82nd Conference on Glass Problems

Edited by
S.K. Sundaram

Ceramic Transactions
Volume 270

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Edited by

S. K. Sundaram

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Foreword

The 82nd Conference on Glass Problems (GPC) was organized by the Kazuo Inamori School of Engineering, The New York State College of Ceramics, Alfred University, Alfred, NY 14802, and The Glass Manufacturing Industry Council (GMIC), Westerville, OH 43082. The Program Director was S. K. Sundaram, Inamori Professor of Materials Science and Engineering, Kazuo Inamori School of Engineering, The New York State College of Ceramics, Alfred University, Alfred, NY 14802. The Conference Director was Bob Lipetz, Executive Director, Glass Manufacturing Industry Council (GMIC), Westerville, OH 43082. The GPC Advisory Board (AB) included the Program Director, the Conference Director, and several industry representatives. The Board assembled the technical program. Donna Banks of the GMIC coordinated the events and provided support. Despite continuing world-wide COVID-19 pandemic, the Conference was held face-to-face. It started with a full-day plenary session followed by technical sessions. The themes and chairs of four technical sessions were as follows:

Refractory

Larry McCloskey, Anchor Acquisition, LLC, Lancaster, OH

Eric Dirlam, Ardagh Glass, Muncie, IN

Data, Chemistry, Energy

Justin Wang, Guardian Industries, Auburn Hills, MI

Chris Tournour, Corning Incorporated, Corning, NY

Energy/Combustion

Glenn Neff, Glass Service USA, Inc., Stuart, FL

Uyi Iyoha, Linde Inc., Peachtree City, GA

Jan Schep – Owens-Illinois, Inc., Perrysburg, OH

Sensors/Energy

Glenn Neff, Glass Service USA, Inc., Stuart, FL

Preface

This volume is a collection of papers presented at the 82nd year of the Glass Problems Conference (GPC) in 2021. The GPC continues the tradition of publishing the papers that goes back to 1934. The manuscripts included in this volume are reproduced as furnished by the presenting authors but were reviewed prior to the presentation and submission by the respective session chairs. These chairs are also the members of the GPC Advisory Board.

As the Program Director of the GPC, I am thankful to all the presenters at the 82nd GPC. This year's meeting was another record-breaking year under the extraordinary situation. We had a total of 357 registered attendees including 6 students from across the country. I appreciate all the support from the members of Advisory Board. Their volunteering sprit, generosity, professionalism, and commitment through an unprecedented world-wide pandemic were critical to the high-quality technical program at this Conference. The Conference Director, Mr. Bob Lipetz, Executive Director of GMIC forged ahead with strong leadership against all odds and worked tirelessly with the Advisory Board in making this Conference a success. I also appreciate continuing excellent support from Ms. Donna Banks of GMIC in organizing the GPC. I look forward to continuing our work with the entire GPC team in the future.

Please note that The American Ceramic Society and I did minor editing and formatting of these papers. Neither Alfred University nor GMIC is responsible for the statements and opinions expressed in this volume.

S. K. Sundaram
Alfred, NY
January 2022

Acknowledgements

It is my great pleasure to acknowledge the dedicated service, advice, and team spirit of the members of the GPC AB in planning this Conference, inviting key speakers, reviewing technical presentations, chairing technical sessions, and reviewing manuscripts for this publication:Kenneth Bratton - *Bucher Emhart Glass, Windsor, CT*

