75th Conference on Glass Problems

November 3 – 6 | Greater Columbus Convention Center | Columbus, Ohio USA

The glass industry’s trusted conference for 75 years

www.glassproblemsconference.org
PM, SO\textsubscript{x} AND NO\textsubscript{x} IN ONE SYSTEM

CERAMIC FILTER SYSTEMS ARE THE NEW STANDARD FOR GLASS FURNACE EMISSIONS CONTROL

AIR–FUEL FURNACE EMISSIONS
UltraCat catalyst filter system treats particulate, SO\textsubscript{2}, HCl, metals and NO\textsubscript{x} in a single all-on-one system.

OXY–FIRED FURNACE EMISSIONS
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Particulate captured on the surface; does not penetrate the surface wall

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Inlet gas composition – Particulate PM, Sorbents for SO\textsubscript{2}, HCl, NO\textsubscript{x} + injected ammonia

• Treats any gas flow volume – modules are placed in parallel.
• Multiple modules provide built-in redundancy to ensure up-time. No “ESP bottleneck.”
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Welcome to the 75th Conference on Glass Problems (GPC). The 75th Conference on Glass Problems is a content-rich, technically-oriented conference, designed as a high value resource for the glass industry professional.

The Glass Manufacturing Industry Council (GMIC), the leading trade association bridging glass segments, in partnership with Alfred University, the leading American glass teaching and research institution, co-organize the conference, with programming direction provided by an industry advisory board.

We are committed to expanding the scope and value of technical resources available to serve the glass manufacturing industry. The GPC is unique in the breadth and depth of its technical educational. We set high standards in programming and the publication of the proceedings manuscripts. Participation in the GPC continues to grow by double-digit figures.

As organizers, we strive to provide one of the most extensive platforms for glass manufacturing industry networking and exhibiting in North America, with comprehensive exhibits, hospitality salons, hospitality booths, and other social events. Exhibition space is again sold out. We appreciate the participation and support of the industry’s leading solutions providers.

Evaluations from 74th GPC provided high marks for the conference. More importantly, your input provided direction for planning the conference. A common request was to increase the “real world” problems content from manufacturers. We increased the presentations by manufacturers and encouraged solutions providers to co-present with manufacturers, citing actual data from manufacturing facilities.

Evaluations emphasized the importance of technical education. We have increased these offerings. On Monday, we begin with C. Philip Ross’ popular Fundamentals of Batch and Furnace Operations, which is an excellent short course for engineers early in their careers or for solutions providers looking to understand their clients concerns. Also offered, is the technically-rich short course from Celsian Glass & Solar B.V., Glass Furnace Designs and Furnace Operation—Modeling of Glass Melting & Combustion Processes and Advanced Furnace Control, taught by Andries Habraken and Oscar Verheijen.

Also on Monday, attendees can benefit from a collaboration between the GMIC and the EPA’s ENERGY STAR®, Energy Productivity as a Competitive Edge in Glass Manufacturing. This excellent joint symposium has been organized by some of the leading energy officers of American manufacturing companies to support all manufacturers’ effort to increase energy efficiency in glass manufacturing.

Driven by the success of past symposia, GMIC is again organizing a full-day technical symposium, Hot Sensors—Instrumentation and Control Innovation in Glass Manufacturing. Organized by GMIC’s glass manufacturing and supplier members, this symposium brings together some of the leading experts in the field providing in-depth education on the latest technologies to support critical processes and address current challenges in the glass manufacturing process.

We look forward to your participation and trust you will find it a valuable and rewarding experience.
WHO IS GMIC

The Glass Manufacturing Industry Council (GMIC) is a trade association of the glass industry that includes among its members, representatives of all four sectors: container, fiber, flat, and specialty glass companies as well as leading suppliers to the industry, research institutes, and industry experts. Our goal is to promote the interests, growth, and sustainability of the glass industry. GMIC does for individual companies what they can’t easily do on their own—provide technical education, coordinate technical initiatives, advocate with law makers, and promote the usage and image of glass products as a vital part of society around the globe.

If you are a glass industry manufacturer, supplier, or research organization, and you are not presently a member, we encourage you to join GMIC now to ensure the vitality of the industry through your support of the industry’s trade association. Membership dues are based on company size and category. Contact GMIC’s Executive Director, Robert Weisenburger Lipetz, for full information.

GMIC EXECUTIVE COMMITTEE

Keith Bagarus, RoviSys, President; Steve Badger, Pittsburgh Corning, Immediate Past President; Steve Weiser, O-I, Vice President; Bruno Purnode, Owens Corning, Treasurer; Robert Weisenburger Lipetz, Secretary

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Robert Weisenburger Lipetz, Executive Director
Donna M. Banks, Executive Assistant

CONTACT GMIC

600 N. Cleveland, Suite 210, Westerville, Ohio 43082
+1-614-523-3033 | dbanks@gmic.org | www.gmic.org

GMIC MISSION

Facilitate, organize and promote the interests economic growth and sustainability of the glass industry through education and cooperation in the areas of technology, productivity and the environment.

ALFRED UNIVERSITY

The Kazuo Inamori School of Engineering at Alfred University (AU) is a leader in glass and ceramics education. Established in 1900 as the New York State School of Clayworking, the School has a long-standing history of providing industry a workforce well-educated in the manufacturing of glass and ceramic materials. Today, the School offers BS and MS degrees in five disciplines: Biomaterials Engineering, Ceramic Engineering, Glass Engineering Science general Materials Science and Engineering, and Mechanical Engineering as well as doctoral degrees in the materials disciplines.

The School also serves industry by advancing the forefront of ceramics and glass research. In addition to maintaining an active portfolio of federally funded research, the faculty routinely collaborate with industry on projects ranging from fundamental research through product/process development. Interactions with industry are conducted through the Center for Advanced Ceramic Technology (CACT) and the Center for High Temperature Characterization (CHTC). The CACT facilitates collaboration between industry and academia with the goal of creating economic impact for the CACT’s industrial partners. The CHTC is a user facility that provides research unparalleled access to equipment designed for characterizing materials in situ at high temperatures.

More information about the Kazuo Inamori School of Engineering: http://engineering.alfred.edu

Doreen Edwards, Dean, Inamori School of Engineering
Alfred University, dedwards@alfred.edu

S.K. Sundaram, Inamori Professor of Materials Science and Engineering
Alfred University, sundaram@alfred.edu

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PUBLICATION OF THE 75TH GPC PROCEEDINGS

Registered attendees of the 75th Conference on Glass Problems will receive a bound copy of the proceedings, published by The American Ceramic Society and Wiley, and shipped to you mid 2015.
BUILDING ON MORE THAN TWENTY YEARS OF THERMAL IMAGING EXPERIENCE, AMETEK LAND HAS CONTINUED TO WIDEN ITS RANGE OF TEMPERATURE MEASUREMENT SOLUTIONS WITH THE NIR BORESCOPE.

WITH THE NIR BORESCOPE IT IS POSSIBLE TO USE THE PROVEN TECHNOLOGY OF THE NIR THERMAL IMAGER TO ACCURATELY PROFILE THE TEMPERATURE OF THE ENTIRE AREA WITH ONLY A SMALL OPENING IN THE WALL OF GLASS MELT TANKS. THE NIR-B OFFERS CONTINUOUS, THERMAL IMAGING WITH FULL TEMPERATURE MEASUREMENTS WITHIN THE SCENE.

PROVEN APPLICATIONS OVER A 65 YEAR HISTORY IN THE GLASS INDUSTRY

FEATURES & BENEFITS

- **High temperature measurement accuracy** - enables optimum process control using high definition temperature maps
- **Simple installation and ease of use** - minimizes cost and complexity
- **Short wavelength sensor** - low sensitivity to emissivity changes; can be used through glass or quartz view ports
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SCHEDULE AT A GLANCE

Monday, November 3, 2014
11 a.m. – 6 p.m.  Registration
11:30 a.m. – 4:30 p.m.  Student Plant Tour
12 – 5 p.m.  Fundamentals of Batch and Furnace Operations
5 – 5:30 p.m.  EPA ENERGY STAR®/GMIC Joint Energy Efficiency Symposium
5 – 11 p.m.  Hospitality Suites*
5:30 – 7:30 p.m.  GPC Advisory Board Dinner

Tuesday, November 4, 2014
7:30 a.m. – 5:30 p.m.  Registration
8 – 9 a.m.  Exhibiting
9 – 10:30 a.m.  Glass Melting Session
10:30 – 11 a.m.  Exhibiting
11 a.m. – 12:30 p.m.  Forming Session
12:30 – 2 p.m.  Lunch & Exhibiting
2 – 4:30 p.m.  Energy and Environmental Session
4:30 – 5:30 p.m.  Exhibiting
7:30 – 11 p.m.  Hospitality Suites*

Wednesday, November 5, 2014
8 a.m. – 4 p.m.  Registration
8 – 9 a.m.  Exhibiting
9 – 10 a.m.  Refractories Session
10 – 10:30 a.m.  Exhibiting
10:30 a.m. – 12 p.m.  Sensors and Control Session
12 – 1:30 p.m.  Lunch & Exhibiting
1:30 – 4 p.m.  Modeling Session
4 – 5 p.m.  GMIC Membership Meeting

Thursday November 6, 2014
7:30 a.m. – 12 p.m.  Registration
8 a.m. – 4 p.m.  Hot Sensors Symposium
11:50 a.m. – 12:30 p.m.  Lunch
*Takes place at the Hilton Columbus Downtown

EPA ENERGY STAR®/GMIC Joint Energy Symposium - Energy Management as a Competitive Edge in Glass Manufacturing

Monday, November 3, 2014
Corporate energy management programs not only save energy and money across operations but also position a company to withstand energy risks. This workshop will help companies take energy programs to the next level and prepare for their energy future.

