GGBS

A Truly Green and Low Carbon Cement –Complying with SS EN 15167:2008

EnGro's VCEM GGBS production complies with SS EN 15167: 2008 (BS EN 15167: 2006). Class 1A certificate was awarded to VCEM plant in China by TÜV SÜD PSB. *(Kindly refer to the certificate shown below)*

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

TÜV SÜD PSB Singapore

CERTIFICATE OF CONFORMITY

Product Listing Scheme* : Class 1A

This Certificate is issued to
EnGro Corporation Limited
29 International Business Park
#08-05/06 Acer Building Tower B
Singapore 609923

FOR

Product: Ground granulated blast furnace slag (GGBS)

Brand: VCEM

Model: -

Country of Origin: China

Product Details: Ground granulated blast furnace slag for use in concrete, mortar and grout

which has complied with the requirements of the scheme and based on the following:

Standard(s)	Test Report(s)
SS EN 15167-2:2008	7191000124-MEC11/01A-DLM, 7191000124-MEC11/01B-DLM, 7191000124-CHM11-LSM-CR1

Vice-President (Certification Department)
TÜV SÜD PSB

Certificate No:	Date of Original Issue:	Date of Last Revision:	Date of Expiry:
012132	19/06/2009	09/04/2012	18/06/2015

* All products listed under Class 1A/1B must have this mark affixed / printed on them. Failure to comply with this requirement may result in revocation of this certificate.

This Certificate is part of a full report and should be read in conjunction with it. This Certificate remains the property of TÜV SÜD PSB Pte Ltd and shall be returned upon request. The use of this Certificate is subjected to the terms and conditions of the Product Listing Scheme. The manufacturer is solely responsible for compliance of any product that has the same designation as the product type-tested. Persons relying on this Certificate should verify its validity by checking TÜV SÜD PSB's website at www.tuv-sud-psb.com.

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PSB 12307/12

In addition, the high quality raw slag supply from the steel mills ensures that VCEM GGBS has more stable chemical constituents as compared to other mineral additives, such as fly ash and silica fume.

Proven Track Record:

GGBS has been reliably in used for more than 100 years. In 1865, GGBS was firstly used in Germany. In France, GGBS was used in the construction of Paris Metro as early as 1889. VCEM GGBS has more than 100 reference projects in both Singapore and overseas.

Featured Projects:

Singapore

- Marina Coastal Expressway (MCE) (ongoing)
- 8 @ Woodleigh (Condominium) (ongoing)
- Gardens by the Bay (2012)
- CDL: The Livia (2011)
- Oversea Union House (2011)
- Pasir Panjang Wharf Terminal (2007-2009)
- Marina Bay Sands Integrated Resort (2007-2008)
- Deep Tunnel Sewerage System (DTSS) (2003-2005)
- JTC Summit (1998)
- Tuas Undersea cable Tunnel (1996-1998)
- MOE building (1996)
- Suntec City (1995)

Overseas

- Beijing-Shanghai High-Speed Railway (China) (2008-2011)
- Jinan Yanshan Flyover Bridge (China) (2005)
- The Rantambe Dam (Sri Lanka) (1987)

Test Results (typical):

Test Items		SS EN 15167-1: 2008 Requirements	PSB Test Results
Fineness (m^2/kg)		≥275	436
Initial Setting Time (Minutes)		Not more than twice as long as setting time of test cement on its own	130
Activity Index (%)	7 days	>45	80.2
	28 days	>70	98.2
Magnesium Oxide as MgO, %		Max. 18	10.9
sulphate as SO_3,	%	Max. 2.5	1.3
Sulphide as S,	%	Max. 2.0	1.0
Loss On Ignition,	%	Max. 3.0	0.18
Chloride as Cl^-,	%	Max. 0.10	0.01
Moisture Content,	%	Max. 1.0	0.13
$CaO+MgO+SiO_2$	%	Min. 67	83.5
$(CaO+MgO)/SiO_2$	%	Min. 1.0	1.37

Note: Test results were provided by TÜV SÜD PSB Lab.

