

An Innovative Ceramic Based Flexible Chimney Flue Liner

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Abstract. The aim of the project is to design and develop an innovative ceramic based flexible chimney flue liner that will be capable of reducing the risk of fire and easy to install while withstanding the higher flue gas temperatures produced by today's highly efficient stoves.

Keywords: chimney flue liner, ceramic, textile, flue gas, corrosion resistance

1. Introduction

Modern enclosure solid fuel stoves and appliances are designed to operate at high level of efficiency and produce flue gas temperatures of around 600oC. Installing such with a conventional chimney liner can result in increased heat transfer in to the brick wall and as a result elevating the temperature of timber/thatch to ignition conditions. This was the cause of a high number of domestic fires over the last three years.

Identifying an opportunity to develop an intelligent combustion management system for these buildings, and the potential to exploit the £700m chimney liner industry, the consortium has developed an intelligent system, which can be used in domestic solid fuel heating systems as well as the commercial market.

In this research, we report a novel flexible ceramic-cement chimney-flue-liner that is easy to install and provides corrosion resistance backed by insulation and delivery with a high tenacity textile. A computational fluid-thermodynamics (CFD) analysis was carried out to assess the performance of the proposed flue liner design. The first set of computations was carried out to investigate the thermal behaviour in a radial direction whereas the rest of the computations were aimed towards analysing the flow of emissions through a typical flue liner - chimney configuration.

2. Materials and Methods

The proposed flue liner is composed of four layers. As shown in figure 1(a), the innermost layer is made of a ceramic material and a three dimensional textile. For the purpose of computational analysis carried out here, the ceramic material was considered to be made of ceramic. The ceramic layer is enclosed by a three-dimensional textile made of Glass fibres. Next to the textile layer is the backing insulation. The fourth layer is a textile braid of which the main purpose will be to maintain the composure of the flue liner. Thermal effects of having a textile braid are not considered in the computational study due to its small thickness.

3. Results and Discussion

The liner delivers the following:

- Corrosion resistant lining – abrasion resistant surface (for sweeping) that will contain flue gases at elevated temperatures and in a highly corrosive environment.
- Highly insulating liner – minimise heat transfer to the chimney and surrounding structures.
- Flexible circular liner construction – deliver uniform insulation (no seam or 'weak point' for heat to be conducted through) and introduce easy installation.

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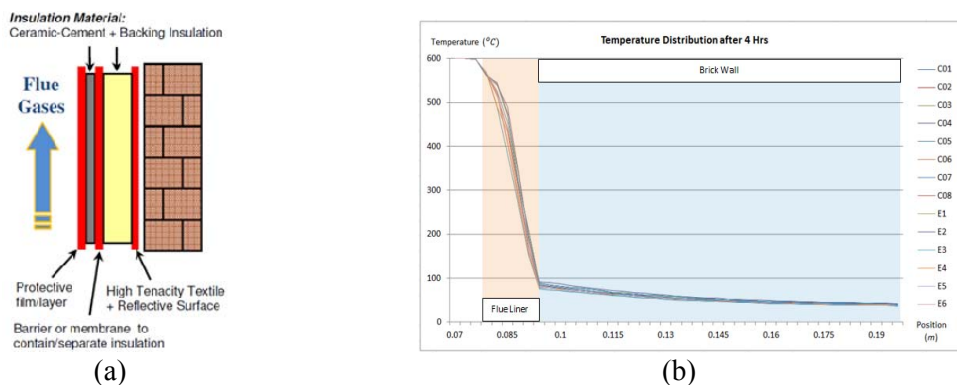


Fig. 1: (a) Cross-Section of the Flue Liner, (b) Thermal Performance of the Flue-liner

The results of this CFD study demonstrate (figure 1b) that the proposed flue liner design perform as a thermal barrier to a high enough degree and maintains the chimney wall temperature below 150 °C under industry standard testing conditions and under standard operating conditions. Also presented within this piece of work are the effects on temperature when thicknesses of the tri-layer combination were altered [1, 2 and 3].

4. Conclusion

This project will combine the ease of installation of a flexible metal liner with the high temperature operation and corrosion resistance of ceramic-clay pumice materials. There are no flexible ceramic liners for chimneys currently in the market and this liner will be a first. Advantages in technical textile manufacturing will be used to deliver a seamless circular liner which will deliver a ceramic inner lining backed by an insulation lining and an outer protective skin for delivery of the liner. The liner will be spooled for ease of transport/storage and its flexibility will enable quick and easy installation, minimizing the impact on the home owner/occupants.

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