

Inhibition of internal expansive reactions in cement based materials with mineral additions

A. Santos Silva, D. Soares, L. Matos, M. Salta, A. Gonçalves, A. Bettencourt Ribeiro
LNEC, Materials Department, Laboratório Nacional de Engenharia Civil, Av. Brasil 101, 1700-066 Lisboa, Portugal
ssilva@lnec.pt; dsoares@lnec.pt; lpmatos@lnec.pt; msalta@lnec.pt; arlindo@lnec.pt; bribeiro@lnec.pt

Keywords: RAS, DEF, Fly Ash, Metakaolin, Blast-Furnace Slag, Silica Fume, Limestone Filler.

Abstract: The degradation of concrete structures caused by internal sulphate reaction (DEF) and alkali-silica reaction (ASR) is a problem that affects many concrete structures worldwide [1]. When these reactions occur their effects are particularly dangerous since their reactions products are extremely expansive causing the cracking of the concrete, contributing for a large reduction in the lifetime of the structure and ultimately forcing its demolition. Hence, there is an urgent need to find preventive methods that may enable the inhibition of these reactions in new concrete structures. Actually, it's well known that the use of supplementary cementitious materials, e.g. type II mineral additions, could sustain this degradation form. Moreover, its effect depends of the chemical and mineralogical composition and also of the cement content replacement. This paper presents the findings of a long-term study [2,3] on the expansion rate and microstructure of concretes with different amounts of mineral additions, like fly ash, metakaolin, ground granulated blast-furnace slag, silica fume and limestone filler. For this purpose different concrete compositions were produced by using the same cement type (CEM I 42,5R) water/cement (w/c) ratio. The results of the blended-concrete compositions were compared with control compositions, and the conclusions were extracted.

References

- [1] Divet, L., Pavoine, A., Clement, J.L., Santos Silva, A., 2004. As Reacções Expansivas Internas no Betão Devidas à Formação de Etringite Retardada. Métodos de Diagnóstico e de Prognóstico. In *Encontro Nacional BETÃO ESTRUTURAL 2004*, Faculdade de Engenharia da Universidade do Porto, PORTO, Volume 1, p. 83-90.
- [2] Santos Silva, A.; Ribeiro, A.B.; Jalali,S. and Divet, L.; 2006. The use of fly ash and metakaolin for the prevention of alkali-silica reaction and delayed ettringite formation in concrete. In *International RILEM Workshop on Performance Based Evaluation and Indicators for Concrete Durability*, 19-21 March, 2006, Madrid, Spain.
- [3] Divet, L.; Fasseu, P.; Santos Silva, A.; 2006. Optimization of the choice of cement in order to reduce the expansion of concrete as a result of delayed ettringite formation (DEF). In *Seventh CANMET/ACI International Conference on Durability of Concrete*, 331-342, May, 2006, Montreal, Canada.