12:00 – 12:05 p.m.  WELCOME – Robert Weisenburger Lipetz, Executive Director, Glass Manufacturing Industry Council
12:05 – 12:45 p.m.  Energy Management as a Business Advantage – Peter Garforth, President, Garforth International
12:45 – 1:15 p.m.  Building a Corporate Energy Management Program – Walt Tunnessen, CEM, Manager, Industrial Sector Program ENERGY STAR®, U.S. Environmental Protection Agency
1:15 – 1:45 p.m.  Evolving Energy Management at PPG – Jeff Yigdall, Director, Engineering & International Business, PPG Industries, Inc.

Tuesday, November 4, 2014 (cont’d)
1:45 – 2:15 p.m.  How to Get Projects Implemented – Bruce Bremer, President, Bremer Energy Consulting Services, Inc. Identifying projects is the easy part. How do successful companies get projects implemented? Learn successful strategies for getting the work done.
2:15 – 2:30 p.m.  BREAK
2:30 – 3:15 p.m.  Make Sure Obvious Systems are Addressed – Patrick Jackson, Manager, Global Energy, Corning Incorporated
3:15 – 4:00 p.m.  Benchmarking Energy Use in Glass Manufacturing – Gale A. Boyd, Director Triangle Census Research Center & Senior Research Scholar, Duke University Tracking, baselining and measurement are critical to energy management. Benchmarking uses energy data and enables long-term tracking and goal setting. What is the value of benchmarking energy in an energy program? How do you do it? This presentation will address these questions and lay out an approach that any company can use.
4:00 – 5:00 p.m.  Plant Energy Assessment Made Easy: Treasure Hunts – Bruce Bremer, President, Bremer Energy Consulting Services, Inc. The energy treasure hunt process uses internal staff to identify energy savings at a plant. Learn how to perform a plant energy assessment through a team you assemble.
5:00 p.m.  ADJOURN
PROGRAM SCHEDULE
Monday, November 3, 2014
11:30 a.m. – 4:30 p.m.  STUDENT PLANT TOUR – departs at Greater Columbus Convention Center

Fundamentals of Batch and Furnace Operations Short Course
12 – 5 p.m.  |  E160
Instructor: C. Philip Ross, President, Glass Industry Consulting International (GICI)

12 – 5 p.m.  |  E162
Instructors: Andries Habraken, B.ASc, Senior Consultant, Computational Fluid Dynamics, CelSian Glass & Solar B.V. and Oscar Verheijen, Senior Consultant, CelSian Glass & Solar B. V.

EPA ENERGY STAR®/GMIC Joint Energy Symposium—Energy Productivity as a Competitive Edge in Glass Manufacturing
12 – 5 p.m.  |  E160
5 – 5:30 p.m.  |  E160
5:30 – 7:30 p.m.  |  E160
5 – 11 p.m.  |  E160

Tuesday, November 4, 2014
8 – 9 a.m.  |  Ballroom 5
EXHIBITING
9 – 10:30 a.m.  |  Ballroom 5
Technical Session: Glass Melting
Session Chairs: Glenn Neff, Glass Service USA, Inc. and Martin Goller, Corning Incorporated

9 – 9:30 a.m.  |  Ballroom 5
Dr. Michael S. Pambianchi, Research Director, Glass Research, Corning Incorporated Glass Challenges in Consumer Electronics

9:30 – 10 a.m.  |  Ballroom 5
Carol Click, Manager Glass Science Group, Owens-Illinois, Inc. – Effect of Dissolved Water on Physical Properties of Soda-Lime Silicate Glasses

10 – 10:30 a.m.  |  Ballroom 5
Henry Dimmick Jr., Owner and Chief Executive Officer, American Glass Research – Comparison of SEM/EDX Analysis to Petrographic Techniques for Identifying the Composition of Stone in Glass

10:30 – 11 a.m.  |  Ballroom 5
EXHIBITING

11 a.m. – 12:30 p.m.  |  Ballroom 5
Technical Session: Forming
Session Chairs: James Uhlik, Toledo Engineering Co., Inc. and Kenneth Bratton, Bucher Emhart Glass.

11 – 11:30 a.m.  |  Ballroom 5
Jonathan Simon, Senior Scientist, Bucher Emhart Glass – Multi Gob Weight Production

11:30 a.m. – 12 p.m.  |  Ballroom 5
Jonathan Simon, Senior Scientist, Bucher Emhart Glass – Closed Loop Control of Glass Container Forming

12 – 12:30 p.m.  |  Ballroom 5
Steven Brown, Principal Mechanical Engineer, Bucher Emhart Glass; Dubravko Stuhne, Production Technical Specialist, Vetroconsult – “Hard Glass” – Commercial Progress of Thermally Strengthened Container Glass

12:30 – 2 p.m.  |  E162
LUNCH
12:30 – 2 p.m.  |  E162
EXHIBITING

2 – 4:30 p.m.  |  Ballroom 5
Technical Session: Energy and Environmental
Session Chairs: Uyi Iyoha, Praxair, Inc. and Warren Curtis, PPG Industries, Inc.

2 – 2:30 p.m.  |  Ballroom 5
Julien Pedel, Development Specialist, Praxair, Inc. – Oxygen Enhanced NOx Reduction (OENR) Technology for Glass Furnaces

2:30 – 3 p.m.  |  Ballroom 5
Steven B. Smith, Independent Consultant – U.S. Air Regulations Involving Glass Manufacturing

3 – 3:30 p.m.  |  Ballroom 5
Richard Pont, Technical Director, Global Combustion Systems, Ltd. – New Combustion Technique for Reducing NOx and CO₂ Emissions from Glass Furnaces

3:30 – 4 p.m.  |  Ballroom 5
Diego Filippi, Chemical Engineer, Area Impianti SpA – Environment and Energy Flue Gas Treatment and Heat Recovery Integrated System in Glass Industry

4 – 4:30 p.m.  |  Ballroom 5
Stefan Laux, Director R&D Praxair, Inc. – Regenerative Thermo-Chemical Heat Recovery for Oxy-Fuel Fired Glass Furnaces

4:30 – 5:30 p.m.  |  Ballroom 5
EXHIBITING
7:30 – 11 p.m.  |  Ballroom 5
HOSPITALITY SUITES
### Wednesday, November 5, 2014

**8 – 9 a.m.** EXHIBITING
- Technical Session: **Refractories**
  - Session Chairs: Laura Lowe, North American Refractories Company and Larry McCloskey, Anchor Acquisition, LLC

**9 – 9:30 a.m.**
- David Michael, Senior Research Engineer, North American Refractories Company – **Basic Material Developments for Glass Industry Regenerators**

**9:30 – 10 a.m.**
- Sebastien Bourdonnais, Project Manager, Saint-Gobain SEFPRO – **SEFPRO Cruciforms: Modern and Competitive Regenerator Designs for Glass Industry**

**10 – 10:30 a.m.** EXHIBITING

**10:30 a.m. – 12 p.m.** Technical Session: **Sensors and Control**
- Session Chairs: Jan Schep, Owens-Illinois, Inc. and Elmer Sperry, Libbey, Inc.

**10:30 – 11 a.m.**
- Yakup Bayram, Chief Technology Officer, PaneraTech, Inc. – **Detection of Early Stage Glass Penetration and Weak Refractory Spots on Furnace Walls**

**11 – 11:30 a.m.**
- Henning Katte, Chief Executive Officer, Ilis GmbH – **Fast and Objective Measurement of Residual Stresses in Glass**

**11:30 a.m. – 12 p.m.** Fred Aker, Sales Director West and Marketing Manager, Nikolaus Sorg GmbH & Co. KG – **Feeder Expert Control System for Improved Containers**

**12 – 1:30 p.m.** LUNCH

**12 – 1:30 p.m.** EXHIBITING

**1:30 – 2 p.m.**
- Jian Jiao, Associate Engineer, Owens-Illinois, Inc. – **3-D Transient Non-isothermal CFD Modeling for Gob Formation**

**2 – 2:30 p.m.**

**2:30 – 3 p.m.**
- Liming Shi, Engineer II, Owens-Illinois, Inc. – **Energy Analysis for Preheating and Modeling of Heat Transfer from Flue Gas to a Granule**

**3 – 3:30 p.m.**
- Oscar Verheijen, Senior Consultant, CeSian Glass & Solar B. V. – **Experimental Simulation of Process Steps in Industrial Glass Furnaces**

**3:30 – 4 p.m.**
- Arvind Atreya, Professor, University of Michigan – **Heat Transfer in Glass Quenching for Glass Tempering**

**4 – 5 p.m.** GMIC MEMBER MEETING

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**SAVE THE DATE!**

**The 76th Conference on Glass Problems**

**November 2 — 5, 2015 | Columbus, Ohio**

The Exhibit and Technical Sessions will take place in the Greater Columbus Convention Center. The Hospitality Suites will be located across the street at the Hilton Columbus Downtown.
Instrumentation and Control Innovation in Glass Manufacturing
A Symposium Organized by the Glass Manufacturing Industry Council

Thursday, November 6, 2014 | D131

The Hot Sensors Symposium on Instrumentation and Control Innovation in Glass Manufacturing is focused on the latest technologies in the market to support critical processes and address current challenges in the glass manufacturing process. It provides a forum for the audience to gain technical knowledge and exchange experiences with each other in support of the advancement and application of sensors and controls technologies.

