

# Refractories Owensville MO, USA



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# Introduction RATH LLC



- Since 2019, member of RATH Group
- Since 1927, developing and manufacturing quality refractories for the glass container industry.
- Located in Owensville, MO, USA.
- The refractory materials used today by the Global Container Glass Industry were, for the most part, developed in the Owensville plant over the years. As a result, the Emhart Glass System have become the Industry Standard.

# RATH LLC Owensville, USA



# Major Failure Modes of Refractories in Glass

- ◆ It is important to be aware of the **four main causes for refractory failure**:
  - **Thermal Shock**
  - **Alkali Vapor Attack**
  - **Static Glass Corrosion**
  - **Dynamic Glass Corrosion**
- ◆ Owensville has test methods to determine each material's resistance to these four failure modes, to ensure that the correct material is put into service.
- ◆ Owensville RDE / Lab will evaluate material returned from customer plants (often with assistance from UMR ) and determine the cause of failure when applicable.

# Evaluating Refractory Material


- ◆ Test methods to determine material's resistance
  - ◆ Against failure causes
  - ◆ To match the correct material to the customer specific glass composition
  - ◆ Refractory Database
- ◆ Analyze failure modes of returned material from the customer
  - ◆ Potential cause of the failure
  - ◆ Improvements on design and material



# Customer Testing Refractory Analysis

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## Customer Testing Refractory Analysis



*Emhart Glass is dedicated to meeting the requirements of our internal and external customers.*

*In an environment of continual improvement, our commitment is to satisfy our customers by providing on-time delivery of error-free products and services.*

*Quality and Customer Satisfaction have the highest priority at Emhart Glass.*




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sample. The refractory surface below the glass line indicated significantly less corrosion in the 301 sample than the 315. However, the resulting state of the glass left these results in question.

The 357 sample provided a good result. It appears that during the test the glass dissolved silica from the crucible, slightly raising the silica content of the glass along the edge of the crucible and causing the glass to devitrify. This result is an unintended consequence of the test temperature and stagnant nature of the test.

All three crucible materials, 301, 315, and 357, were retested with this glass to further study the cloudy effect in the 301 and 315 samples. In the second test, the temperature was reduced to 1350°C for 72 hours in air. The results can be seen below.

Refractory crucible of Material 315 after being heated at 1350°C for 72 hours with glass from Precious.    Refractory crucible of Material 301 after being heated at 1350°C for 72 hours with glass from Precious.    Refractory crucible of Material 357 after being heated at 1350°C for 72 hours with glass from Precious.

The cloudy appearance remained in the 315 and 301 samples, but was significantly reduced. Samples of the glass were taken to the Missouri University of Science and Technology, where the crystalline substance in the glass was analyzed using X-Ray Diffraction (XRD). It was determined that the resulting substance was lead-oxide.

The standard cup test performed by Bucher Emhart Glass consists of heated in the crucible to a high temperature for a long period of time, and then cooling the glass slowly. This slow cool helps to anneal the glass, releasing any residual stress which makes it safer when sectioning the crucibles for analysis. When the samples were heated to 1450°C, it caused lead, previously dissolved in the glass, to precipitate. The slow cooling cycle allowed the lead precipitate to crystallize and grow, providing the glass with the cloudy appearance. When the glass was tested at 1350°C, precipitation again occurred, but at a significantly reduced rate. The reduced temperature also resulted in a shorter cooling time, giving those precipitates less time to grow.

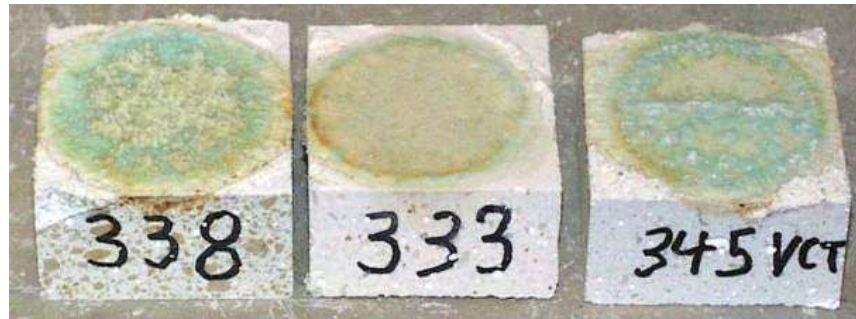
The 357 sample did not display any of the lead precipitation. This may be due to the nature of the crucible used. The silica in the crucible most likely changed the chemistry of the glass enough to stabilize the lead and prevent the precipitation that was seen in the other samples.