Chris Bloom - *Owens Corning, Granville, OH*

Shrikar Chakravarti - *Linde Inc., Peachtree City, GA*

Weijian Chen - *Libbey Glass, Toledo, OH*

Eric Dirlam - *Ardagh Glass, Muncie, IN*

David Girvan - *Vitro Architectural Glass, Cheswick, PA*

Erik Helin - *Johns Manville, Littleton, CO*

Uyi Iyoha – *Linde Inc., Peachtree City, GA*

Bob Lipetz - *Glass Manufacturing Industry Council, Westerville, OH*

Larry McCloskey – *Anchor Acquisition, LLC, Lancaster, OH*

Glenn Neff - *Glass Service USA, Inc., Stuart, FL*

Adam Polcyn – *Vitro Architectural Glass, Cheswick, PA*

Jan Schep – *Owens-Illinois, Inc., Perrysburg, OH*

Christopher Tournour – *Corning Incorporated, Corning, NY*

Phillip Tucker - *Johns Manville, Littleton, CO*

James Uhlik – *Toledo Engineering Co., Inc., Toledo, OH*

Justin Wang – *Guardian Industries, Auburn Hills, MI*

I appreciate the positive spirit of Bob Lipetz, GMIC with which he has led the GPC to a success this year. I am indebted to Donna Banks, GMIC for her patience, support, and attention to detail in making this conference a big success and this Proceedings possible.

Finally, the whole team has worked tirelessly against all odds of the ongoing world-wide pandemic making this a successful face-to-face conference. The determination and enthusiasm are simply outstanding.

PLENARY

THE UNITED NATIONS INTERNATIONAL YEAR OF GLASS-2022

Manoj K. Choudhary*, L. David Pye**, and Alicia Duran***
*The Ohio State University, Columbus, Ohio, USA
**Alfred University, Alfred, New York, USA
***Instituto de Cerámica y Vidrio, Madrid, SPAIN

Summary NOx Reduction

Date	L-R	R-L	
Apr-16	1943	1698	Testo340
20-May	2188	2060	Lancom 4
21-May	2212	2233	Kimo
22-May	2201	2109	Kimo
22-May	1800		Kimo
23-May	1981	1714	Kimo
	10.5%	23.2%	Reduction from 21/5

- 20/5 and 21/5 were baseline with Lancom then Kimo.
- On 22nd am the fuel profile was changed
- On 22nd pm the new nozzle in Port#5 LHS was replaced with the old design.
- On 23rd pm Port#5 RHS was converted.

Conclusions

- The NIR B has identified
  - Potential sources of parasitic cold air.
  - Problems with #4 Regen RHS
  - Demonstrated ability to see where NOx is being formed.
    - NOx reduced through optimisation
  - Potential to use for trouble-shooting the “arches”
- The new Global nozzle design suggested by Neil has potential to be modified to lower NOx

Overall, the NOx was reduced by 10-23% compared with the first day’s operation.

Possible Next Steps to lower NOx

- Investigate repair of superstructure holes
- Install new conical burner in Port#6
- Consider using the STG Lambda system
- Modify the new Global nozzle to increase gas to inner nozzle.

CONCLUSIONS

The float thermal survey achieved all its objectives. The preceding survey report is a summary of the 467 slides presented to the local environmental protection agency. It identified areas and sources of parasitic air. Previously on other float applications, when repaired, can reduce energy by 3-5%. The thermal profile of the furnace had changed slightly (½ port) from Port 4 to between Port 3 and 4. Since this was the first thermal survey with the NIR-B, it is unclear whether this has really changed, although it could be influenced by the previously unseen regenerator damage on port 4. The view inside the regenerator is dramatic and highlights the area of planned ceramic repair. The selective virtual thermocouples show potential

(Industry 4.0) for thermal cameras to be mounted in the regenerators for both asset protection and improved operational control. Using the reflection method [1], it would be possible to measure the glass surface temperature for a critical period of low iron glass production. The port 5 combustion analysis is unprecedented on a cross-fired furnace and shows the potential to use thermal imaging to optimise burner design and operation in future. NOx reduction of 10% and 23% was achieved by changing the nozzle on one port only.

REFERENCES

[1] N.G. Simpson, M. Bennett, S.F. Turner: Use of Continuous Infrared Temperature Image to Optimize Furnace Operations, *Glass Problems* 2017.

[2] N.G. Simpson, M. Bennett, S.F. Turner: Industry 3.9 Thermal Imaging Using the Near Infrared Borescope (NIR-B) 2018

[3] N.G. Simpson, M. Bennett, S.F. Turner, J. Naughton: Not Just A Pretty Picture – In-Furnace Thermal Imaging (NIR-B), *Glass Problems* 2019