Program Committee:
Co-Chairs: C. Keith Bagarus, Director Global Automation, RoviSys; Dale A Gaerke, Director-R&D Controls and Electrical Engineering, I-O; Euan Evenson, Associate Director Program Development, Praxair; Aaron Huber, Furnace Research Manager, Johns Manville; James MacPhee, Senior Engineer, Melting/Fiberizing Sciences, Owens Corning Composite Materials; Erik Muijsenberg, Vice-President, Glass Service Inc.; Glenn Neff, Vice-President, Glass Service Inc.; Robert Roth, Process Control Engineer, O-I; Oscar Verheijen, Senior Consultant, Celsian Glass & Solar B.V.; Jeffery Watts, Global Furnace Operations Leader, O-I; Robert Weisenburger Lipetz, MBA, Executive Director, Glass Manufacturing Industry Council

8:00 – 8:30 a.m. INTRODUCTION – Historical Review of Sensors and Controls in Glass Manufacturing – Keith Bagarus, Director Global Automation, RoviSys – Symposium Co-Chairman

8:30 – 9:30 a.m. PROGRAM I – CURRENT NEEDS
8:55 – 9:00 a.m. Q&A

9:00 a.m. – 1:30 p.m. PROGRAM II – BENEFITS AND APPLICATIONS OF CRITICAL MEASUREMENTS

9:00 – 9:25 a.m. Using High Temperature Cameras to measure Level, Width, Temperature, Gob, Onion, and other process glass applications in the glass industry – Thomas Canty, President, JM Canty
9:25 – 9:30 a.m. Q&A
9:30 – 9:50 a.m. Break
9:50 – 10:15 a.m. Interferometric Radar Technology for Noncontact Glass Level Measurement – Claudio Viti, Sales Manager, Glass Service Srl and Daniele Mecatti PhD, R&D Engineer, Glass Service Italy
10:15 – 10:20 a.m. Q&A
10:20 – 10:45 a.m. Re-engineering TDLAS Sensor Systems for the Glass Industry – Dr. Andrew D. Sappey, CTO, Zolo Technologies
10:45 – 10:50 a.m. Q&A
10:50 – 11:15 a.m. Application of Online Energy Balance Monitoring at Industrial Glass Furnaces – Oscar Verheijen, Senior Consultant, Celsian Glass & Solar B.V.
11:15 – 11:20 a.m. Q&A

11:20 – 11:45 a.m. Advanced Temperature Sensing Technologies for Improved Glass Conditioning – Nate Youel, Applications Engineer – Optical Temperature Sensing, BASF
11:45 – 11:50 a.m. Q&A
11:50 a.m. – 12:30 p.m. Lunch

12:30 – 1:30 p.m. PROGRAM II CONTINUED – CRITICAL MEASUREMENTS

12:55 – 1:00 p.m. Q&A
1:00 – 1:25 p.m. Industrial Experiences With a Zirconium Oxide Based in-situ CO/O₂ Sensor for Combustion Control – Dr.-Ing. Peter Hemmann, President, STG Combustion Control GmbH&Co KG
1:25 – 1:30 p.m. Q&A

1:30 – 2:00 p.m. PROGRAM III – CONTROL SYSTEMS

1:30 – 1:55 p.m. Pixelizing the Image for Batch Line Control – Erik Muijsenberg, Vice President – Glass Service, Chairperson ICG TC 21 & 15
1:55 – 2:00 p.m. Q&A
2:25 – 2:30 p.m. Q&A
2:30 – 2:50 p.m. Break
2:50 – 3:15 p.m. The Future of Control Room Design – Paul Krumrich, CEO, Sensory Environment Design
3:15 – 3:20 p.m. Q&A
3:20 – 3:50 p.m. Roundtable Panel Discussion - Future Challenges and Innovations – Moderated by Dale A Gaerke, Director-R&D Controls and Electrical Engineering, I-O; Panel Members: Keith Bagarus, Director Global Automation, RoviSys; Thomas Canty, President, JM Canty; Dr.-Ing. Peter Hemmann, President, STG Combustion Control GmbH&Co KG; Paul Krumrich, CEO, Sensory Environment Design; James MacPhee, Senior Engineer, Melting/Fiberizing Sciences, Owens Corning Composite Materials; Daniele Mecatti, R&D Engineer, Glass Service Italy; Erik Muijsenberg, Vice-President, Glass Service Inc.; Robert Roth, Process Control Engineer, O-I; Dr. Andrew D. Sappey, CTO, Zolo Technologies; Oscar Verheijen, Senior Consultant, Celsian Glass & Solar B.V.; Claudio Viti, Sales Manager, Glass Service Italy; Jeffery Watts, Global Furnace Operations Leader, O-I; Nate Youel, Applications Engineer – Optical Temperature Sensing, BASF; Doug Child, Director, US Glass and Solar Industries, Siemens Industry, Inc.
3:50 – 4:00 p.m. Concluding Remarks – Keith Bagarus, Director Global Automation, RoviSys – Symposium Co-Chairman
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FlammaTec, spol. s r.o. (Czech Republic) and its daughter company FlammaTec GmbH (Germany) have become leading suppliers of advanced burner technology for glass furnaces. FlammaTec was founded by two partner companies (STG Combustion Control GmbH & Co KG, and Glass Service, Inc.) as a joint venture. After 6 years since its start in 2008, FlammaTec has already supplied well over 1500 burners to over 90 projects on float, container, tableware and special glass furnaces. FlammaTec offers the following burner types:
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Frazier-Simplex, Inc. was founded in 1918 in Washington, PA and has remained under Frazier family ownership for three generations. For over 90 years, Frazier-Simplex, Inc. has had continuous service to the glass industry in equipment and designs from raw materials through glass conditioning. Innovative furnace designs and equipment are just examples of why Frazier-Simplex, Inc. has been a respected member of the world-wide glass community for many years. We are experienced in all types of glass and glass production, from soda lime to borosilicate pharmaceutical glass.

Fuse Tech/Hot Tech Group
Booth: Emerson Burkhart B
3400 Silica Road, Sylvania, Ohio 43560
Phone: +1-419-841-9323
www.fusetech.com
Fuse Tech’s core business is Ceramic Welding and Refractory Repair on both cold and hot furnaces. We also have equipment to photograph inside the furnace for use in damage and operation evaluation. Through the use of high pressure water laser, Fuse Tech is able to remove debris from port sills as well as the tops of checker packs and flues and tunnels. Hot Tech will help you with your Refractory and Operational Problems. Specializing in drilling, rebuilds, hot repairs, cold repairs, diamond chainsawing, burner block replacements and overcoats. Fuse Tech/Hot Tech also is a source for Consulting on furnace operation and refractory problems.

Glass Service, Inc.
Booth: 200
3340 SE Federal Highway, #200, Stuart, Florida 34997
Phone: +1-772 287 6061
www.gsl.cz
Glass Service, Inc. (GS) is a leading global consultant specializing in glass melting/conditioning, furnace control, operation, troubleshooting, and furnace design optimization. GS has developed the successful Expert System, ES III, which has become the leading platform for fully automatic furnace and forehearth control, providing significant cost savings to glass production. Another development of GS, furnace modeling software GFM 4 optimizes furnace design and doubles as a successful troubleshooting tool. The GS laboratory performs defect analyses, and utilizes basic and applied research in its melt testing facilities. Headquarters located in Czech Republic, with offices in Netherlands, Slovakia, United States, and China.
Hardy Process Solutions
Booth: 301
9440 Carroll Park Drive, Suite 150, San Diego, California 92121
Phone: +1-858-278-2900
www.hardysolutions.com

Hardy Process Solutions has been providing customers with process control solutions for over 90 years and is best known for its innovative technology. The company prides itself on its ability to continuously provide superior product quality and excellent customer support. Hardy, an ISO 9001-certified manufacturer, currently services the food, chemical, petrochemical, pharmaceutical, feed & grain, mining & metal, pulp & paper, oil and gas, power, and general automation industries.

Heye International GmbH
Booth: 305
Lohplatz 1, 31683 Obernkirchen, Germany
Phone: +49 5724 26-0
www.heyeproducts.com

WE ARE GLASS PEOPLE: Heye International, based in Obernkirchen, Germany is one of the foremost suppliers of production technology, high performance equipment and know-how for the container glass industry worldwide. Our mechanical engineering has set the standard in the industry for more than 50 years. The industry expertise, attitude and enthusiasm of the employees of Heye International form the motto “We are Glass people”. The three sub-brands HiPERFORM, HiSHIELD and HiTRUST form the portfolio of Heye International.

