OYAK CEMENT GROUP

ENVİRONMENT FRİENDLY SLAG CEMENT

Blast Furnace Slag

2 – Granulated Blast Furnace Slag

3 – Ground Granulated Blast Furnace Slag and Fields of Use

4 - Blast Furnace Slag Cement

5 – Fields of Use for Blast Furnace Slag Cement

6 – Advantages of Use for Blast Furnace Slag Cement

7 – Environment Friendly Slag Cement

8 – Values of Resistance, Thermal Crack and Heat of Hydration

9 – Overseas Operations

10 - Examples for Project in which Blast Furnace Slag Cement has been used

11 – OYAK Cement Quality

12 – Contact Us

GRANULATED BLAST FURNACE SLAG

Blast Furnace Slag is an industrial by-product for production of pig iron from iron ore in blast furnaces. Molten Slag is cooled and dried by means of granulation so that it can be used as a bonding agent and transformed into the amorphous phase.

The product activity of the granulated slag depends on the chemical structure of the amorphous phase, and Granulated Slag, along with cement, behaves as a binder in cement production if it is ground at a fineness of cement. The more active the slag is, the more resistant the concrete is.

Iron ore, coke and limestone

Warm air

Slag

Molten slag Iron

Molten iron

GROUND GRANULATED BLAST FURNACE SLAG (GGBS)

If Granulated Blast Furnace Slag is ground at a fineness of 5000 – 6000 cm^2/g, so becomes a kind of hydraulic binder, then it is called ground granulated slag.

FIELDS OF USE

Ground Granulated Blast Furnace Slag is used as a mineral additive for concrete production and substitutes for cement. (TS EN 15167-1)

Slag cement can be used as the main additive. (TS EN 197-1)

Ground granulated blast furnace slag ensures that concrete has the following favorable features when it is used as a mineral additive at particular proportions in concrete.

Fresh Concrete

- Facilitates workability and settlement;
- Increases impermeability;
- Decreases water need;
- Reduces shrinking when dried;
- Decreases heat of hydration;
- Slows down heat evolution;
- Decreases density of concrete;
- Enables use of coarse aggregate in larger amounts.

Hardened Concrete

- Increases lifetime of concrete;
- Increases ultimate resistance;
- Increases strength development for the entire life of concrete;
- Minimizes alkali-silica reactions in aggregate;
- Increases resistance to aggressive environments (cid, sulfate, chloride);
- Reduces thermal cracks;
- Prevents diffusion of harmful liquids and gases;
- Increases freeze-thaw resistance by means of its nonporous structure.

BLAST FURNACE SLAG CEMENT

Blast Furnace Slag Cement is a hydraulic binder, which is obtained by mixing portland clinker with some limestone and ground granulated blast furnace slag (GGBS).

Blast Furnace Slag Cements are used in order to increase concrete strength, increase economic life and protect the environment. If slag cement is used in concrete production more commonly, the amount of CO2 emission in atmosphere will decrease and so dangerous impacts of greenhouse gases will be reduced and the environment we live in will be healthier and areas on which natural agriculture is done will broaden.

Slag Cement is designated as CEM III in the standard TS EN 197-1 and this cement has three sub-types depending on the ratio of slag use (CEM III/A, CEM III/B, CEM III/C).

The slag ratios in these three types of cement are given in the following table.

Our Cement Plants in Adana and Bolu produce the following types of Blast Furnace Slag Cement.

Cement Type		Ratio of Blast Furnace Slag (%)
Blast Furnace Slag Cement	CEM III/A	min 36 – max 65
	CEM III/B	min 66 – max 80
	CEM III/C	min 81 – max 95

	Cement Type		Clinker Ratio (%)	Ratio of Blast Furnace Slag (%)	Resistance Class
Adana	Blast Furnace Slag Cement	CEM III/A	min 35 – max 64	min 36 – max 65	42,5N
		CEM III/B	min 20 – max 34	min 66 – max 80	42,5L
		CEM III/B	min 20 – max 34	min 66 – max 80	32,5N
Bolu	Blast Furnace Slag Cement	CEM III/A	min 35 – max 64	min 36 – max 65	42,5N
		CEM III/B	min 20 – max 34	min 66 – max 80	42,5N
		CEM III/B	min 20 – max 34	min 66 – max 80	32,5N

