effect of Bicyclic Carbonates on Soybean Oil-Based Non-Isocyanate Polyurethane Adhesives 652

Olivera Bilic, *Pittsburg State University*
Ivan Javni, *Pittsburg State University*
Zoran Petrovic, *Pittsburg State University*

Hydroxyl-terminated Polybutadienes in 2K PU Sealants for Electrical Insulation 653

Niko Haberkorn, *Evonik Industries AG*
Andreas Berlineanu, *Evonik Industries AG*

Chemistry and Fundamentals

Development of Viscoelastic Foam having Excellent Low Temperature Properties 654

Seulgi Kim, *Kumho Petrochemical*

Effect of Montmorillonite Based Organoclay Addition on the Microstructure of Rigid Polyurethane 655

Oktay Uysal, *Anadolu University*
Kubra Ortac, *Anadolu University*
Bilge Erdem, *Anadolu University*
Ender Suvaci, *Anadolu University*
Metin Kaya, *Arcelik A.S. Refrigerator Plant*
Goksin Sayer, *Arcelik A.S. Refrigerator Plant*

Influencing the Cell Structure of Flexible Polyurethane Foams by Additives 656

Ruediger Landers, *Evonik Industries AG*
Harald Modro, *Evonik Industries AG*
Roland Hubel, *Evonik Industries AG*

The Impact of Polymer-Particle Interaction on the Mechanical Properties of Polyurethane Nanocomposites 657

Elizabeth Sims, *Cabot Corporation*
Elizabeth Burns, *Cabot Corporation*

Utilization of Polymer Stabilized Nanoscale Silver as an Effective Antimicrobial / Anti-Odor Agent in Polyurethane Foams 658

Mathew Henry, *NanoHorizons Inc.*
Chris Haupt, *NanoHorizons Inc.*

Emissions/Catalysts/Renewable Materials

Development of Bio based Polyurethane Foam from Coffee Ingredients659

Fan-Jeng Tsai, *Industry Technology Research Institute*
Yi-Che Su, *Industry Technology Research Institute*
Yuung-Ching Sheen, *Industry Technology Research Institute*
Jay Chiang, *Industry Technology Research Institute*

Lio Chang, *SINGTEX Technical Fabric, Ltd.*

Leon Wan, *SINGTEX Technical Fabric, Ltd.*

Molded Polyurethane Foam Containing High Levels of Renewably-sourced Carbon 660

Bob Dawe, *Lear Corporation*

Alex Konovalenko, *Lear Corporation*

Jason Demille Virgil Kowalski, *Lear Corporation*

Paul Fielding, *Lear Corporation*

Greg Carter, *Lear Corporation*

Ash Galbreath, *Lear Corporation*

New Additive Active Polyol for Low Amine Emission Molded PU Foams 661

Michael Malanga, *Dow*

Esther Quintanilla, *Dow*

Adrian Birch, *Dow*

Novel Reactive Catalyst System for Polyurethane Foams with Improved Durability and Reduced Amine Emission 662

Katsumi Tokumoto Hiroshi Fujiwara, *TOSOH Corporation*

Yoshinori Shirakura, *TOSOH Corporation*

Yoshihiro Takahashi, *TOSOH Corporation*

Takao Suzuki, *TOSOH Corporation*

Hiroyuki Kiso, *TOSOH Corporation*

Polyurethane Foams Based on Olefin Modified Glycerin 663

Ivan Javni, *Pittsburg State University*

Getent Tegegn, *Pittsburg State University*

Olivera Bilic, *Pittsburg State University*

Jeanne Norton, *Pittsburg State University*

Mihail Ionescu, *Pittsburg State University*

Zoran Petrovic, *Pittsburg State University*

Modeling and Simulation

Modeling Epoxy Ring Opening of Epoxidized Soybean Oil by Oxide Addition Catalyzed by Toluene Sulfonic Acid 664

Rima Ghoreishi, *University of Missouri, Columbia*

Galen Suppes, *University of Missouri, Columbia*

Simulation of Catalyzed Urethane Polymerization--An Approach to Expedite Commercialization of Bio-Based Materials 665