Klug Systems by Optimization
Booth: 303
50 High Tech Drive, Rush, New York 14543
Phone: +1-585-321-2300
www.optimation.us

Optimation offers a multi-disciplined design team for any aspect of your batch processing needs, with best practices for equipment arrangements, dust collection, storage, weighing, mixing and transport of batch. The team has tackled a full-range of batch problems, providing leading-edge solutions for end clients. During the feasibility phases of your projects, Optimation can provide services for cost assessment, risk assessment and high-level design. Once capital approval is secured, the design team is available for engineering drawing packages, equipment schedules, site plans and test plans. We offer continuity throughout specification, design, integration, development, implementation, calibration, troubleshooting, start-up, debug and production.

Praxair, Inc.
Booth: 201, 203
39 Old Ridgebury Road, Danbury, Connecticut 06810
Phone: 1-800-PRAxAIR
www.praxair.com

Praxair is a leader in innovative oxyfuel technologies for the glass industry. With over 70 years of oxyfuel combustion experience in the glass industry and over 200 oxyfuel projects completed worldwide, our technologies can deliver substantial fuel savings, increased productivity and product quality, reduced NOx emissions and alkali volatilization, and prolonged furnace campaign. Praxair is a Fortune 300 company. We also supply atmospheric, process and specialty gases, high performance coatings, and related services and technologies. Among the gases we supply are oxygen, nitrogen, argon, carbon dioxide, helium, and hydrogen.

ONLINE CONFERENCE EVALUATION

Help us improve the value of the Conference on Glass Problems by filling out our online evaluation.

We are continually striving to improve the quality of the conference. Your feedback from the online evaluation will be carefully considered by the GPC advisory board in designing future conferences.

Please go to the website address below for this brief evaluation.

https://www.surveymonkey.com/r/75_GPC_All_Attendees

Thank you for taking the time to provide your feedback on the conference.

Online Conference Evaluation (for exhibitors only)

If you presented an exhibit booth at the 75th Conference on Glass Problems, we would appreciate your feedback to help us continue to improve the exhibiting opportunity. (This survey is for exhibitors only)

Please go to the website address below for this brief evaluation.

https://www.surveymonkey.com/r/75_GPC_Exhibits

Thank you for taking the time to provide your feedback on conference exhibiting.

Online Conference Evaluation (for hospitality suites hosts only)

If you presented a hospitality booth or salon at the 75th Conference on Glass Problems, we would appreciate your feedback to help us continue to improve the opportunity. (This survey is for hospitality suite hosts only)

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RHI AG is the world market and technology leader in high-grade ceramic refractory materials. A global player with Austrian roots, RHI employs roughly 8,000 people worldwide at 33 production sites in Europe, North America, Latin America, South Africa and China and is represented by over 70 sales offices in four continents. RHI is the only global refractories supplier to offer products for all aggregates of the basic industry. The RHI umbrella brand combines a series of traditional brands that have been established in the market for many years, including Didier, Veitscher, Radex, Dolomiti Franchi, Interstop and Monofrax.

RoviSys
Booth: Bellows A
1455 Danner Drive, Aurora, Ohio 44202
Phone: +1-330-995-8103
www.rovisys.com

As an engineering service company, RoviSys specializes in process control and information automation. We have incorporated state of the art systems around the world for major glass manufacturers. As an independent company, we work with you to design and develop the best solution to meet your needs, not ours. With 400 employees and four locations worldwide we are well suited to provide you with state of the art control and information systems. We have experience in all major sectors of the glass manufacturing industry. From your batch house to your warehouse RoviSys delivers on time, every time.

Saint-Gobain Sefpro
Booth: 205, 207
9200 Shelbyville Road, Suite 531, Louisville, Kentucky 40222
Phone: +1-502-329-7605
www.sefpro.com

SEFPRO is glad to support glassmakers’ success by delivering top quality refractory products and services that give you the advantage. Thanks to our worldwide network and outstanding innovation power, you can trust us for meeting your ever evolving needs. Tell us about your projects — working together, we can and will make the difference!

SSOE Group
Booth: Bellows E
1001 Madison Avenue, Toledo, Ohio 43604
Phone: +1-419-255-3830
www.ssoe.com

At SSOE, our experience spans decades and includes projects with every major glass manufacturer, every aspect of plant operations, and furnace design. We promise to save you time, trouble, and money. We can make this promise because we’ve achieved savings on multiple projects. Over 800 projects completed in the last five years alone. SSOE has worked extensively in the glass industry, and we apply this broad knowledge to come up with the best solution for clients that manufacture containers, specialty glass, fiberglass, float glass, residential shingles and automotive glass.

Varo Engineers, Inc.
Booth: 304
2751 Tuller Parkway, Dublin, Ohio 43017
Phone: +1-614-459-0424
www.varoengineers.com

Varo Engineers, Inc. is a privately owned full service engineering and design consulting firm with 60+ years of experience. We emphasize on customer service, while tailoring to our client’s needs in the industrial, manufacturing, institutional and power generation markets. Our specialties include process applications, material handling systems, furnace design, nuclear services, energy audits and electrical power and controls. We also provide project management and client site services for multidiscipline projects. We serve our clients through a flexible, multidiscipline approach that results in project specific solutions.
Advanced Control Solutions, Inc.
Booth: 39
8750 Resource Park Drive, Sylvania, Ohio 43560
Phone: +1-419-843-4820
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As an integrator of information and control system solutions, ACSI engineers in both the United States and Europe are able to provide customers with quality technical engineering, system design, factory acceptance, installation supervision, commissioning services, and training. Our knowledge can be applied to Float Glass, Fiberglass, Container Glass, Tableware, Lighting, Tubing, and Specialty systems. Types of solutions we provide are temperature control, DCS replacement, batching control, glass level control, model based control, packaging & sortation control, and production tracking.

Allstates Refractory Contractors, LLC
Booth: 22
218-B Mechanic Street P.O. Box 256, Waterville, Ohio 43566
Phone: +1-419-878-461
www.allstatesrefractory.com
We are a full-service industrial process general contractor providing all-encompassing solutions for the glass, metals and petrochemical industries.

American Ceramic Society, The
Booth: 8
600 N. Cleveland Avenue, Suite 210, Westerville, Ohio 43082
Phone: +1-866-721-3322
www.ceramics.org
Founded in 1898, The American Ceramic Society is the leading professional membership organization for ceramic and materials scientists, engineers, researchers, manufacturers, plant personnel, educators and students. The Society serves more than 9,000 members from more than 70 countries.

American Glass Research
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603 Evans City Road, Butler, Pennsylvania 16001 USA
Phone: +1-724-482-2163
www.americanglassresearch.com
American Glass Research stands as the preeminent consultant to the glass packaging industry and is committed in the years to come to continuing the traditions of service excellence and building on a documented history of providing customer value.
Ametek Land, Inc.
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150 Freeport Rd., Pittsburgh, Pennsylvania 15238
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www.ametek-land.com

Monitors and analyzers for industrial infrared temperature measurement, combustion efficiency and infrared temperature measurement. Product range includes on-line thermometers and systems, portable infrared thermometers, thermal imagers, and infrared linescanners.

Antonini srl
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Phone: +011-39-0571-93221
www.antoninisrl.com

Designers, manufacturers, supplies and installers of annealing and decorating Lehr’s also special Lehrs for glass blocks, toughening and car head lamps. Mould pre-heating ovens.

Area Impianti S.p.A.
Booth: 11
Via Leonino Da Zara A 3/A, 35020 Albingnasego, Padova, Italy
Phone: +17814280638
www.areaimpianti.it

Area Impianti projects, installs and manages flue gases treatment and co-generation turnkey plants worldwide. Area Impianti’s FGT systems boasts of the most advanced technology aimed at reducing emissions of pollutants such as acid gases, dust, dioxins and NOx. The company is mainly present in waste incineration sector, glass industry, foundries, smelters, and cement and tyres incineration factories. The company also designs complete lines of incineration, fermentation and anaerobic digestion that process green and agricultural wastes, sludge and biomass in order to produce electric and thermal energy. The company is certified ISO 9001, 14001, OHSAS 18001 UL and SOA OS 14.

Borton-Lawson
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613 Baltimore Drive, Suite 300, Wilkes-Barre, Pennsylvania 18702
Phone: +1-570-821-1999
www.borton-lawson.com

Borton-Lawson is a leader in engineering consultancy, design, and technical support. For more than 20 years, Borton-Lawson has been the consultant of choice for glass manufacturers. Our licensed professional engineering provide complete project solutions, including project management, procurement services and structural, mechanical, electrical, process, and instrumentation and control engineering. As a leading A/E/C firm, we are proud to rank among the nation’s Top 500 design firms (ENR, 2014).