FIELDS OF USE FOR BLAST FURNACE SLAG CEMENT

- Any kind structure where concrete produced by using Portland Cement and Sulfate-Resistant Cement;
- Any kind of concrete manufactures in dam and pond constructions (spillway, water intake and distribution structures);
- Tunnels where water with chemical substance content leaks;
- Bore piled foundations within the scope of bridge, viaduct and highway projects;
- Port, jetty and dock constructions, pier and marina structures, sea retaining walls, river-mouth road crossings;
- Drainage channels, pumping stations;
- Plaster, briquette, concrete blocks, interlocking paving stone, any kind of city furniture;
- Smooth mosaics (when smoother surfaces are needed);
- Concrete/reinforced concrete tubes used for sewage network;
- Treatment plants, watering channels (vertical and trapezoid channels, water intake structures);
- Any kind of mass concrete and blast furnace stacks of factories;
- Underwater concrete injection, underground concrete injections, concrete wells;
- Highways;
- Underground structures, areas where structures contact the ground;
- Runway and apron constructions in airports;
- Mass concrete;
- Concrete for which aggregate silica reaction caused by reactive aggregate is required to be minimum;
- Structures subject to acid rains or chloride attack;
- Nuclear waste encapsulation, biogas plants, geothermal plants, agricultural pesticide and fertilizer depots;
- Precast concrete.

Blast furnace slag cement can be used simply anywhere where concrete produced by using Portland Cement is used. It is suitable for manufacture of all classes of concrete.

ADVANTAGES OF USE FOR BLAST FURNACE SLAG CEMENT

High resistance against Sulfate and Acid attacks.
Blast Furnace Slag Cement (Used as substitute for sulfate-resistant cement) delivers a very high performance against water including sulfate, chloride, carbonate, thermal water, seawater and defrosting materials. It has been proved that slag cement performs better than other cement types against the effects of dangerous environments involving acidic water, sulfated water and chloride water. Slag cement is particularly known for its advantage over other kinds against chloride permeability and sulfate effect.

Longer strength development compared to CEM I type cement.
Reaches and exceeds concrete strength of CEM I in 28 days.

Effective against possible expansion due to alkali-silica reaction.
It minimizes the alkali-silica reactions and so prevents hazardous volume expansion and formation of gel of hydrophilic calcium silicate which deteriorates concrete.

For higher ratios of slag/clinker, the favorable effect is more significant.

Low heat of hydration that prevents thermal cracks.
It reduces the maximum temperature of concrete and prolongs the time to reach the maximum temperature by decreasing the heat of hydration.

Prevention of chloride ion leakage into concrete.
Voids containing calcium hydroxide in concrete are filled with silicate hydrates that are a result of slag cement hydration and prevent aggressive sulfate intake by decreasing the permeability of the paste.

It also decreases the permeability of chloride ions that cause deterioration of steel equipment and carbonation depth.

Light color, attractive appearance.
A lighter color of concrete improves the decorative appearance and also provides cooler and more luminous buildings by means of its capability to reflect the light.

Resistance to high temperature as in case of fire.
Deformation is less compared to CEM I type cement when subject to fire and high temperatures.

Increasing economic life of buildings.
The resistive capability of concrete increases throughout its lifetime against abrasive physical and chemical incidents that originate from the ambient conditions where concrete is used.

It increases the lifetime of a building up to 200 years.