9 December 2013

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# Alkali Vapor Attack

- ◆ Glass vapors contain large amounts corrosive of alkali's
  - ◆ Sodium
  - ◆ Potassium
- ◆ Hot vapors come in contact with the refractory  
→chemical reactions that lead to blisters, spalling, or pitting →thus shortening the life of the refractory
- ◆ Covers and roof blocks must be made of materials capable of resisting this corrosion



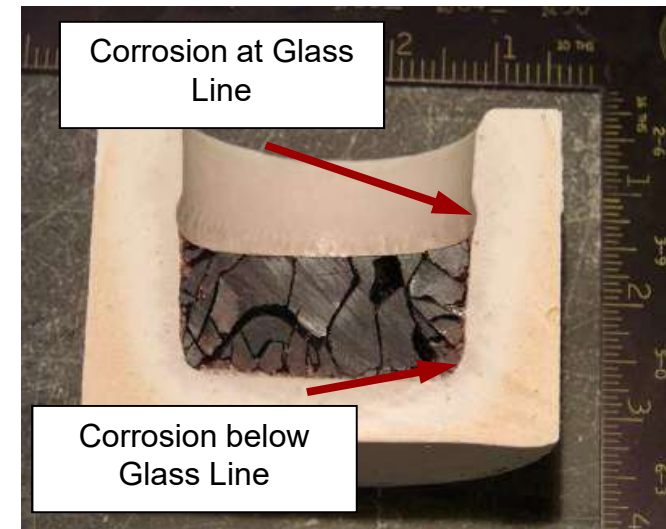
# Thermal Shock

- ◆ Material is heated or cooled too quickly  
→ crack and fail
- ◆ Some materials are more susceptible to thermal shock than others
- ◆ Thermal Shock must be considered when conducting:
  - ◆ hot repairs
  - ◆ feeder replacements
  - ◆ start-ups
  - ◆ shut-downs



# Static Glass Corrosion

- ◆ Molten glass is a highly corrosive
- ◆ Tests are conducted to determine the effectiveness of materials
- ◆ Typical applications are channels and spouts
- ◆ Glass can attack the refractory in 2 ways:
  - ◆ Corrosion at the Melt Line
  - ◆ Corrosion below the Melt Line
- ◆ Corrosion at the Melt Line is due to the interaction of glass, refractory and air
- ◆ Corrosion below the Melt Line is due to diffusion of components from the glass into the refractory, potentially changing the material and its properties



# Dynamic Glass Corrosion

- Stirrers and tubes wear differently because they are constantly rotated while in service
- The motion of the parts can significantly alter the rate of wear
- Up to 3 samples can be tested simultaneously in the same glass
- The degree of erosion is measured in order to identify the best available material for the system



# Slip cast vs. Chem cast - Technology comparison

## Slip cast

Binder:	refractory clay
Mold:	plaster
Drying method:	50 oC 72 – 200 hours
Firing:	1.500 oC
Grinding:	standard
Surface quality:	rough
Internal structure:	mullite binding
Production time:	slow

## Chem cast

Binder:	colloid silica / low cement
Mold:	wood, resin, aluminium
Drying method:	no required
Firing:	1.500 oC
Grinding:	standard
Surface quality:	smooth
Internal structure:	mullite binding
Production time:	fast

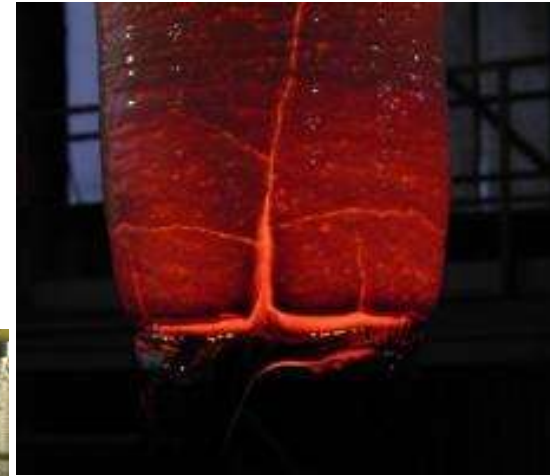


# Thermal Shock Resistant Tubes

- ◆ In 2017, some customers reported that they have been unable to install Bucher Emhart Glass tubes without cracking.
- ◆ Three mixes are currently being developed to address this issue
  - ◆ E89 succesful field trials; successful trials in the EGRC and at Vetropack Moravia

*Average lifetime of a metering tube is 3-4 months, we reached 8 months at Vetropack in 2018.*

- ◆ E91 limited field trials; awaiting reports
  - ◆ E94 planed trials; awaiting mold delivery Q3, 2016
    - ◆ E89 and E91 have continuing development of application properties
    - ◆ E94 has continuing manufacturability development
- ◆ New mix development with special environmentally friendly binding system
  - ◆ Received specialized vendor training, pilot scale samples produced



# Kiln modernization – No 7.

- ◆ Fiber Roof
- ◆ Open Front
- ◆ Quicker Loading
- ◆ Better Handling of Parts
- ◆ Less downtime for Repairs
- ◆ Longer life



## Kiln modernization – No 5.



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