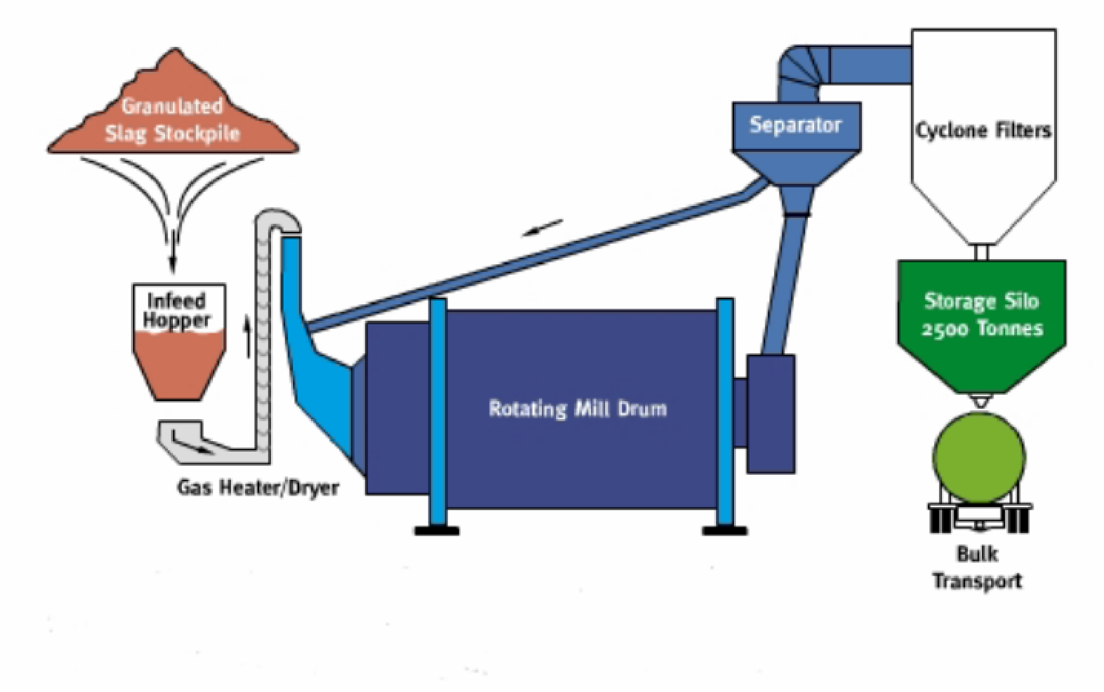
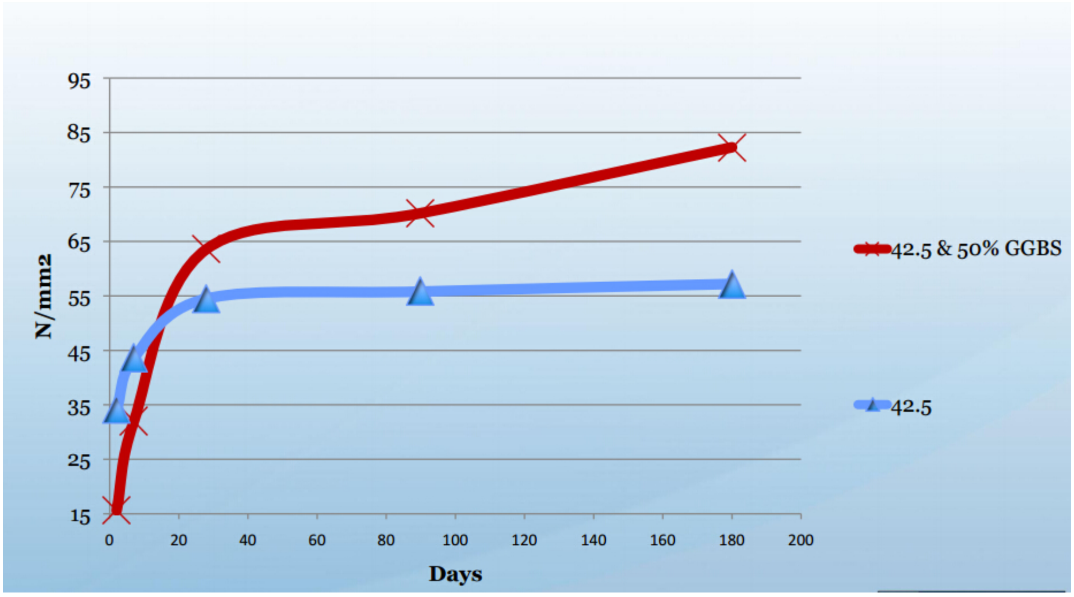
1. GGBS introduction:

