Calumite is produced from a by-product, reducing the need to quarry raw materials and also counting towards the recycled content of glass containers.

Calumite, more than just a raw material

Liam Wray* highlights the benefits of using Calumite in the glass manufacturing process. It is increasingly being recognised for its environmental properties and the reduction of CO_2 emissions that can be achieved with its use.

Calumite offers more than the sum of its parts. In addition to being a valuable source of the major glass making oxides, it is a glassy material that offers similar benefits to cullet with the additional benefits of a refining agent. When used correctly in the batch, Calumite can offer many benefits:

Energy saving:

- Reduced energy consumption
- Increased furnace pull
- Reduced furnace temperatures

Glass quality:

- Reduction in seed and blister
- Improved redox control
- Colour stabilisation

An increasingly important factor in using Calumite is the reduction in CO_2 emissions that can be achieved. Both process and combustion CO_2 emissions are reduced, resulting in up to 700kg CO_2 saved per tonne of Calumite used. This will become ever more significant as the price of CO_2 rises and the industry drives towards net zero.

Further adding to its sustainability credentials, Calumite is produced from a by-product, reducing the need to quarry raw materials and also counting towards the recycled content of glass containers, as defined by the British Glass calculation for recycled content.

Material background

Calumite is manufactured from granulated blast furnace slag (GBS), a product of the iron making process. Calumite has been used as a raw material in glassmaking for more than 75 years, initially used as an alumina source, now valued for its impact on glass quality and environmental benefits.

The material originates inside the blast furnace where limestone and dolomite react with coke and iron ore to create slag. The slag contains lime, silica, alumina, magnesia and sulphides along a with small amount of other oxides. Although a by-product for ironmakers, these compounds are essential for glassmakers.The liquid slag is tapped from the furnace and solidified by rapid water jet quenching to form a glassy, sand like material.

Calumite is used in all types of soda-lime-silica glass production and is used in all glass colours at between 1-4% (of dry sand weight) in extra clear flint and up to 30% in amber glass.

Typical Calumite Chemistry (%)	
CaO	39.5
Al_2O_3	12.0
SiO_2	36.5
MgO	8.5
Na_2O	0.2
K2O	0.6
St (Total Sulphur)	0.85
S^{2-} (Sulphide)	0.83
Fe_2O3	0.30
C	0.02
Redox	-0.075

Table 1. Typical Calumite chemistry.

Energy saving

Calumite leads to faster melting within the glass batch as CaO, SiO_2, Al_2O_3 and MgO are added as a glassy phase. See ***table 1*** for the full chemistry specification. As a result, the energy required to melt the batch whilst maintaining existing temperatures is lower.

The benefits of Calumite can be seen through the results of a trial in a green

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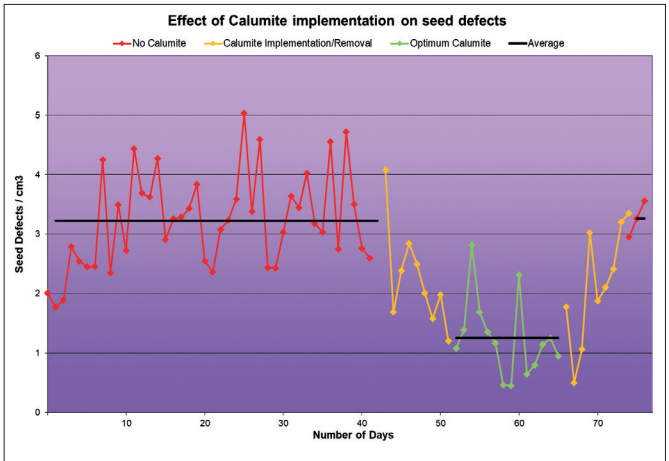
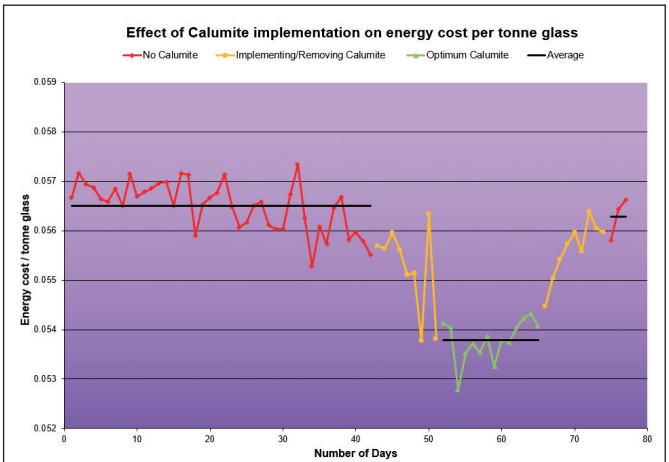


