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A Discussion of the Paper "BLAST FURNACE CEMENT MORTARS MANUFACTURED WITH FRESH GRANULATED AND WEATHERED SLAGS: INFLUENCE OF GYPSUM CONTENT AND AGEING ON CARBONATION DEPTH AND STRENGTH DEVELOPMENT" by G. Frigione and R. Sersale*

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The research conducted by Frigione and Sersale (1) to examine the application of wathered slag in the blended cement manufacturing process is quite appreciable. The authors found that in identical fineness blast furnace slag cements manufactured with weathered slag achieved lower strength than the cement with fresh granulated slag, but both the cements achieved identical strength when the weathered slag was ground finer than the fresh slag, keeping power consumption equal.

A similar study was conducted in our laboratory to examine the effect of ageing of salg on blended cement properties. We find that blended cement incorporating granulated blast furnace slag (BFS), exposed to "weathering" process for a long period, produces similar strength as the cement containing fresh BFS. So it is felt worthwhile to examine the differences between the two studies.

In our study, two identical blended cements were prepared using one fresh slag (BFS-I) and another slag exposed to the sun and rain for a period of 12 years (BFS-II). Both the slags were from the same blast furnace.

XRD patterns (Cu-K_α) of the two slags examined are almost identical (Fig.1). Other physico-chemical properties are also found to be more or less similar (Table-1). In contradication to the findings of Frigione and Sersale (1), our study shows that from the point of physical properties (Table-2), the cement containing the old slag (BFS-II) is not iferior to the other containing the fresh slag (BFS-I).

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* CCR 24 (3) 483-487 (1994)

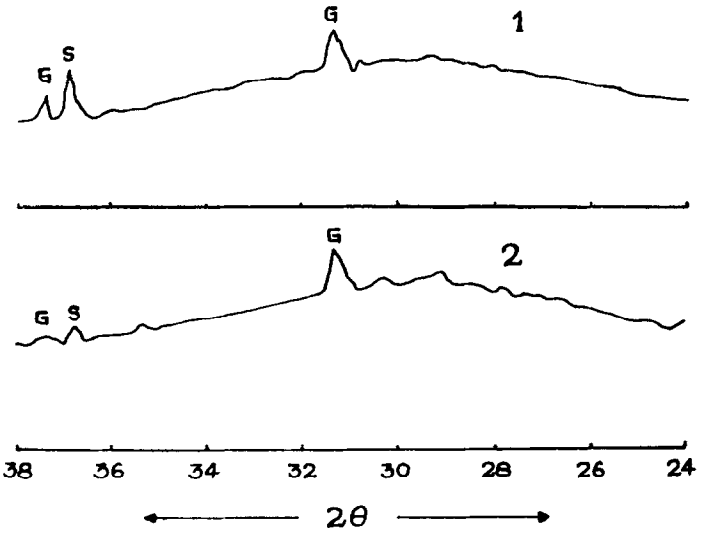

FIG.1 : XRD spectra (Cu-Kα , Ni filter) of granulated Blast Furnace Slag, (1) Fresh Slag (BFS I) and (2) Weathered Slag (BFS II).

Frigione and Sersale (1) have pointed out that the glass content in the fresh slag sample was higher than that in the weathered slag examined by them. This is expected to be the inherent difference between the two slags. Devitrification temperature of blast furnace slag are generally found to be above 900 deg.C (2) and so it is not likely that due to weathering, crystalline phases increased and the glass content decreased in the "weathered" slag. On the other hand, glass content of the slag is known to be of the greatest importance for the hydraulic activity of the slag. In an extensive work on characterization of

TABLE-1

Physico-chemical Properties of the examined slag samples

	BFS-I (Fresh)	BFS-II (Old)
Glass content (Wt.%)	94	96
Refractive index	1.632	1.632
$\frac{CaO}{SiO_2}$	0.95	0.96
$\frac{CaO + MgO + 1/3\ Al_2O_3}{SiO_2 + 2/3\ Al_2O_3}$	0.94	0.95

TABLE-2

Physical properties of the examined Blended Cements

P r p o p e r t i e s		Cement with	
		BFS-I (Fresh)	BFS-II (Old)
Specific surface $cm^2/g.$ (Blaine)		2960	2920
Setting times (minutes)	Initial	160	165
	Final	200	220
Compressive strength (kg/cm^2)	3 days	167	182
	7 days	260	270
	28 days	397	392

slag, Uchikawa et al. (3) have established a relationship between the content of glass phase basicity, ratio of monomer/dimer of silica ion and the amount of SiO2 elated by 0.1N NaOH solution. This only suggests the importance of glass content in controlling the properties of the blended cements. Accordingly it is evident that the difference between the strengths of the cements examined by Frigione and Sersale (1) is only due to the difference in the glass conents of the two slags used. It may be conceived that if the glass contents would have been similar (as in the slags examined in our laboratory), the strength of the two cements would also have been similar.

Frigione and Sersale (1) have also reported that with equal power consumption, the weathered slag reached much higher

TABLE-3

Granules sizes of Slag A and B and their Grinding Times to achieve Identical Fineness (5 kg batch)

1. Granules size (mm)	Material contents (Wt.%)	
	Slag A	Slag B
+ 4.75	4.7	11.2
4.0 - 4.75	2.9	5.4
3.0 - 4.0	10.5	9.7
2.0 - 3.0	17.1	18.6
1.0 - 2.0	26.8	28.8
- 1.0	38.0	26.3
2. Grinding time (minutes)	105	130

fineness (500 m2/kg) than the fresh slag (380 m2/kg). But this may not be due to weathering alone. We have found in laboratory tests that in grinding two slags of different granule sizes, to reach a particular fineness, the finer slag needs less time, consequently less energy than the coarser one. For example, in identical grinding conditions, slags A and B (Table-3) needed 105 and 130 minutes respectively to achieve the same fineness.

It is not likely that blast furnace slag is affected by weathering. As shown in Tables 1 and 2, neither the properties of the slag, including glass content, nor that of the blended cement change with the exposure of slags to the weathering agencies. Thus classification of slag as a "weathered" and a "glassy" is not tenable. While totally agreeing with the view that proper grinding fineness makes up for the deficiency in quality of a blast furnace slag (1) in the light of our work presented here, we are of the opinion that deficiency in quality does not occur owing to a prolonged open-air storage of the slag.

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