JSW GGBS

Ground Granulated Blast Furnace Slag by

JSW Cement Ltd confirming to IS 16714:2018

Technical Data Sheet

What is GGBS?

Ground Granulated Blast Furnace Slag (GGBS) from JSW Cement Limited is a cementitious material used to partially replace Ordinary Portland Cement (OPC) for various Concrete, Masonary, Cement based product manufacturing and Other purposes.

Manufacturing of GGBS

Ground granulated blast furnace slag (GGBS) is a by-product from the blast-furnaces used to make iron. Blast-furnaces are fed with a controlled mixture of iron-ore, coke and limestone, and operated at a temperature of about 1,500°C. When iron-ore, coke and limestone melt in the blast furnace, two products are produced ie molten iron and molten slag. The molten slag is lighter and floats on the top of the molten iron. The molten slag comprises mostly silicates and alumina from the original iron ore, combined with some oxides from the limestone. The process of granulating the slag involves cooling of molten slag through high-pressure water jets. This rapidly quenches the slag and forms granular particles generally not bigger than 5 mm. The rapid cooling prevents the formation of larger crystals, and the resulting granular material comprises around 95% non-crystalline calcium-alumino silicates. The granulated slag is further processed by drying and then grinding in a vertical roller mill or Ball press mills to a very fine powder, which is GGBS.

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Typical Physical & Chemical Composition for GGBS by JSW Cement Ltd

GOI %	CaO %	SiO_2 %	Al_2O_3 %	Fe_2O_3 %	MgO %	MnO %	CL %	IR %	SO_3 %	Sulphide Sulphur %
-0.35	37.63	34.81	17.92	0.66	7.80	0.21	0.004	0.19	0.20	0.51

Fineness (M^2/kg)	Specific Gravity	Residue by wet basis on 45µ (%)	7 days Slag Activity Index	28 days Slag Activity Index	Glass Content
386	2.9	4.60%	71.32%	91.82%	96.85%

GGBS - A sustainable material for Green building construction

JSW GGBS is an ISO 14001- 2015 (Environmental Management System), ISO 9001-2015 (Quality Management System) certified company & CII Green Products and Services Council Certified Company.

- The raw material is a by-product which, if not processed, might end up as landfill, and the manufacturing of GGBS utilizes all of the slag and producing no waste. By utilizing a by-product, GGBS requires no quarrying of virgin material or mineral extraction.
- Replacing the Portland cement by GGBS helps in reducing CO_2 emissions and in conserving non –renewable resources of lime stone.
- The carbon footprint can be reduced in direct proportion to reduced clinker content by partial replacement of Portland cement with GGBS.
- Use of GGBS in concrete is recognized by LEED (Leadership in Energy and Environmental Design) and add points towards its certification.
- Solar reflectance of GGBS mixed Concrete: Concrete made with GGBS will have a high solar reflectance. Studies have shown increases of 20 percent in reflection of sunlight by concrete with GGBS. This will reduce the "heat island" effect in urban developments.

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Advantages of GGBS

- **Improved workability:** GGBS based concrete demonstrate improved workability and finish-ability when compared with 100% ordinary Portland cement concrete system due to its high fineness, as a result we can get segregation free and cohesive Mix.
- **Reduced heat of hydration:** Due to reduced heat of hydration, plastic shrinkage cracks can be minimized.
- **High compressive and flexural strength:** Concrete made with GGBS provides higher compressive and flexural strength compared with Ordinary Portland cement concrete due to additional calcium silicate hydrate(C-S-H) formation. Silicates in GGBS combine with the calcium hydroxide ($CaOH_2$), a byproduct of hydration and form C-S-H which enhances both compressive and flexural strength. Compared to concrete produced with only OPC, the GGBS blend produced concrete tend to have a higher tensile strength and elastic modulus for a given compressive strength.
- **Reduced permeability:** The inter connectivity of capillary pores will be discontinued and thus permeability will be reduced.
- **Resistance to alkali- silica reaction (ASR):** Use of GGBS will reduce the potential of ASR occurring by reducing the amount of alkali available in the system that is available for reaction with the aggregate.
- **Better Particle packing:** Concrete made with GGBS has better particle packing due to particle shape and improved hydration.
- **Excellent resistance to Sulphate attack:** GGBS does not contain C_3A, so its addition in concrete dilutes the total amount of C_3A and also reduces the permeability due to which the sulphates do not penetrate in to concrete.
- **Resistance to chloride attack:** Due to reduced permeability and increased densification the diffusion of chloride ions will be greatly minimized in the concrete containing GGBS.
- **Lighter in colour:** An Aesthetic appearance and low heat absorption due to its light colour.
- **Reduced life cycle cost:** Concrete produced by using GGBS can significantly improve the durability and extends the life of the structure and thus reduce the lifecycle cost of the structure.
- **Fire resistance:** Structures made with GGBS based concrete resist the high temperature than the structures made with Ordinary Portland cement.
- **Resistance to erosion:** Concrete made with GGBS demonstrated the resistance to erosion compared with Ordinary Portland slag cement. The Engineering Consultants and Designers from all over the world are recommending GGBS due to its superior engineering properties.

Applications of GGBS

- Commercial & Site based Captive RMC units for manufacturing of Concrete of Cast in Situ or Precast nature
  1. Roads, Bridges, Tunnels, Retaining walls and Other infrastructure works
  2. Dams, Canals, Concrete Pipes, Precast Tunnel Linings
  3. High Rise Residential and Commercial Construction with conventional and modern formwork. For all structural and non-structural concrete applications.
  4. Airport Taxi Ways and Other Terminal Structures
  5. Nuclear Structures construction
  6. LNG Storage Tanks construction
  7. Metro, Mono Rails and all Railway Based applications
- Manufacturing of Cement Based Products such as Grouts, Plaster, Mortars, AAC Blocks, Partition Boards, Cement Pipes, Roofing Sheets, Solid and Hollow Concrete Blocks and Bricks, Wall putty
- GGBS can be used as a performance enhancer and be blended while manufacturing of OPC and White Cement.
- Globally GGBS is a proven material for Soil Stabilization
- We have also exported GGBS to middle east region for specific projects and continuously seek opportunities to expand the reach of GGBS.
- GGBS is a principle ingredient in manufacturing of Geopolymer Concrete.

Conclusion

GGBS blended concrete have been used successfully in concrete for many years in many countries throughout the world. From all the available technical literature it is suggested that there are potentially many technical benefits to be gained from using the GGBS. Where structures have to be designed for durability requirements in very aggressive environment GGBS blend mixes are recommended in standards of most developed and developing countries. Many countries have accepted the benefits and have recommended its use in their national standards. Once the user is made aware of the properties of the material and understood the benefits to be gained there is no reason why it should not continue to be used successfully and more often in existing and future project.