



**A Reply to the Discussion by G. Goswami and P.K. Panigrahy 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"***

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Thanks are due to Drs. Goswami and Panigrahy for the question raised, which gives us the opportunity to go back to a subject of great interest, not yet entirely investigated.

The possible weathering of blast furnace slag, due to open air storage, has long been known in the cement industry, although not yet thoroughly examined from a strictly scientific view-point. Several factors are responsible for the manifestation of such a phenomenon, the way of laying included. Since 1960, Leon Blondiau⁽¹⁾ in a chapter concerning selection and storage, in order to ensure characteristics of regularity to blast furnace slags, has advised not exceeding a storage of about six months, so as to avoid, first of all, a set of the mass which would hamper recovery, as well as devitrification. C. Jolicoeur et al.⁽²⁾ claim that the reactivity of a slag decreased upon standing, through a surface passivation phenomenon which remains little understood.

In the present state, it appears therefore too simplistic to claim that a classification of slag as a "weathered" and a "glassy." One, it is not tenable, for the following reasons: As already emphasized, many factors can affect devitrification of blast furnace slag; temperature is, of course, one of these, but is not unique. Great influence is exercised also by chemical composition, the former/modifier of network ratio, the thermal history, and the characteristics of storage environment.

It is to be remembered also that every glass is a thermodynamically unstable form at any temperature. Nucleation rate and crystal growth reach, of course, a maximum of about 900°C, but one cannot exclude that at room temperature, under the action of the atmospheric agents, and perhaps also under the action of mechanical stress as, for instance, the stress due to the circulation of motor vehicles on the heaps of slag lying on open ground, could start a surface alteration, favoring an incipient devitrification, with kinetics, of course, far lower.

With reference to grindability, it is to be noted that in the case of strong comminutions (starting for instance from materials with grains of about a millimeter and reaching particles of about some micrometer) the influence of the initial granulometry-power employed being the same is in practice negligible, since the power required for the grinding operation exponentially increases with the specific surface area.⁽³⁾ In our opinion, it is the extent of weathering that exerts a noticeable and conclusive influence.⁽⁴⁾ Even if the weathering of blast furnace slag would be attributable to a generic passivation phenomenon, one cannot exclude that a stronger grinding could favor its lowering, including a higher reactivity to the grains surface.

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

In conclusion, hydraulic quality of granulated slag is diminished by weathering. Reduction is higher with slags with high activity. Slags with poor hydraulic quality are less sensitive.

References

1. L. Blondiau, *Qualité et applications des ciments de haut-fourneau Belges*. Convegno sui cementi Siderurgici. Napoli, 1960. Atti della Fondazione Politecnica del Mezzogiorno d'Italia. G. D'Agonstin Ed., p. 93.
2. C. Jolicoeur, M.A. Simard, T.C. To, J. Sharman, R. Zamojska, M. Depuis, N. Spiratos, E. Douglas and V.M. Malhotra. *Chemical Activations of Blast-furnace Slag: An Overview and Systematic Experimental Investigation*. V.M. Malhotra, Ed., Energy, Mines and Resources. Canada, 1992, p. 474.
3. F. Keil, *Cemento Editores Técnicos Asociados*, s.a. Barcelona, 1973, p. 442.
4. A.K. Chatterjee, *Chemico-Mineralogical Characteristics of Raw Materials*. *Advances in Cement Technology*, S.N. Ghosh Ed. Pergamon Press, 1983, p. 61.