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GGBS

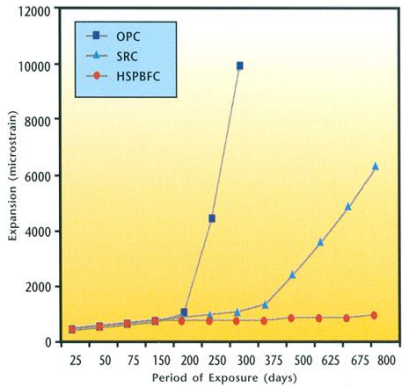
A Truly Green and Low Carbon Cement –Complying with SS EN 15167:2008

EnGro's ground granulated blast furnace slag (GGBS) under the **"VCEM"** brand name is a pioneer and leading brand which has established itself as a superior cementitious material that can be used as partial substitute of conventional cement for producing high performance concrete. Presently, GGBS associate plants in China and Korea have a combined annual GGBS production capacity of 7.1 million tons and would rise to 9.5 million tons by 2013.

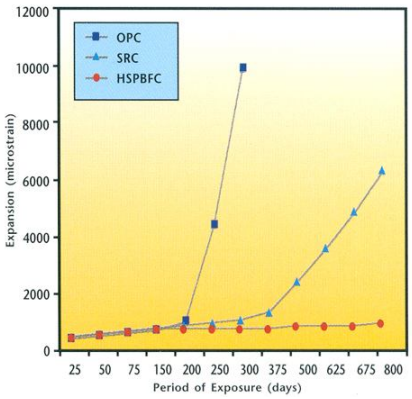
The raw material for GGBS is obtained by quenching molten iron blast furnace slag (a by-product of steel making) in water or stream. Subsequently, GBS is dried and then ground into the desired fineness. VCEM GGBS has the same chemical constituents as Portland cement, only with slightly difference in proportion. The main hydration product of GGBS is the same as Portland cement, that is, *calcium-silica-hydrate*, which is the major chemical compound providing strength in hardened cement concrete.

Benefits:

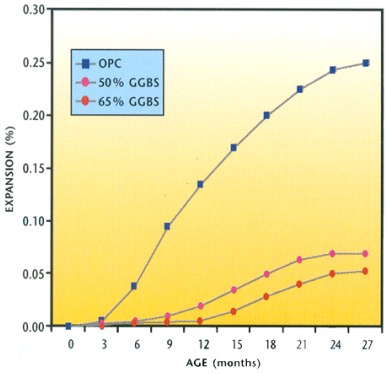
Reduce Thermal Cracking



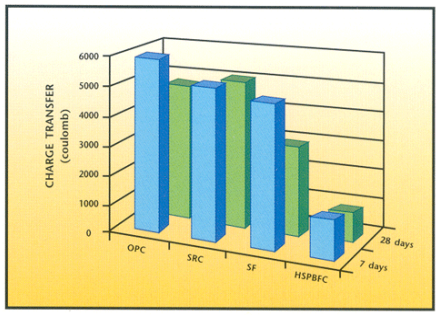
Resistance to Sulfate Attack



Resistance to Alkali-Silica Reaction

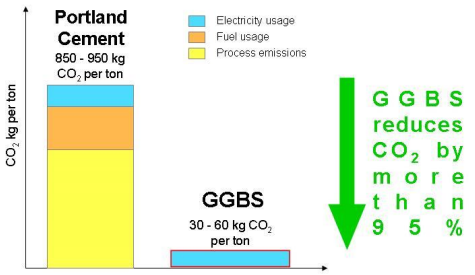


Resistance to Chloride Attack



OPC: Ordinary Portland Cement.
HSPBFC: High Slag Blast Furnace Cement containing 65% GGBS.
SRC: Sulfate Resistance Cement.
SF: Silica Fume.

Reduce Carbon Footprint



Consistent Quality

VCEM is produced by sourcing the high activity index raw slag from steel mills and it is then carefully ground using our state-of-the-art vertical mill. This results in a superior product in terms of its consistent fineness with well-graded particle size distribution and high hydration reactivity requiring less water demand for standard consistency.

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Identification Number: 022 003
Eco Friendly Building Material
Recycled Content: 95-100%
Carbon Emission Value: 60 kg/ton