Ground-granulated blast-furnace slag (GGBS or GGBFS) is obtained by quenching molten iron slag (a by-product of iron and steel-making) from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder.

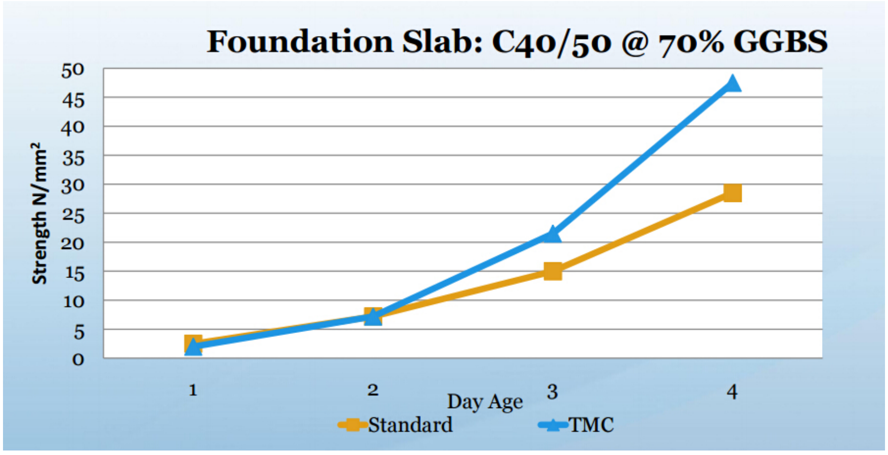
2. GGBS Manufacture:



3. GGBS –Long term strength development:



1).1m deep base with 70% GGBS



2). increased resistance to acids

Peaty soils – acidic environment

Table 6. Average Loss and Percentage Loss of Compressive Strength as a Result of Exposure to Silage Effluent

Sample	Average loss in compressive strength (N/mm^2)	% loss in compressive strength
100% OPC	7.05	46.74
30% GGBS	5.79	32.74
50% GGBS	4.11	21.82

Table 7. Average Mass Loss as a Result of Ten Cycles of Immersion in $MgSO_4$ Solution