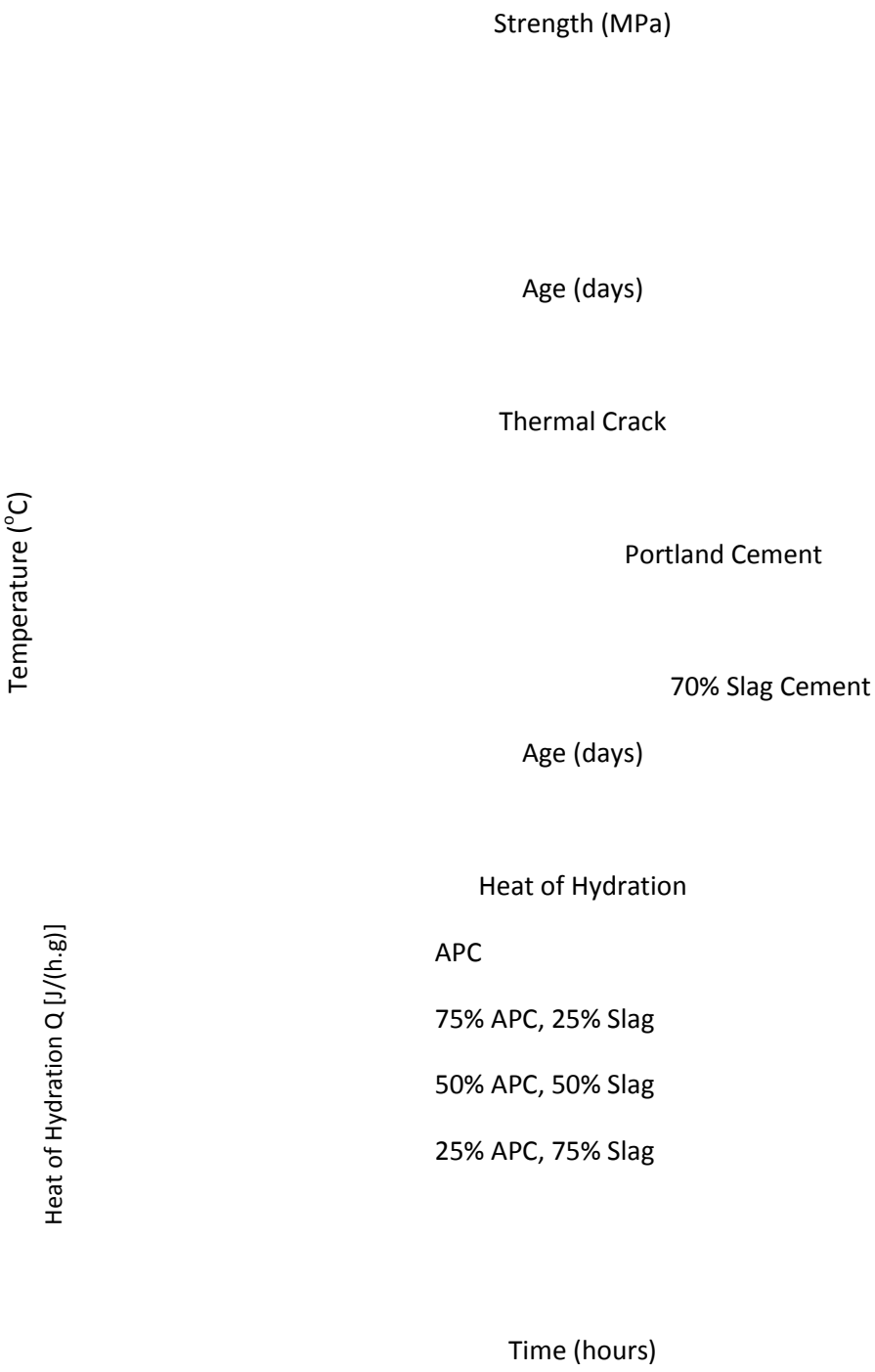
Increase of low temperature at early ages.
Since it prevents high temperatures while mass concrete is poured, it provides some advantages enabling faster pouring of concrete.

Cement Type	CEM I	CEM III/A (50% GGBS)	CEM III7B (70% GGBS)
Clinker Ratio	90%	40%	20%
Amount of CO2 emitted as a result of production of 1 tonne cement	900 kg	CO_2 Emission Gain 400 kg 56% 200 kg 78%	

Conversion rate: For 1 tonne clinker, app. 1.0 tonne CO_2 emission.

ENVIRONMENT FRIENDLY SLAG CEMENT

Slag cements are more affordable and environment friendly thanks to their large rate of additives and low rate of clinker use. They economize consumption of natural raw materials used for concrete production and of also fuel and electric energy. By means of decreasing fuel consumption, they prevent formation of harmful gases that are emitted into the atmosphere. Therefore, slag cement is widely used in developed countries.


Strength (MPa)
Age (days)
Thermal Crack
Temperature (°C)
Portland Cement
70% Slag Cement
Age (days)
Heat of Hydration
Heat of Hydration Q [J/(h.g)]
APC
75% APC, 25% Slag
50% APC, 50% Slag
25% APC, 75% Slag
Time (hours)

OVERSEAS OPERATIONS

About OYTAS

Oytaş İç ve Dış Ticaret A.Ş., which was founded in 1974 in order to evaluate the foreign trade potential of OYAK Group, performs importing and exporting activities of OYAK associates, OYAK Cement Group being in the first place.

It has established a prestigious and reliable presence in world markets in both exporting and importing thanks to its expertise, professionalism, experience, qualified personnel, service quality certified by ISO 9001:2008 Quality Management System and emphasis on customer satisfaction maintained for more than 30 years.

Loading for export is done at ports of Erdemir and İsdemir, which are companies of OYAK Group, without any draft restriction by using big bags, sling bags or as bulk.

EXAMPLES FOR PROJECT IN WHICH BLAST FURNACE SLAG CEMENT HAS BEEN USED

Marmaray, project of the century

Pozantı-Ankara Highway

Baku-Tiflis-Ceyhan Pipeline

Taşucu Ağalar Port

Afşin Elbistan Thermal Power Plant

İskenderun Sugözü Thermal Power Plant

Adana Waste Water Treatment Plants

Adana Potable Water Treatment Plants

OYAK CEMENT QUALITY

TS ISO EN 9001:2000 Quality Management System

TS ISO EN 14001: Environment Management System

OHSAS 18001: Occupational Health and Safety Management System

TS ISO/IEC 27001 Information Security Management System

EC Certificate of Conformity

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