

Working with Ground Granulated Blastfurnace Slag (GGBS) Concrete

Water Demand

GGBS allows for water reduction of 3 to 5% in concrete without any loss in workability. Water should not be added to GGBS concrete after dispatch from the concrete plant as it reduces strength and durability of the concrete.

Placing, Compacting and Pumping

GGBS makes concrete more fluid, making it easier to place into formwork and easier to compact by vibration. GGBS concrete remains workable for longer periods allowing more time for placing and vibrating. Pumping is also easier due to the better flow characteristics.



Concrete with 50% GGBS

Strength development

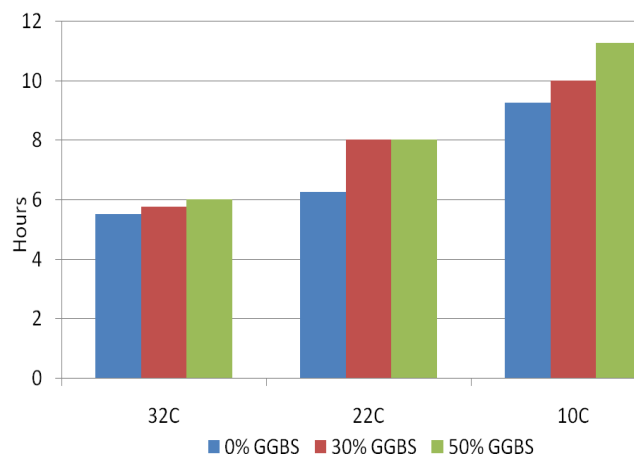
GGBS concrete has slightly slower strength development at early ages, but will have equal if not greater strength at 28 days compared to non GGBS concrete. At 7 days GGBS concretes will have 50 to 60% of its characteristic strength compared to 70 to 80% for Portland cement only concrete at the same time. At 28 days GGBS concrete will have fully developed its characteristic strength and will continue to develop strength past 90 days. It is good practice to make 56 day cubes when using GGBS concrete at 50% and above should there be any concern over later strength development.

Setting Times

The initial setting time of concrete is dependent on the concrete's constituents, curing conditions and its application use. Concrete with up to 30% GGBS will exhibit similar initial setting as concrete with Portland cement only. At replacement levels of 40 to 50% the initial set is likely to be extended by one to two hours and for concrete containing more than 50% GGBS setting time maybe extended past three hours.

Non-destructive methods such as Temperature Matched Curing, LOK Test or Capo Test can be used to determine optimum striking times where there are concerns for early age in-situ strength and program schedule.

Initial Setting Time of Concrete at Different Temperatures



Longer setting times can have the advantage of allowing concrete to be worked for longer periods meaning time delays, including delays in transport, between mixing and using concrete are less critical. They also reduce the risk of cold joints in larger concrete pours.

Initial set of all concretes is extended in cold conditions and the effect of cold temperatures on extending the initial setting time of GGBS concrete is more pronounced. This effect can be 10 to 12 hours depending on conditions, concrete constituents and the section size of the pour. The Irish Concrete Federation guidelines for concrete in cold weather sets out minimum ambient air temperatures for placing concrete as not below 5°C on a falling thermometer or not below 3°C on a rising thermometer and these guidelines should be consulted for further advice on concreting in cold conditions.

Bleeding

Concrete with up to 40% GGBS replacement does not exhibit different bleeding characteristics from that of concrete made with Portland cement. For higher percentages of GGBS there is a longer period of bleeding due to the increase in setting times of these mixes. Concrete should be allowed to bleed fully before finishing. Early finishing can lead to the remixing of the surface layer of the concrete which can reduce the surface integrity and lead to dusting and delamination.

Power floating

Concrete produced with GGBS cement can be power floated in the same way as Portland cement only concrete. GGBS concrete stays plastic for a longer time than non GGBS concrete enabling the contractor to achieve a very good quality finish. Experience in Ireland has shown that if using greater than 50% GGBS, particularly in cold weather, it may be necessary to change the finishing regime: concrete could be placed late in the afternoon and power floated first thing the following morning.



Concrete with 40% GGBS

Curing

Good curing practice is essential for all concrete. Horizontal surfaces in particular are susceptible to poor curing and problems such as plastic shrinkage cracking due to exposure to direct sunlight and strong drying winds. Properly cured GGBS concrete is more durable and ultimately stronger than concrete made with Portland cement only. Water in GGBS concrete takes slightly longer to combine chemically to form hydration products making GGBS concrete a little more sensitive to poor curing. To get the full benefit of GGBS in concrete, it is essential to protect against early loss of moisture over the first 7 days.

Colour

GGBS is white in colour and it will noticeably lighten the colour of concrete at replacement levels of 50% plus.



Concrete with 70% GGBS

Admixtures

GGBS concrete is compatible with all admixtures. However care should be taken if retarding agents are specified as GGBS can have a retarding effect on the set. If you require specific advice consult your admixture supplier or contact Ecocem.

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