Sample type	% average mass loss
OPC	3.5–2.8
30% GGBS	1.5–1.4
50% GGBS	1.2–0.8

0% GGBS

30% GGBS

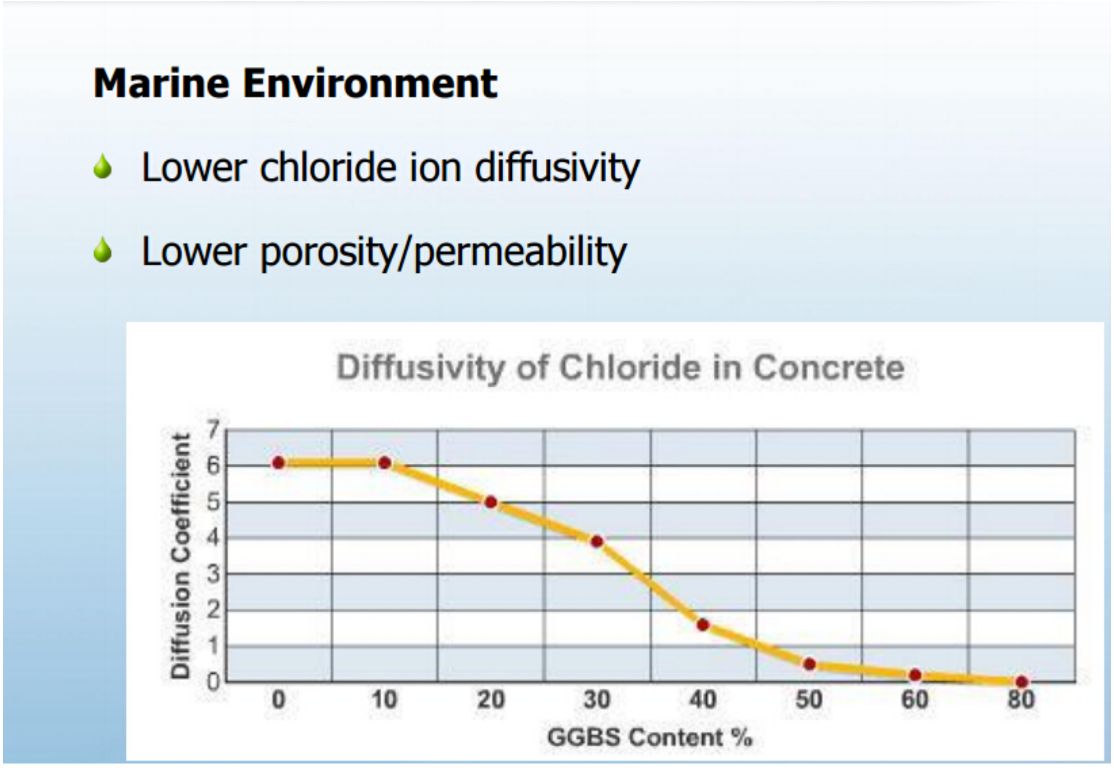
50% GGBS

3). increased resistance to sulphates

Table NA.7 Recommended limiting values for aggressive chemical environments exposure classes

Exposure Class	Min. Strength Class	Max. W/C Ratio	Min cement content	Cement Type
XA1	C32/40	0,50	340	CEM I, CEM II/A-L,LL, CEM II/A-V, CEM II/A-S or combinations with GGBS up to 49%
	C30/37	0,55	320	SRPC, CEM III/A, CEM III/B or equivalent combination (see Note 1)
XA2	C35/45 (see Note 3)	0,50	360	CEM I, CEM II/A-L, LL, CEM II/A-V, CEM II/A-S, CEM II/B-V, CEM III/A or equivalent combination
	C30/37 (see Note 2)	0,50	320	SRPC, CEM III/B or equivalent combination
XA3	C40/50 (see Note 3)	0,45	400	CEM I, CEM II/A-L, LL, CEM II/A-V, CEM II/A-S, CEM II/B-V, CEM III/A or equivalent combination
	C32/40 (see Note 2)	0,45	360	SRPC, CEM III/B or equivalent combination

4). increased resistance to salts



The main components of blast furnace slag are CaO (30-50%), SiO2 (28-38%), Al2O3 (8-24%), and MgO (1-18%). In general increasing the CaO content of the slag results in raised slag basicity and an increase in compressive strength. The MgO and Al2O3 content show the same trend up to respectively 10-12% and 14%, beyond which no further improvement can be obtained. Several compositional ratios or so-called hydraulic indices have been used to correlate slag composition with hydraulic activity; the latter being mostly expressed as the binder compressive strength.

Permitted proportions for combinations (% by mass)	ggbs	⩽35	35 <ggbs< 80	50 <ggbs<80
	pfa	⩽20	20 <pfa< 55	35 <pfa< 55
Max. w/c ratio[b,c,e]		0.40	0.50	0.[illegible]0
Min. cement content (kg/m³)[b]		400	360	360
Min. cover to reinforcement[g,f]		60	50	40

The glass content of slags suitable for blending with Portland cement typically varies between 90-100% and depends on the cooling method and the temperature at which cooling is initiated. The glass structure of the quenched glass largely depends on the proportions of network-forming elements such as Si and Al over network-modifiers such as CA, Mg and to a lesser extent Al. Increased amounts of network-modifiers lead to higher degrees of network depolymerization and reactivity.