Yusheng Zhao, *University of Missouri, Columbia*

Galen Suppes, *University of Missouri, Columbia*

Simulation of Polyurethane Height Profile Using Matlab 666

Harith Al-Moameri, *University of Missouri*

Galen Suppes, *University of Missouri*

Use of Simulation to Engineer Rigid Foams with Reduced Residual Isocyanates 667

Galen Suppes, *University of Missouri, Columbia*
Rima Ghoreishi, *University of Missouri, Columbia*
Harith Al-Moameri, *University of Missouri, Columbia*
Yusheng Zhao, *University of Missouri, Columbia*

Process and Equipment

Direct Injection of Blowing Agent into the Mixing Head as Third Stream 668

Eraldo Greco, *Impianti OMS Spa*

Integrated Footwear Design with Polyurethanes 669

Karsten Stoebener, *KLÖCKNER DESMA Schuhmaschinen GmbH*
Bjorn Dormann, *KLÖCKNER DESMA Schuhmaschinen GmbH*

InterWet Provides Solutions to Replace Metal in Heavy-Duty Parts with Polyurethane Composite 670

Max Taverna, *Retired (Cannon SpA)*
Maurizio Corti, *Cannon Afros*
Francesco Abba, *Cannon Afros*

JFlex: New Slabstock Foaming Technology 671

James Shoup, *Hennecke Inc.*

Manni 2.0, A Retrofitting Kit For The Production Of Discontinuous Insulated Panels With Vacuum-Assisted Technology 672

Max Taverna, *Retired (Cannon SpA)*
Cristiano Ligabo, *Manni Presse*
Piero Corradi, *Cannon Afros*

Rigid and Spray Foams/Blowing Agents

Formacel® 1100: A Unique, High Performance, Next Generation Foam Expansion Agent for Polyurethane Foam Applications 673

Joseph Creazzo, *DuPont*
Gary Loh, *DuPont*
Ernest Wysong, *DuPont*

MEETING THE NEED FOR SUSTAINABLE BUILDING DESIGN: Final Results from SPFA's Industry-Wide LCA and EPD Project for Spray Polyurethane Foam Insulation and Roofing 674

Richard Duncan, *Spray Polyurethane Foam Alliance*
Shen Tian, *Bayer MaterialScience LLC*

Methylal: An Environmentally Friendly Blowing Agent Newly Introduced in North

America 675

Michel Beaujean, *Lambiotte S.A.*

Reducing Thermal Conductivity in Cyclopentane Blown Rigid Polyurethane Foams 676

Tim Dawsey, *Pittsburg State University*

Madhu Srinivasan, *Pittsburg State University*

Ivan Javni, *Pittsburg State University*

Jong Yeol Choi, *Samsung Electronics Co., Ltd.*

Won Jang, *Samsung Electronics Co., Ltd.*

Eung Ryeol Seo, *Samsung Electronics Co., Ltd.*

Results of Latest Field Evaluations of Solstice® Liquid Blowing Agent in Spray Foam 677

Mary Bogdan, *Honeywell*

David Williams, *Honeywell*

Testing and Safety

Evaluation of Modified FLEC® Cell and Micro Chamber Prototype for Monitoring Methylene Diphenyl Diisocyanate (MDI) Emissions 678

John Sebroski, *Bayer MaterialScience LLC*

Jason Miller, *Bayer MaterialScience LLC*

Mark Spence, *International Isocyanate Institute, Inc.*

Furniture Fire Safety Solutions: A Study on the Open Flame Ignition Resistance of California Technical Bulletin 117-2013 Compliant Upholstered Furniture 679

Marshall Moore, *Great Lakes Solutions, a Chemtura business*

Robert Campbell, *Great Lakes Solutions, a Chemtura business*

Carl Powell, *Great Lakes Solutions, a Chemtura business*

Production Near Testing of Foam Generation Parameters 680

Erland Hofmann, *Format Messtechnik GmbH*

Frank Bertuzzi, *Eurotech Distributors, Inc.*

Unloading Non-Regulated Polyol and Urethane Resin System Tank Trucks 681

Center for the Polyurethanes Industry Transportation Work Group

Validation of Direct-Read, Colorimetric Aromatic Isocyanate Detection System 682

Julian Parker III, *Morphix Technologies, Inc.*

Kimberly Pricensk, *Morphix Technologies, Inc.*