products

Slag

Ground granulated blast furnace slag (GGBS)

GGBS is primarily a latent hydraulic binder used as a type 2 addition to cement which produces Portland blastfurnace cement (6-35% of GGBS) or blastfurnace cement (36-90% GGBS) which is produced primarily by blending at the concrete mixer but can also be used to produce factory blends generally at the cement factory. When produced at the concrete plant mixer these cements will have the designation CII or CIII, and when produced as a cement factory blend they have the designation CEM II or CEM III.

Production

GGBS is produced by grinding Granulated Blastfurnace Slag to a controlled fineness.

There are a number of different methods of grinding granulated blastfurnace slag. Traditionally, standard ball mills have been used, but since the early 2000s the use of roller presses and vertical mills has increased.

Granulated blastfurnace slag is a very hard material and as a result necessitates the use of high wear resistant materials in the grinding process. The grinding process takes account of mean particle size, grading (particle size distribution), fineness and the particle shape in order to ensure that when used in concrete performance is maximised.

Typically GGBS possesses a specific surface area of 450-550 m2/kg.

Applications

- Ready mixed concrete.
- Precast concrete
- Mortar
- Grout
- Hydraulic bound mixtures
- Cut-off walls
- Tile adhesive
- Plaster
- Nuclear waste encapsulation

Application	Description
Chloride environment (Sea water or de-icing salts)	GGBS concrete is significantly less permeable to aggressive elements such as chlorides than comparable CEM I concrete it also has significant capacity to complex and bind any chloride that are present
Aggressive ground	GGBS at the appropriate addition level, is suitable for every designed chemical class of aggressive ground and is the only cement type suitable for DC-4m where the Thaumasite form of attack is a risk
Alkali reactions	GGBS is internationally recognised as being effective in reducing the risk of alkali silica (ASR) reactions. No cases of ASR have occurred in concrete containing suitable proportions of ggbs and that high addition rates in excess of 50% are effective controlling expansion with reactive aggregates
Thick sections	GGBS reactions rates are slower and produce different proportions of hydration products which evolve less heat than CEM I. As such it is very effective for reducing the risk of thermal cracking in thick sections such as foundations
Colour	GGBS is off white and as a result produces a much lighter coloured concrete

GGBS is covered by European Standard BS EN 15167.

For case studies applicable to the use of slag aggregates refer to:
http://www.mineralproducts.org/prod_agg01.htm

Case Studies

Type: Cement Replacement

GGBS concrete has been used in many high profile structures including:

- Humber bridge North Lincolnshire
- Queen Elizabeth II Bridge, Dartford
- Second Severn Crossing
- Tsing Ma Suspension bridge Hon Kong (Supplied from Scunthorpe)
- Manchester Airport Second Runway

For more information on aggregates, please contact (info@mineralproducts.org) or phone us on 020 7963 8000

product details

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- Many motorways and major trunk roads From the M8 M74 in Glasgow, Al-MI link in the midlands and the A34 at Newbury
- Channel Tunnel Rail Link
- Cross rail projects
- Nuclear projects at Sellafield and the next generating plant at Hinkley
- Norfolk and Norwich Hospital
- The Millennium Seed Bank, Royal Botanic Gardens, Wakehurst

And many, many more. Indeed approximately 15 million cubic metres of ggbs concrete are produced each year.

For further information go to the Cementitious slag makers association at http://www.ukcsma.co.uk/index.html

Contact: Mike Connell, mike@mikeconnell.org.uk

Case Studies

British Nuclear Fuels BNFL Selafield, formerly Seascale

Over the past 35 years numerous major structures have been constructed on this site using typically 70% GGBS replacement. The first structure being pond 5 used for cooling fuel rods prior to reprocessing this structure continue in service. Over the last 15 years 70% GGBS replacement has been the preferred option used construct the series of encapsulation plants and storage facilities as well as other structures. 70% GGBS was the cement type was used to meet the stringent temperature rise criteria specified for these structures.

Queen Elizabeth II Bridge M25 London

C70 concrete mixes for piles, foundation and bridge segments, CEM I and 70% GGBS mixes All pylons and approach columns cast with 70% GGBS using stepforming. (durability DC 3/4 ground conditions, colour, control of heat of hydration)

GGBS volume 40,000m3

Bridge project: Crossing point for the M25 motorway, over the Thames at Thurrock

Start/finish dates: 1988/1991

Bridge type: Cable-stayed

Length: 812m (305m main span)

Structure:137m concrete pylons, CFA piles, cages, hollow column stems

Production: In situ concrete pour in cassions and underwater in coffer dams

2nd Severn Crossing

All concrete designs included CEM I and between 20% and 70% Regen (GGBS) depending on the element (durability, control of heat of hydration and colour) C70 concrete mixes for piles, foundation and bridge segments (6500 ton ship at 20 knots)

Regen (GGBS) volume 60,000m3

Bridge project: Crossing point for the M4 motorway, over the Severn Estuary

Start/finish dates: 1992/1996

Bridge type: Cable-stayed

Length: 5km (456m main span)

Structure: 150m concrete pylons, precast cross beams, composite deck and twin box girder viaduct

Main Contractor: Laing-GTM

Channel Tunnel Rail Link CTRL 250

Mix Design incorporating Regen (GGBS) to reduce micro-cracking and to better prevent the diffusion of chlorides and other aggressive agents.

Hanson UK was involved in the manufacture of the tunnel lining segments for CTRL 250 in 2002, producing over 80,000m3 of concrete.

For more information contact Martin Bridges