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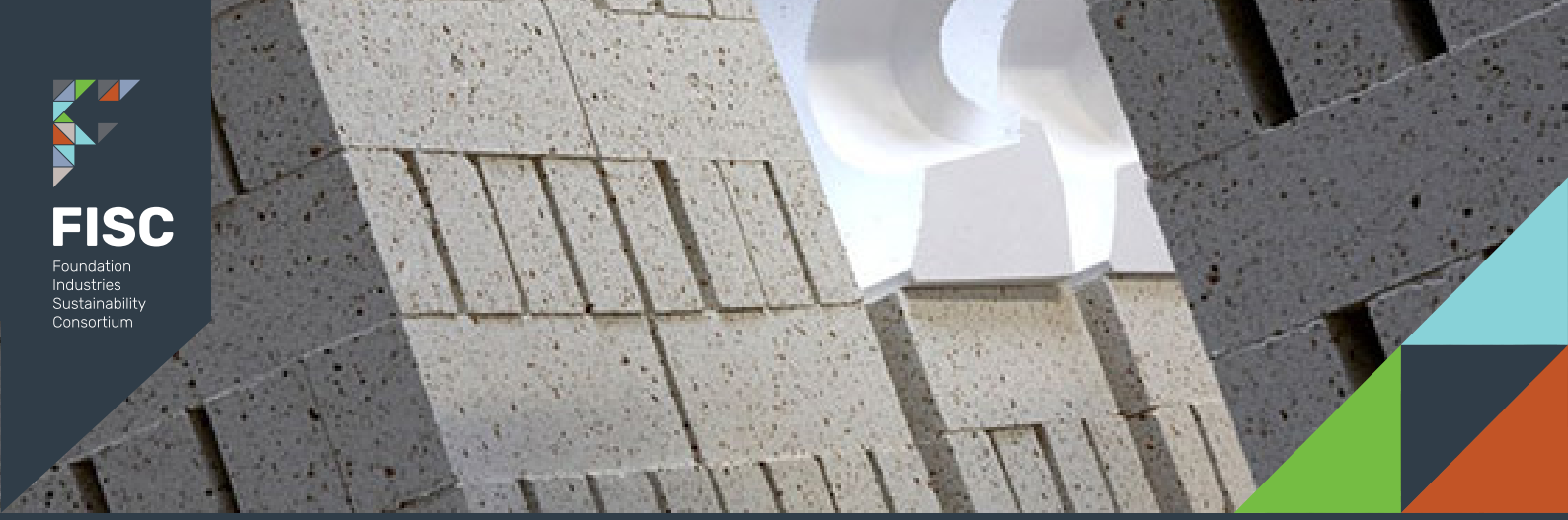
Foundation Industries Sustainability Consortium



ECONOMISER CASE STUDY

Thermodynamic modelling of vapour phase corrosion of refractories in hydrogen and hybrid furnaces with DSF Refractories & Minerals Ltd

Keywords: Process Optimisation | Glass Furnaces | Hydrogen | Refractories

BACKGROUND

In an effort to reduce carbon emissions and contribute to meeting net-zero targets, a possible route for decarbonising glass melting furnaces is by using hydrogen as fuel for the combustion process.

Switching from natural gas to hydrogen results in a big change of the combustion atmosphere. This is particularly true in oxy-hydrogen combustion atmospheres where the water vapour concentration will rise to very high values. The concentration of chemically aggressive vapour phases like alkali-hydroxides and alkali-borates, evaporating from glass melts, will also increase considerably. These vapours may react with refractory blocks in the glass furnace.

Thermodynamic modelling provides a tool to study the chemical interactions involved, including the evaporation of volatile components from the glass melt and the vapour phase corrosion of refractory materials.

As we navigate towards net-zero, carbon emissions and the technological demands to meet such targets, The ability to create a digital twin of a manufacturing process has never been more important.

ABOUT DSF REFRACTORIES & MINERALS LTD

DSF are specialists in refractory production, producing high alumina and special refractories. They are specialist suppliers to the Glass Industry and have a wide range of products used in most heat containment industries including Petrochemical production, Carbon Black, Steel, Lime kilns and many other specialist applications.

ABOUT THE ECONOMISER PROJECT

Through the EconoMISER project, The Henry Royce Institute (Royce) was fundamental in facilitating access to thermochemical simulation software FactSage, via fellow FISC partner, the Materials Processing Institute (MPI).

Glass Futures, another FISC partner, provided an expert with knowledge in glass, whilst a senior researcher at MPI was brought onto the project as a thermodynamic modelling expert.

Thermodynamic modelling using FactSage software has proven to be a powerful tool in predicting corrosion of refractory materials in glass melting furnaces. With all experimental work being digital, the platform provides a rapid, low cost and green avenue for optimising process conditions.

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RESULTS

Thermodynamic modelling calculations were completed for glass melting furnaces with hydrogen combustion atmospheres. The high temperature evaporation from two typical glass melt compositions was studied: a typical soda lime silicate melt and a special borosilicate glass. The refractory types studied were selected in consultation with DSF. The results of these calculations inform guidelines to select suitable refractory types and to optimise furnace operating conditions for refractory suppliers and glass producers, respectively.

Results from this project have helped inform how different refractory materials will behave under hydrogen fuel conditions before any expensive physical trials are performed.

Visit **dsf.co.uk** to find out more about the company.

Visit **ukfisc.org** to find out more about the Foundation Industries Sustainability Consortium

Visit **royce.ac.uk** to find out more about equipment available to access through the Henry Royce Institute.

"The calculations succeeded in giving us the quantitative effect of oxy-hydrogen combustion on sodium borate vaporisation from the glass and the effect of this on existing and new lining compositions. We were very happy with the quality and speed of the work from Royce, enabling us to move on the practical testing of these materials."

Trevor Wilson
Area Sales Manager, DSF Refractories & Minerals Ltd

HENRY ROYCE INSTITUTE

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