Bristol Instruments, Inc.
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Phone: +1-585-924-2620
www.bristol-inst.com

Bristol Instruments, a leader in optical interferometer-based instrumentation, offers a thickness gauge for glass manufacturers whose development and production processes require precise thickness information. High accuracy and exceptional long-term repeatability result in the most reliable thickness measurement available. The 157 Series Optical Thickness Gauge employs proven technology used in hundreds of research laboratories and manufacturing facilities around the world. The model 157 provides non-contact thickness measurement of a single layer or multiple layers. The system’s accuracy is +/- 0.1 µm and is traceable to NIST standards. Its measurement repeatability is +/- 0.05 µm, and unmatched stability virtually eliminates thermal drift.

Bucher Emhart Glass
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405 East Peach Ave., PO Box 580, Owensville, Missouri 65066
Phone: +1-573-473-2132
www.emhartglass.com

Bucher Emhart Glass is the world’s leading international supplier of equipment, controls and parts to glass container industry. With broad-based expertise in glass container forming, glass conditioning, gob forming, ware handling, cold end inspection, refractory parts and quality assurance, the company’s machines and systems are established as standard products worldwide. Emhart Glass also provides installation, training, production assistance, and maintenance related services.

BWF Envirotec USA
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1800 Worldwide Blvd., Hebron, Kentucky 41048
Phone: +1-859-282-4550
www.bef-envirotec.us

BWF Group provides the Pyrotex® KE KAT catalyst candle elements for glass furnace emissions to simultaneously perform both particulate and NOx removal in a single process stage. The extremely high chemical resistance of the Pyrotex® KE candle elements also allows for acid gases to be removed by including a dry absorption system. The candle elements are 100% spark resistant, can operate at continuous temperatures of 850ºC and achieve particulate emissions of < 1 mg/Nm3.
Carmeuse Lime & Stone

Booth: 10
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Phone: +1-412-777-0747
www.carmeusena.com

Carmeuse Lime & Stone is a leading manufacturer of lime and limestone/dolomite to the glass industry. Carmeuse has 28 plants that supply and serve most of the USA and Eastern Canada. We also have a technical service laboratory in Pittsburgh PA, staffed by glass industry experts.

Delta Energy Services, LLC

Booth: 57
5555 Perimeter Drive, Dublin, Ohio 43017
Phone: +1-614-339-2600
www.deltaenergyllc.com

Delta Energy Services is a leading international provider of customized Energy Management Services for large industrial energy end-users. We provide strategic procurement, robust and accurate data management, sophisticated price risk management, sustainability and other energy-related services. Delta is a certified Woman Business Enterprise. Headquartered in Dublin, Ohio, Delta has North American offices in Richmond, Virginia, Toronto, Ontario and Montreal, Quebec.

DSF Refractories & Minerals Ltd.

Booth: 21
Friden, Newhaven, Nr. Buxton, Derbyshire, SK17 0DX, United Kingdom
Phone: +44 1629 636 271
www.dsf.co.uk

DSF Refractories & Minerals Limited; established in 1892 in the Derbyshire Peak District is the largest shaped refractory manufacturer in the UK. Recognized as one of the worlds leading suppliers of bonded refractories to the glass industry, products include a wide range of high alumina refractory bricks & shapes based on mullite, andalusite, chamotte, bauxite, spinel and pure alumina. Shapes are manufactured by pressing or casting techniques which are then high fired to give optimum properties in service. The company has a highly knowledgeable sales & technical team with a determination to provide the best solution for our customers.

Edward Orton Jr. Ceramic Foundation, The

Booth: 54
6991 Old 3C Highway, Westerville, Ohio 43082
Phone: +1-614-818-1321
www.ortonceramic.com

The Edward Orton Jr. Ceramic Foundation manufactures pyrometric products and thermoanalytical instruments. In addition, the Foundation operates an independent material testing laboratory specializing in refractory, glass, whiteware, and advanced ceramic materials.

Eurotherm by Schneider Electric

Booth: 26
44621 Guilford Drive, Suite 100, Ashburn, Virginia 20147
Phone: +1-703-724-7300
www.eurotherm.com

Eurotherm by Schneider Electric offers enterprise control systems for the glass industry, in addition to highly advanced process control solutions. Process control systems operate in a timescale appropriate to the production process, whereas Management Information Systems typically provide time delayed information. This delay seriously impacts the decision making process for both management and operators. Eurotherm by Schneider Electric enables the glass industry to transfer productivity data into information in a timely manner, thereby providing both management and operators information indicating real time profitability in a dashboard format. Eurotherm by Schneider Electric will discuss several offerings including Wonderware System Platform, Eurotherm process control, Foxboro field devices and Avantis Asset Management.

F.I.C. (UK) Limited

Booth: 42
Longrock Industrial Estate, Penzance Cornwall, TR20 8HX United Kingdom
Phone: +44 01736366962
fic-uk.com

F.I.C design and supply all-electric furnaces and electro-heat applications for glass conditioning and boosting of a wide range of glass types and manufacturing processes, including float, fibre, container, TV panel and borosilicate glasses. Within the range of electrode holders manufactured by F.I.C. is our unique High ‘Q’ holder in which the cooling circuit is replaceable. F.I.C. produces a special HVP (high vapour pressure) forehearth design for volatile glasses such as borosilicate, opal or lead. We also offer the Isothermal Unit which provides very efficient forehearth or distributor boost, improving thermal homogeneity in coloured glasses or for high productivity forehearths in flint glass. ISO 9001 accredited.
EXHIBITORS

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United Kingdom
Phone: +44 1235 811 111
www.fivesgroup.com
Fives Stein Limited is a leading supplier in high-quality melting and conditioning for all types of glass. We design, manufacture, install, commission and service glass plant and equipment tailored to your specific needs. With over 90 years of experience in a wide range of glass processes and applications all over the world, we can provide a complete range of services. We provide full support and training for your teams, on our equipment, to assist with your full-scale glass production needs. We are part of the Fives, an industrial engineering group, who design and supply machines, process equipment and production lines for the world's largest industrial groups.

**GEA Process Engineering, Inc.**
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9165 Rumsey Road, Columbia, Maryland 21045
Phone: +1-410-997-8700
www.niroinc.com
GEA Process Engineering offers a wide range of technology for gas cleaning in various industrial markets. This includes dust collection, dry, semi-dry and wet processes for removing SOx and other acid gases, separating heavy metals, dioxins and furans and other relevant off-gas components. Our range of services includes consultancy, engineering, supply, assembly and commissioning of complete plants.

**General Glass Equipment Company**
**Booth: 12**
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Phone: +1-609-345-7500
www.generalglassequipment.com
General Glass Equipment Company is an engineering and manufacturing organization that has dedicated its corporate activities exclusively to the domestic and worldwide glass manufacturing industry for more than 80 years. The activities of the firm encompass virtually every aspect of glass manufacturing from plant design and construction, personnel training, project engineering, and general consultation to innovative product development for manufacturing economies. Our extensive background in the industry offers General Glass clients the benefit of a comprehensive perspective of glass manufacturing on a domestic and an international scale.

**Glassworks Hounsell**
**Booth: 41**
Park Lane, Halesowen, West Midlands B63 2QS, United Kingdom
Phone: +44 1384560666
www.glassworkshounsell.co.uk
Glassworks is a leading global supplier of all types of batch charging and wetting equipment for all varieties of furnaces and tonnages. We are also a world-wide provider of Stannex Tin Oxide electrodes and ancillary equipment for all electric melting, boosting and refining. With more than 40 years experience and ISO9001 registered we are precision engineers for the glass industry.

**GMIC**
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600 N. Cleveland Avenue, Suite 210, Westerville, Ohio 43082
Phone: +1-614-818-9423
www.gmic.org
GMIC is a trade association of the glass industry that includes among its members, representatives of all four sectors: Flat, Container, Fiber and Specialty glass companies, as well as leading suppliers to the industry, research institutes and industry experts. Our goal is to promote the interests and growth of the glass industry.

**H.C. Starck, Inc.**
**Booth: 38**
45 Industrial Place, Newton, Massachusetts 02461
Phone: +1-617-630-5800
www.hcstarck.com
H.C. Starck’s innovative research, engineering development, manufacturing execution, and diverse product portfolio make it a leading manufacturer for the glass melting industry. H.C. Starck is one of the world’s largest suppliers of the refractory metals: molybdenum, tungsten, tantalum, and niobium. Large diameter molybdenum tubing suitable for quartz melting vessels and orifice plates are extruded at its premier extrusion and forging facility. Fabricated products from molybdenum and tungsten include: glass melting electrodes, crucibles, extruded tubes, and other components. H.C. Starck’s molybdenum, with its exceptional purity level (99.95% minimum), has outstanding resistance to chemical corrosion, degradation, and minimal detrimental glass discoloring.
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Phone: +1-201-647-8672
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Heraeus specializes in the manufacture of platinum, gold, iridium, and specialty metal parts for the glass industry. With over 150 years of experience in precious metals and worldwide operations, Heraeus has the capability to provide the highest quality products in the most sophisticated designs. Items include stirrers, liners, electrodes, crucibles, cladding, and other custom designed parts, in high strength alloys and grain stabilized materials, specifically designed for glass manufacturing. All of our products are backed by our expertise and world-class technical support.

