



# Ground Granulated Blast Furnace Slag (GGBS)

---

Ground Granulated Blast Furnace Slag (GGBS) from LKAB Minerals is a partial cement replacement which is manufactured from a by-product of the iron and steel industry.

# What is GGBS?



## Production efficiency

GGBS is able to replace more than 70% of the Portland cement in a concrete mix, significantly improving the environmental credentials of a mix, without compromising quality.

According to the Institution of Structural Engineers, the embodied carbon of a ready-mixed concrete containing 50% GGBS now typically contains 450 kg CO<sub>2</sub>e/tonne\*.

## Grinding process

GGBS is manufactured by grinding Granulated Blast Furnace Slag (GBS), a by-product of the iron making industry. GBS is formed in the blast furnace which has an operating temperature more than 1500°C.

A chemical reaction takes place between the three constituents of coke, iron ore and limestone to form iron. The iron sinks to the bottom of the furnace and a molten crust forms on top, called iron slag.

Once removed from the furnace, the slag is “quenched” to below 800°C by jetting it with cold water, forming granulated blast furnace slag (GBS), a glassy, sand-like material.

By drying and carefully milling the GBS through our grinding plant in Scunthorpe, we produce the off-white powder of Scunthorpe GGBS.

\*[https://www.istructe.org/IStructE/media/Public/Resources/ARUP-Embodied-carbon-concrete\\_1.pdf](https://www.istructe.org/IStructE/media/Public/Resources/ARUP-Embodied-carbon-concrete_1.pdf)

## Typical chemical composition of LKAB Minerals GGBS

SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub> *	Fe <sub>2</sub> O <sub>3</sub>	CaO	MnO	TiO <sub>2</sub>	S <sup>2-</sup>	SO <sub>3</sub>	Cl
37.5	12.8	0.4	39.67	0.36	0.80	0.91	0.11	0.03

## Typical physical characteristics of LKAB Minerals GGBS

Activity index		Glass count	Fineness	Initial setting	Relative	Bulk	Brightness
7 day	28 day	%	m <sup>2</sup> /kg	Time mins	Density g/cm <sup>3</sup>	Density Mg/m <sup>3</sup>	L* whiteness
70	92	90-100	470-540	190-250	2.9	1.050	80-90%

\*LKAB Minerals GGBS Alumina content does not exceed 14% qualifying it for use in +SR (Sulfate Resisting) with all CEM I cement combinations according to BS 8500-2

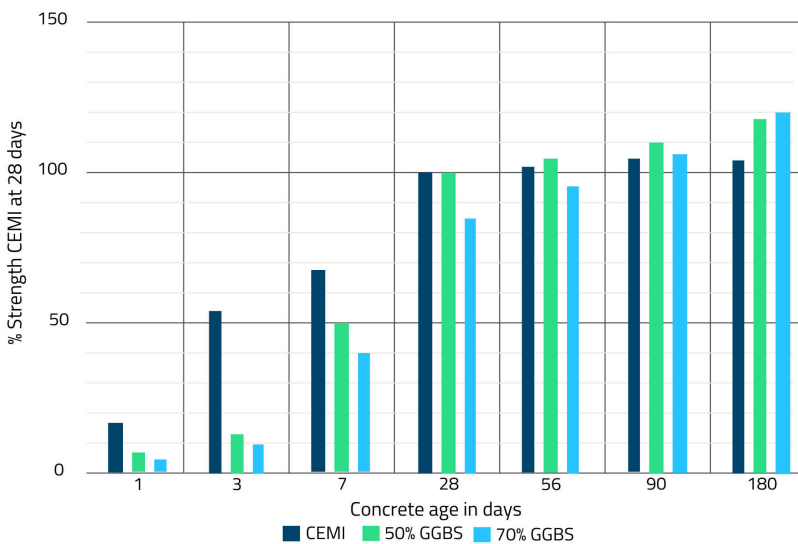
## Key features and benefits

The benefits of GGBS include its durability, sustainability and environmental credentials:

- Resistance to sulfate and chloride chemical attack when specified in accordance with BS 8500-1, helps to improve the lifetime of structures
- Reduces the potential damage caused by alkali-silica reaction
- Reduced heat of hydration (reducing the risk of thermal cracking)
- Extended setting time allows for larger pours and reduced risk of cold joints in warmer weather
- Strength gain is continued over longer periods of time, giving higher ultimate strengths
- Better workability helping concrete placement
- GGBS is produced from a by-product which might otherwise end up as landfill and avoids the quarrying of virgin material or mineral extraction



## Concrete age in days



Graph 1 - Comparative strengths of CEM I 50% and 70% GGBS Concretes

### Cement Combination Designation (Table 1 BS 8500-2)

BS 8500-2 Designation	GGBS Proportion %	
CII/A-S	6	20
CIIA (With PLC)	*	
CII/B-S	21	35
CIII/A+SR	36	65
CIII/B+SR	66	80

\*Depends on Limestone content in Cement

### Using GGBS as a cement replacement

GGBS is sold by LKAB Minerals as a separate product but can be added to concrete in the manufacturer's batching plant along with CEM I, aggregates, water and admixtures. GGBS directly replaces the CEM I by weight, although due to the slower strength gain, total powder contents may need to be increased with higher addition levels if 28-day strengths are the requirement. Typically, 40% - 50% CEM I replacement is used in most readymix applications, although can be higher.

## Find out more

Discover more about GGBS by calling +44 (0) 7475782513 or visiting [www.lkabminerals.com](http://www.lkabminerals.com)

## About LKAB Minerals

---

LKAB Minerals is an international industrial minerals group with a leading position in a number of product applications. We develop sustainable mineral solutions in partnership with our customers, supplying natural minerals engineered for functionality and usability. LKAB Minerals is part of the Swedish company LKAB, one of the world's leading producers of highly upgraded iron ore products and other related mining services and products.

### Value driven

We are proud and passionate about what we do – this is reflected in our values Committed, Innovative and Responsible.

Learn more at [lkabminerals.com](https://lkabminerals.com)