▲ Fig 1. Reduction in energy cost during a trial of 13% Calumite in a green container furnace.



▲ Fig 2. Reduction in Seed defects during a trial of 13% Calumite in a green container furnace.

Price CO_2 (GBP / t)	Savings per tonne of Calumite used, GBP		
	Process CO_2	Combustion CO_2	Total
£16.00	£6.40	£4.80	£11.20
£27.00	£10.80	£8.10	£18.90
£50.00	£20.00	£15.00	£35.00

▲ Table 2. CO_2 saving per tonne of Calumite used (£).

container furnace where Calumite was added at 13% of the dry sand weight. In this trial the addition of Calumite had an immediate visual impact with the batch logs being more active. The batch line retreated, which allowed the crown temperatures and fuel set point to be reduced. In addition, the faster melting with Calumite meant that the furnace bottom temperatures increased, allowing a reduction in electric boost and saving of more than 25% electrical energy.

Overall, this led to a 5% reduction in energy cost through using Calumite (***Fig 1***).

The faster melting with Calumite can be exploited in different ways depending on the specific requirements of the glassmaker:

- Furnace pull - Furnace productivity can be increased without increasing temperatures or affecting glass quality, by up to 5% depending on the percentage of Calumite used.
- Furnace temperatures can be reduced during an emergency or towards the end of the furnace life, trials show reductions of up to 40oc with only 4% of Calumite used.
- Energy consumption – faster melting allows for energy to be reduced. Savings are typically between 0.25 and 0.36% energy saving per 1% Calumite addition.

CO_2 reduction

An increasingly significant benefit of Calumite is the impact on CO_2 emissions. Calumite provides CaO and MgO to the glass without the evolution of CO_2, which leads to substantial reductions in process CO_2 emissions due to the reduction in limestone and dolomite usage. The amount of limestone and dolomite required to provide the same CaO and MgO as 1 tonne of Calumite leads to savings of 400kg CO_2 per tonne of Calumite. In amber glass this equates to up to a 25% saving in process CO_2emissions.

In addition, combustion CO_2 can also be saved due to lower gas consumption. Depending on furnace operations this can be between 200-300kg of CO_2 per tonne of Calumite used.

So overall, up to 700kg CO_2 is saved for each tonne of Calumite used in the batch. With the current price of CO_2 this equates to saving of £19 for each tonne of Calumite used, but as the price of CO_2 increases, so the value of Calumite increases to the glassmaker.

Glass quality

Despite its clear benefits in terms of energy and the environment, Calumite is perhaps most valued by glassmakers for its impact on furnace stability and therefore glass quality.

Due to the low levels of sulphur as sulphide, Calumite works as a refining agent. It has a low and stable redox number, it is sized to be similar to other batch materials, so it is evenly mixed within the batch. This reduces the seed count (***fig 2***). As well as reductions in average seed count, the variability is also reduced. These reductions were seen during the same trial period as ***fig 1***, demonstrating how glass quality and energy saving can occur simultaneously.

Calumite is also particularly useful in the production of amber glasses. The presence of sulphide and iron in Calumite work together to form the amber chromophore that provides the amber colour, thereby improving amber colour control and colour stability in glasses containing the amber colour component, such as dead leaf green. The presence of sulphide also reduces the possibility of foaming or reboil as a result of excess sulphate.

Summary

Use of Calumite offers many benefits to the glassmaker due to its glassy nature and chemical composition. Calumite has been supplied to the UK glass industry from our plant in Scunthorpe for more than 50 years and from Ostrava in the Czech Republic in excess of 20 years. Calumite is also shipped overseas with current customers operating in Africa and the Middle East. ■

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