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Phone: +49 9131 9747790
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ilis develops, produces and distributes software solutions, measuring systems as well as automated test equipment for quality assurance in the glass and optical industry. With the measuring and testing equipment of the StrainMatic™ and StrainScope™ series, the company develops imaging polarimeter systems for the automatic and objective measurement of residual stress in glass and plastics. BatchMaker™ and Chroma™ provide the glass industry standardized software solutions for simple and reliable calculation of batch recipes and glass properties, as well as for transmission and color measurement.

Johnson Matthey Noble Metals
Booth: 37
1397 King Road, West Chester, Pennsylvania 19380
Phone: +1-859-276-1570
www.glass.noble.matthey.com
Johnson Matthey Noble Metals is a long-established supplier of platinum group metals (PGM). These alloys are inert in contact with molten glass and provide unequalled resistance to erosion. Johnson Matthey is the only global fabricator offering a complete range of complementing PGM technologies for glass manufacturers.

Lahti Precision Oy
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www.lahtiprecision.com
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By supplying:
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• Weighing, dosing and mixing systems and components
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www.longwallservices.com
Longwall Services Inc. manufactures and supplies cullet conveyors, glass breakers, bottle sinkers and conveyor belt cleaners for the glass industry. Products for the glass industry include:
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1565 Jefferson Road, Suite 420, Eagle’s Landing Business Park, Rochester, New York 14623
Phone: +1-585-214-2455
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Lumetrics® is the leader in flat glass and tubing measurement. Since 2003 Lumetrics® has worked with all of the leading glass manufacturers in the world in the measurement of their specialty glass products. Lumetrics® OptiGauge™ provides non-contact measurement of single and multilayer glass products including tubing, safety and water glass, float glass, and coatings, even in a tin bath. The OptiGauge™ is used in R&D labs, Quality Control, and online process measurement. Our technology is even used for in-process glass slimming measurements to increase customer throughput by over 30%.

Luoyang Dayang High-Performance Material Co., Ltd.
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Songzhuang Development Zone, Mengjin, Luoyang, Henan, P.R. China 471121
Phone: +86 13 933586785
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Leading Chinese Fused Cast Materials Manufacturer, 10,000 tons/year salable products of AZS 33, AZS 36, AZS 41, α-β Alumina, and Fused high Zirconia in 88% and 95%.

Magneco/Metrel, Inc.
Booth: 30
223 W. Interstate Road, Addison, Illinois 60101
Phone: +1-630-543-6660
www.magneco-metrel.com
MMI has developed a family of refractory monolithic products referred to as “Metpump” for Glass Furnace Applications. MMI’s unique cement free colloidal silica bonded monolithic refractory products offer an alternative to the electrofused cast blocks for the glass furnace. Metpump Products can be used in five different applications: 1) Major Repairs of the melter and regenerator 2) Full or Partial Crown Construction or Repair 3) Partial Construction of the furnace 4) Minor Repairs of the melter and regenerator 5) Full Construction of the furnace.

Magnetic Specialties, Inc.
Booth: 50
174 Keystone Drive, Telford, Pennsylvania 18969
Phone: +1-267-384-5231
www.magspecinc.com
Custom manufacturer of saturable reactor based power supplies, design and build custom transformers; capabilities to 3500 KVA, dry-type and water cooled, copper and aluminum, UL recognized insulation systems, high ambient design experience.

McGill AirClean LLC
Booth: 6
1777 Refugee Road, Columbus, Ohio 43207
Phone: +1-614-829-1200
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McGill AirClean has over 40 years of engineering and manufacturing experience helping companies meet stringent air pollution control regulations for boilers, furnaces, incinerators, and a variety of industrial processes in industries such as wood products, pulp and paper, automotive, chemical, pharmaceutical, food, metals, petrochemical, electrical power and steam generation, and solid waste incineration. We have extensive experience and a large number of installations for many types of glass applications. Products and services include dry and wet electrostatic precipitators, fabric filter systems, spray-dry scrubbers, regenerative thermal oxidizers, DeNOx (SCR) reactors, dry reagent injection systems, mobile testing services, and parts and service.

Mixer Systems, Inc.
Booth: 31
190 Simmons Avenue, PO Box 10, Pewaukee, Wisconsin 53072
Phone: +1-262-893-5315
www.mixersystems.com
Mixer Systems is an American manufacturer of four types of mechanical batch mixers for the glass & refractory and ceramic industries. Located near Milwaukee, Wisconsin USA., we have supplied over 3500 projects in 42 different countries worldwide since 1945. The planetary mixer works like an egg beater and provides excellent mixing action for colored batches or hard to mix applications where top to bottom mixing action is critical to the end product.

Motim Fused Cast Refractories Ltd.
Booth: 13
Timföldgyári ut 9-13, Mosonmagyaróvár, 9200, Hungary
Phone: +1-724-499-5800 | +36 96 574 100
motim.hu
Motim Fused Cast Refractories Ltd. is recognized as a world leader producing fused cast AZS and alumina refractories, refractory castables. Our products are used in the glass manufacturing furnaces. More than 95% of our turnover is from export sales. Our traditional markets are Western and Central Europe, but we are present with our products on all continents of the World. Motim is represented in the USA by ARGENT.ENTERPRISES. INC.
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Booth: 5  
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Phone: +1-630-305-2414  
www.nalco.com  
Nalco is the world’s largest Sustainability Services Company. We utilize our expertise and innovation in helping our customers to save water, reduce energy consumption, and improve water and process operations. Our highly trained site engineers will work with you to develop an effective engineering solution that meets your corporate cost, production, and sustainability goals.

SORG Services USA  
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Stoltestr, 23 D-97816, Lohram Main, Germany  
Phone: +1-724-366-6513  
www.sorg.de  
The SORG Group through their member companies can supply turnkey installations from raw material delivery through the glass gob globally. This includes all aspects of the furnace lifetime cycle. From sustainable designs, construction, services, repairs, through demolition at the end of the campaign. SORG through EME, Nikolaus Sorg GmbH & Co. KG, and SKS delivers Made in Germany solutions to all sectors of the glass industry globally. Our latest products include the BATCH3 system comprising often the IRD® Doghouse, EME-NEND® charger and the proven Sorg® Batch Preheating system.

North American Refractories (NARCO)  
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400 Fairway Drive, Moon Township, Pennsylvania 15108  
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The TECO Group, consisting of Toledo Engineering Co., Inc., TECOGLAS Ltd., KTG Systems, Inc., KTG Engineering Ltd., ZEDTEC Ltd. EAE tech and Dreicor Inc. specialize in the design and construction of glass melters of all types, including fuel-fired regenerative and recuperative furnaces, oxy-fuel furnaces, electric melters, electric boost systems and forehearts and distributors/working end. The TECO Group also provides batch plants, emission control systems and process control systems on a turnkey basis. KTG Engineering Ltd. manufactures many items of furnace equipment such as batch chargers, electrode holders, and spy hole covers, etc.
Tri-Mer Corporation offers the UltraCat Catalyst Filter System for glass furnace emissions. Based on low-density ceramic filters, the technology offers a high-performance approach to removing Particulate, SO₂, HCl, and NOx in a single all-in-one system. Acid gases such as SO₂, HCl, and HF are removed with dry sorbent injection. NOx is destroyed by nano-bits of SCR catalyst embedded in the filter element in conjunction with ammonia injection. Other pollutants such as metals are effectively captured. If only PM or PM+ SO₂/HCl need to be controlled, standard filters without catalyst are highly efficient at temperatures up to 1650°F.

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Usable Glass Strength Coalition, LLC
Booth: 8
600 N. Cleveland Avenue, Suite 210, Westerville, Ohio 43082
Phone: +1-614-818-9423
www.gmic.org/ugsc.htm
Most glass companies cannot independently support a fundamental research agenda to understand and improve the usable strength of glass. However by working together with pooled funding and shared risk, the opportunity to improve the usable strength of glass is achievable. The UGSC supports fundamental, pre-competitive research on increasing the usable strength of glass across all sectors; provides an opportunity for researchers to develop expertise in industrial applications; develops tools and measurement techniques for the advancement of glass science; and publishes valuable pre-competitive glass research in the public domain.

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Heat Transfer in Glass Quenching for Glass Tempering

Results of an experimental study of heat transfer characteristics in single and two-phase stagnation point flows pertinent to glass quenching in the glass tempering process are presented. Two-phase flows were generated by injecting water mist into the air far upstream of the nozzle exit. This resulted in a temporal and spatially invariant size distribution of the droplets. PIV measurements were made at the nozzle exit to determine the magnitude and uniformity of air velocity profile in both single and two-phase flows. The two-phase flows were also characterized by measurements of drop size distribution and number density using images of droplets resulting from laser induced fluorescence. Steady state experiments were performed for plate heat fluxes ranging from 10 to 50kW/m2, Reynolds number ranging from 2,000 to 122,000 and water/air mass flow ratios up to 4.75%. Single-phase flow results indicate that the Reynolds number dependence of the Nusselt number is ~Re0.68. Two-phase flow results show a maximum heat transfer enhancement of 26%. For plate temperatures above 200°C and for the drop size distributions tested, it was visually determined that the water droplets do not impinge on the plate surface. Therefore, the heat transfer enhancement was attributed to the evaporation of water droplets within the thermal boundary layer. This is an important condition to prevent spatially non-uniform quenching and the resulting shattering of glass. By changing the water/air mass flow ratio, the cooling curve for a two-phase flow can be adjusted to meet the requirements of the industrial process.

