Modifying the pore size to minimise shrinkage by curing and using reactive and non-reactive additives in Fe-rich inorganic polymer mortars

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Abstract

Inorganic polymers (IPs) are binding materials that can be formed by alkali activating reactive Fe-rich slags; with mechanical properties comparable to those of Ordinary Portland Cement (OPC) based systems. However, IPs durability properties, such as shrinkage, is so far poorly investigated. Therefore, the current research focuses on determining the autogenous and drying shrinkage behaviour of Fe-rich IP mortars and its associated driving forces. IP were produced with an activating solution of a 1.7 SiO_2/K_2O molar ratio and 65 wt% H_2O. IP mortars at ambient curing conditions exhibit an autogenous expansion and a high drying shrinkage, which must be reduced to avoid cracks and to meet durability criteria. In order to reduce the expansion and the drying shrinkage, 2-Methyl-2.4-Pentanediol (2M) and ground granulated blast furnace slag (GGBFS), were introduced to the mixture and sealed curing was performed at ambient or at an elevated temperature. The 2M additive reduces the drying shrinkage with 80% and modified the pore size distribution in such a way that a higher porosity was achieved, while the mechanical properties remained similar. Heat curing of IP mortars with 2M has no significant effect on the drying shrinkage. The introduction of GGBFS in IPs, cured at ambient conditions, had lower autogenous shrinkage but negatively affect the drying shrinkage due to the formation of a finer pore structure. Heat curing, on the other hand, reduces the drying shrinkage significantly and improves the mechanical properties considerably. Current research provides an insight in different pathways to reduce drying shrinkage while maintaining adequate mechanical properties.