An often overlooked media: Refractory spout insulation

This article by Roger Smith* and Andrew Purvis** focuses on an all-too-often underestimated area of the glass conditioning process - the insulation of the refractory spout bowl - and discusses the properties of the available materials.

In glass container plants the world over, heat and energy conservation are second only to glass quality. As such, glass manufacturers make every effort to find the most cost-effective means of insulating their furnaces, distributors, forehearts, and feeders without compromising the glass.

In the case of the feeder, one of the greatest areas of opportunity is the spout, or feeder bowl. This is the last step in the glass conditioning process, making this the last material the glass touches before becoming a container. Over the years, the importance of this area has been taken for granted. This article focuses on the properties of the insulation materials used respectively.

**Considering materials**

The back-up insulation in a spout serves multiple functions. It insulates the spout, conserving heat. It supports the spout refractory and protects it from thermal shock when it is first installed. If the spout refractory were to produce a crack, the back-up layer is the next material the glass will come into contact with, so it should have some resistance to molten glass. Due to these functions, there are several factors to consider when choosing an insulation package for a spout, such as insulation value, strength, resistance to molten glass, ease of installation and removal, and cost.

**Microporous panels**

One of the best materials currently available in terms of insulation value are microporous panels. They are available from multiple suppliers and offer some of the lowest thermal conductivity coefficients achievable. However, microporous panels are quite expensive, and filling the entire cavity with these panels is cost prohibitive. Thus, a common practice has become to use one or two layers of panels directly against the steel casing, with a second form of a less expensive insulation between the panels and the refractory.

**Material options**

There are three materials commonly used to fill the remainder of the cavity: Chopped fibre insulation, diatomaceous earth and insulating castable.

Chopped fibre insulation is generally the easiest of the three to install and remove. The cotton-like material is placed underneath the spout so that it is loosely packed to maximise its insulation value. Unfortunately, the loosely packed insulation provides very little support for the refractory, and should the refractory develop a crack the chopped fibre will quickly be dissolved by the molten glass, allowing the steel casing to fill.

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Diatomaceous earth has long been the standard throughout the world for spout insulation. It is a dry granular material that must be densely packed into the cavity between the refractory and the steel.

It is the most difficult to install, because the process is time-consuming and great care must be taken to ensure that no voids remain underneath the spout. Voids leave the spout unsupported and uninsulated, often leading to cracks in the refractory. Diatomaceous earth does not tend to be very effective against molten glass, although it does fare better than chopped fibres.

Castable insulation is a relatively new material for this application. Emhart Glass has worked to develop a castable specifically designed for spout insulation that addresses the shortcomings of both chopped fibres and diatomaceous earth, named EmCast 25.

**Castable solution**

It is combined with water at a ratio of 1:1 by weight, and poured into the cavity between the spout and the insulation panels. The consistency of the material is such that it will flow underneath the spout to ensure that the cavity is completely filled.

The castable must be allowed to set, or harden, before moving forward with the spout installation. This generally takes between one and two hours.

EmCast 25 provides a better insulation value than either chopped fibres or diatomaceous earth. It has enough strength to properly support the spout, yet is still weak enough to allow the material to be easily removed when the spout refractory must be replaced.

**Resistance**

The product has also been designed to resist molten glass in the event of a crack in the refractory. In the event that molten glass does come in contact with the castable, components in the castable combine with the glass to raise the melting temperature, effectively freezing off the glass.

**Comparing heat loss**

By calculating the steady state heat flow, the amount of heat loss for the various forms of insulation can be compared (see figs 2 – 4). Thermal conductivity values for each of the materials was measured by ASTM Test Method C-1113, Thermal Conductivity by Hot Wire, and the case temperature reported in fig 3 for EmCast 25 was verified to be within 30°C of actual measurements.

The difference in heat loss between EmCast 25 and chopped fibre insulation was calculated to be approximately 450 – 500°C, depending on the size of the cavity. As a result, EmCast 25 keeps more heat inside the spout than either chopped fibre or diatomaceous earth.

**Summary**

The method of spout insulation is an important decision when operating a glass container plant. It can greatly affect the efficiency of the feeder, in regards to heat and energy, as well as manpower and downtime.

There are methods that have been used effectively for decades, while new methods have been developed to ease the installation without sacrificing other properties. It is important to consider all factors when choosing the insulation package that best suits the needs of the plant, and not to underestimate the importance of the insulation.

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