Detection of Early Stage Glass Penetration and Weak Refractory Spots on Furnace Walls

Erosion of the refractory lining in molten glass furnaces is a major problem for the glass manufacturing industry. When erosion on the walls is not detected early enough, it may lead to a molten glass leak through the refractory lining and may result in the suspension of production for several weeks. In some cases, a catastrophic accident may also result. The glass penetration typically starts small within the insulation layer and takes anywhere from a few weeks to several months to penetrate through the insulation layer and result in major catastrophic furnace leak. Therefore, detecting an early stage glass penetration within the insulation layer and identifying weak refractory linings will result in safer and longer furnace operation through preventive and proactive maintenance.

To address this major industry need, we are developing a non-destructive sensor technology for tomographic imaging of insulation and refractory lining. This sensor will identify early stage glass penetration into insulation and identify weak refractory spots for preventive and proactive maintenance. We have already developed a sensor that measures the residual AZS thickness on operational glass furnaces. We have also showed the feasibility of mapping interior walls of insulation layers for glass penetration in an operational furnace. Lastly, the same sensor technology is capable of detecting voids and defects in cold refractories.

At the conference, we will discuss the underlying fundamentals behind the proposed sensor technology, the measurement results pertaining to feasibility and in-situ tests on operational furnaces, and the path forward to an integrated sensor system for smart (self-sensing) furnaces.
ABSTRACTS in Alphabetical Order by Speaker Last Name

Sebastien Bourdonnais, Material Science Engineer, Saint-Gobain SEFPRO; David Lechevailer, PhD, R&D Senior Engineer, Saint-Gobain Northboro Research Center; Michel Gaubil, PhD, R&D Manager, Senior Scientist, Sain-Gobain CREE

SEFPRO Cruciforms: Modern and Competitive Regenerator Designs for Glass Industry
Modern glass manufacturing has become these years a challenging global market. Energy consumption and environmental regulation are now major concerns. For more than 40 years, SEFPRO has developed innovative solutions for regenerative glass furnaces with highest thermal performances and adapted to different running conditions. This presentation summarizes the state-of-the-art practices with typical designs and choices of materials to match this challenging objective and help glass makers in manufacturing high quality glass at competitive cost. Several design optimizations on the regenerator chambers and on the checkers choice to reach minimum specific consumption will be presented, with guidelines for right checker material choice withstanding a full campaign with minimum maintenance. This suppose the checker pack can perfectly resist to usual operating conditions such as reducing conditions for NOx control, carry over attack and thermal cleaning.

Steven Brown, Principal Mechanical Engineer, Bucher Emhart Glass; Kenneth Bratton, Manager of Forming Process Engineer, Bucher Emhart Glass; Tim Ringuette, Senior Mechanical Engineer; Bucher Emhart Glass; Dubravko Stuhne, Production Technical Specialist, Vetronic

Hard Glass – Commercial Progress of Thermally Strengthened Container Glass
A developmental program and market introduction is underway between Bucher Emhart Glass and Vetropack Austria. In this program, a new strengthening machine has been installed and is running in Vetropack’s glass plant located in Poechlarn Austria. The market introduction is based on a 330mL beer bottle being produced for a local Austrian brewer that is a light weighted version (200 gram) – a weight reduction of 33%. This paper will present the results of some initial filling line tests together with lessons learned along the way. It will also include the results of a study performed for Bucher Emhart Glass and Vetropack by Stazione Sperimentale del Vetro (Murano, Italy) regarding the differences between annealed and heat strengthened ware in terms of the resistance of the glass to impact and handling induced defects.

Carol Click, Manager Glass Science Group, Global R&D, Owens-Illinois, Inc.; Udaya Vempati, Scientist I, Owens-Illinois, Inc. and Terence Clark

Effect of Dissolved Water on Physical Properties of Soda-Lime-Silicate Glasses
Dissolved gases in glass melts are known to influence properties of the melts as well as the resulting glass and dissolved water is thought to be one of the most influential of all the dissolved gases. In this work, the effect of vacuum processing and the ensuing changes in dissolved water concentration on various physical properties of soda-lime-silica glasses were studied. Glass melts with varying dissolved water concentration were prepared by melting frit at atmospheric and sub-atmospheric (~100 torr) pressures at 1450 °C. The physical properties of these melts and the resulting glasses were determined by rotating spindle viscometry, beam bending viscometry, and UV-Vis spectroscopy. The densities of the glass samples were also determined. Results from these experiments are discussed in relation to prior work in the field and the implications of changes in properties on the glass making process are discussed.

Henry Dimmick, Jr., CEO, American Glass Research; Brian Collins, Research Scientist, American Glass Research; Gary Smay, Manager Consulting Services, American Glass Research

Comparison of SEM/EDX Analysis to Petrographic Techniques for Identifying the Composition of Stone in Glass
Stones are a problem that can adversely affect glass production in container, flat glass, specialty, and fiberglass manufacturing. Consequently, it is important to quickly and correctly identify the source of the stone and implement appropriate corrective actions. Historically, the analysis of stones required time consuming petrographic analyses. Recently, glass technologists have adopted a method of analyzing stones consisting of a scanning electron microscope (SEM) together with the use of X-ray analysis (EDX). These current methods have the potential of providing accurate, detailed information about the stone in a much shorter time than usual petrographic analyses. This paper compares data derived from analyses of stone identification using an SEM/EDX to the results obtained from petrographic techniques.
**ABSTRACTS** in Alphabetical Order by Speaker Last Name

**Xu Ding**, PhD, Engineer Manager Forming Process Automation and Simulation, Bucher Emhart Glass; **Jonathan Simon**, PhD, Sr. Scientist, Bucher Emhart Glass; **Angelo Dinitto**, Product Manager, Bucher Emhart Glass; **Andreas Helfenstein**, Development Engineer, Bucher Emhart Glass

**Multi Gob Weight Production**

Capability of producing multiple containers with different weights on the same machine line can give the glass plant more flexibility of organizing production jobs, save cost on mold equipment, and reduce production lost due to job changes. Bucher Emhart glass has developed the multi gob weight control system including multi weight feeder and the knowledge for how it can be applied. This paper presents recent multi gob weight control algorithm developments and its application with the multi feeder system. The control algorithm makes the multi gob weight set up procedure quick, accurate, and easy for the end user. Plant trial results are included to validate the control algorithm development.

**Diego Filippi**, Chemical Engineer, Area Impianti SpA; **Francesco Zatti**, Technical Director, Area Impianti SpA; **Alessandro Monte-forte**, Chemical Engineer, Area Impianti SpA; **Gianluca Taramelli**, Chemical Engineer, Area Impianti SpA

**Environment and Energy Flue Gas Treatment and Heat Recovery Integrated Systems in Glass Industry**

Flue gas treatment in glass industry is getting more involved and elaborate to meet environmental emission requirements. Traditionally, three compulsory systems are available to abate pollutants and acids (dusts, NOx, SOx): Electrostatic Precipitators, Bag Filters and Ceramic Candle Filters eventually connected to an SCR reactor. Additionally, flue gas treatment specialists are trying to develop new technology solutions to optimize and increase operating and environmental performance, even using the so called “Lost Third” of Energy, coming out with glass furnace gases. Two typologies of heat recovery are generally possible: thermal and electric; cogeneration is also a third, mixed opportunity. Generally speaking, Rankine cycle is used to produce power normally realized in two ways: - by means of water steam generation (direct exchange with flue gases); - by means of organic fluid (indirect exchange, using thermal oil heated by flue gases).

Where reliability and low maintenance are basic decision elements, Organic Rankine Cycles (ORC) are the most common choice and probably the best available technology. New generation organic fluid turbines are becoming more efficient and comparisons on same cases show that yearly power production with ORC is at least as high as traditional steam cycle, with lower investment in terms of manpower and time spent on this “appendix” of the glass furnace.

The subject of the presentation is the evaluation of the most reliable solution in terms of heat recovery linked with FGT, related to a specific plant situation, and a deep analysis of a typical heat path, considering technical and economic aspects.


**3-D Transient Non-isothermal CFD Modeling for Gob Formation**

To achieve a quality final product in the glass container industry, it is critical to determine the “ideal” glass gob shape to be produced from the feeder after shearing. Large deviations from an ideal gob shape may result in severe consequences for the gob delivery system and molds. The formation of ideal or desired gob shape is dependent upon operational parameters such as glass temperature/viscosity, uniformity, plunger stoke and heat-loss management. A Computational Fluid Dynamics (CFD) model provides an efficient and cost effective way of studying the effects of these parameters when optimizing gob shapes that are subject to the aforementioned operating parameters and conditions.

For the current study, two CFD approaches were used to create a 3-D transient non-isothermal CFD model in order to study the effects of flow and the thermal condition of molten glass on gob formation. In the first approach, a numerical model was developed by utilizing the ANSYS POLYFLOW solver in conjunction with both the Mesh Superposition Technique and the Lagrangian adaptive re-meshing technique to model plunger motion and gob formation respectively. In the second approach, a hybrid model using both ANSYS FLUENT and POLYFLOW was developed, in order to achieve higher computational efficiency and a reduction in computational time. The hybrid model consists of two parts: (1) the flow and thermal condition of the molten glass is modeled by FLUENT using the moving deforming mesh technique for plunger motion, and (2) the gob forming process is modeled in POLYFLOW by mapping/transferring the glass flow and temperature information from FLUENT. The hybrid model used in the second approach shows significant improvement in computational performance with reasonable accuracy.

**Henning Katte**, CEO, ilis GmbH

**Fast and Objective Measurement of Residual Stresses in Glass**

Mechanical stresses can strongly impair the fracture strength and processing ability of glass products. Testing for residual stresses close to production is therefore an important constituent of quality control. For decades manually operated polariscopes and polarimeters have been the standard method for testing the level of residual stress in glass, e.g. according to ASTM C148. However, the measuring results obtained with such devices are strongly dependent on the operator and therefore subjective. The results of statistical Gage R&R tests show that the reproducibility achieved with this method is not acceptable. A newly developed imaging polarimeter features the objective measurement of inherent stresses in glass — as random sample test or directly in the production process. The camera-based instruments are capable of measuring and visualizing stresses in glass in real time and can be used flexibly wherever conventional polariscopes and polarimeters are still used nowadays. A comprehensive Gage R&R study shows substantial improvements in respect to absolute accuracy and practical reproducibility of the measurement.
OPTIMELT™ Regenerative Thermo-Chemical Heat Recovery for Oxy-Fuel Fired Glass Furnaces

The operation of glass furnaces with oxy-fuel combustion in combination with advanced heat recovery is a compelling low cost solution. Praxair has developed a regenerative heat recovery system for oxy-fuel fired furnaces that uses regenerators in a similar way to which conventional regenerators are used for air preheating. The OPTIMELT™ Thermo-Chemical Regenerator (TCR) technology stores waste heat from the hot flue gas and uses this energy to endothermically reform a mixture of natural gas and recirculated flue gas to hot syngas resulting in efficient thermo-chemical heat recovery.

The TCR system is simple and operated at atmospheric pressure without requiring catalysts or separate steam generation. TCR reduces fuel consumption of an oxy-fuel fired furnace by about 20% and offers an attractive conversion option for existing air-regenerator furnaces, with more than 30% fuel reduction compared to the air-fuel base case. The presentation will highlight key technology development steps and include operational data and results from the first installation of OPTIMELT™ TCR on a 50 t/d commercial container glass furnace.

Oxygen Enhanced NOx Reduction (OENR) Technology for Glass Furnaces

Container and flat glass manufacturers in the USA and EU are facing increasing pressure from regulatory agencies to further decrease NOx emissions from glass furnaces. In the past, air-fired glass furnace operators have been able to reduce NOx emissions and comply with regulations by modifications of the primary air combustion system, such as the optimization of natural gas injection method. However, complying with new European Union NOx targets (~1.5 to 2.4 lb NOx/ton of glass for container glass and ~2.5 to 4 lb NOx/ton of glass for float glass) will be difficult to achieve in many furnaces through these optimization steps. Combustion staging by reducing the stoichiometric ratio (air/fuel ratio) of the primary air-gas flame and introducing a secondary oxidant stream at various locations in the furnace has shown to successfully reduce NOx emissions. Well known approaches are oxygen enriched air injection or cold air staging. However, the use of cold air has a substantial energy efficiency penalty. Praxair has developed Oxygen Enhanced NOx Reduction (OENR) technology which uses a pure oxygen stream to attain NOx emissions levels below 1.5 lb/ton, without adversely impacting the energy efficiency of the furnace or disturbing the air-fuel flame, as is sometimes observed with cold air staging. This paper presents and discusses CFD results and data from commercial demonstrations of Praxair’s OENR technology and shows that the technology is a cost effective approach to significantly reduce NOx emissions, while maintaining good glass quality and increasing fuel efficiency.
**New Combustion Technique for Reducing NOx and CO2 Emissions from a Glass Furnace**

The European Glass Industry has the problem of reducing both CO2 and other emissions such as NOx from its primary regenerative melting furnaces. To address this problem a new combustion concept has been developed by a consortium of GDF-SUEZ, Global Combustion Systems and the University of South Wales with financial assistance from the UK’s Carbon Trust. It comprises a novel, patented firing technique (Auxiliary FIRING) that reduces NOx formation at source on primary regenerative glass melters, while simultaneously reducing fuel consumption and CO2 emissions. It avoids or reduces the need for post-furnace NOx clean-up which can be expensive in capital and increases life-cycle CO2 emissions.

If confirmed over longer term testing and on cross-fired furnaces, the results of this project will enable the European glass industry to meet upcoming NOx emission limits on their primary glass melters by reducing NOx formation at source, without the need to install large, expensive and energy-hungry post furnace clean up techniques. Elimination of NOx clean-up will yield simultaneous reductions in NOx and glass life-cycle CO2 emissions.

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n°296042.

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**Energy Analysis for Preheating and Modeling of Heat Transfer from Flue Gas to a Granule**

To reduce energy consumption of an oxy-fired glass furnace, energy loss via the flue gas and through the furnace walls should be minimized since they account for approximately 40 % of the energy usage. One way to minimize flue gas energy loss is to pre-heat the raw batch materials and/or cullet. Energy analysis was conducted to evaluate the maximum amount of energy recoverable and that required for the pre-heating. The maximum pre-heating temperature was calculated under conditions of constant and reduced rate of natural gas usage. Since the flue gas temperature from an oxy-fired furnace is on the order of 1350°C, the maximum temperature for batch pre-heating that could be potentially employed was above 500 °C. However, handling loose batch at such high temperatures is likely to be physically difficult to accomplish reliably. On the other hand, batch in an agglomerated form, such as granules, may be pre-heated easily. Analysis of the heat transfer from flue gas to a single granule was investigated first through computational fluid dynamics (CFD) modeling. Parameters studied included the average diameter and thermal conductivity of the granule, the inlet flue gas temperature, and the flue gas velocity and composition. The data was used to evaluate the time needed to preheat a single representative batch granule to a given target temperature under various heating conditions. In addition, the time-dependent temperature and velocity distributions for the modeled geometry were determined. The results show that granule diameter and gas velocity both have a significant impact on the rate of granule heating.

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**Closed Loop Control of Glass Container Forming**

Recently developed closed loop control systems offer a new means to help container glass manufacturers meet the ever increasing industry and customer expectations for improved yield and quality. In these closed loop systems the process is automatically adjusted based upon actual measured values. Such closed loop controls, have now been developed and introduced into commercial production in two key areas: 1) Blank Cooling Control and 2) Plunger Up Control in which the blank mold temperatures and the rise/dwell time of the plunger respectively are automatically controlled. The technical development of these new control systems, the challenges that needed to be met, and the experience of glass manufacturers adopting these systems will be presented.
Steven B Smith, Independent Consultant

**U.S. Air Regulations Involving Glass Manufacturing**

Recently developed closed loop control systems offer a new The basics of environmental rulemaking is reviewed as well as the role of the states. An overview Part 70, Title V permitting is provided, what various Title V permits exist today, why permit variations occur and when a state should be notified about work on a permitted process. Greenhouse gas requirement are in place today at the Federal level and at the state level one state has set limits and requirements for controls but various agreements foretell expansion of such rulemaking to other jurisdictions.

Oscar Verheijen, Dr., Ir., Senior Consultant, CelSian Glass & Solar B.V.; Hans Van Limpt, Dr.-Ing., Manager Product Development, CelSian Glass & Solar B.V.

**Experimental Simulation of Process Steps in Industrial Glass Furnaces**

The conversion of raw materials into a homogeneous glass melt without bubbles and inclusions can only be achieved if essential process steps like: melting-in of batch, dissolution of sand and removal of gas bubbles taking place in a glass furnace. Preferably the process conditions in the furnace do not lead to unwanted side effects like refractory corrosion and high emissions. Experimental laboratory set-ups to simulate different process steps in the glass melting process have been developed by CelSian Glass & Solar B.V. and applied to optimize glass furnace operation. The High Temperature Melting Observation System (HTMOS) is used to observe the melting-in, foaming and fining process. The Refractory corrosion in the regenerators and combustion chamber are in many cases a result of high evaporation and carry-over rates. On laboratory scale the impact of batch and glass composition, furnace atmosphere, gas velocities and temperature on evaporation and carry-over rates can be investigated and measures to reduce the evaporation and carry-over rates can be derived. A method is applied to study the corrosion of regenerator refractory materials. Refractory samples are exposed to cooling flue gases that contain alkali compounds, SOx and other flue gas species. Oxidizing as well as reducing conditions can be simulated. Results of these experimental studies such as melting and fining behavior, evaporation kinetics and thermodynamic data, semi-empirical relations from carry-over and refractory corrosion experiments are used in CFD modeling studies to improve the performance of industrial glass furnaces.
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