STRUCTURE, ACID-RESISTANCE AND HIGH-TEMPERATURE BEHAVIOR OF SILICA-BASED ONE-PART GEOPOLYMERS AND GEOPOLYMER-ZEOLITE COMPOSITES

Patrick Sturm, Bundesanstalt für Materialforschung und -prüfung (BAM), Germany
patrick.sturm@bam.de
Gregor J.G. Gluth, Bundesanstalt für Materialforschung und -prüfung (BAM), Germany
Sebastian Greiser, Bundesanstalt für Materialforschung und -prüfung (BAM), Germany
Christian Jäger, Bundesanstalt für Materialforschung und -prüfung (BAM), Germany
H.J.H. Brouwers, Eindhoven University of Technology (TU/e), The Netherlands
Hans-Carsten Kühne, Bundesanstalt für Materialforschung und -prüfung (BAM), Germany

Key Words: one-part geopolymers; zeolites; acid-resistance; heat treatment; rice husk ash

One-part geopolymers (OPGs) are a sort of alkali-activated materials (AAMs) which production avoids the use of highly-alkaline activator-solutions and contributes to a better acceptance of alternative mineral binders in terms of safety-related and economic aspects. In the present contribution OPGs were synthesized by blending silica sources (two industrial silicas and two biogenic silicas) with sodium aluminate and only water must be added to initiate the hardening, *i.e.* mixing is performed in the same way as for conventional Portland cements. The OPGs were characterized by XRD, and SEM and the degrees of reaction of the silicas were determined by a chemical dissolution method.

The industrial silicas led to the formation of geopolymer-zeolite composites, that contained, besides geopolymeric gel, crystalline tectosilicates (e.g. zeolite A and hydrosodalite) and depending on the starting composition also unreacted silica. The biogenic silicas provided a higher reactivity and avoided the formation of crystallite by-products. The differences in the microstructures caused differences in the mechanical strength of the specimens [1, 2].

The treatment of the OPG composites at moderate elevated temperatures revealed promising behavior on thermal dehydration in terms of shrinkage and residual strength up to 700 °C. Above 700 °C sintering and partial melting occurred, and new phase formation commenced. After exposure to 1000 °C the specimens appeared virtually amorphous or formed stuffed silica structures of nepheline- or carnegieite-type type [3].

The investigations of the OPG based mortars on their resistance against sulfuric acid in accordance with DIN 19573 (Appendix A) revealed very high residual strengths up to 78 % after treatment with H_2SO_4 (pH 1) for 70d. A mechanism of dissolution of the primary aluminosilicate reaction products of the pastes and the precipitation of a silica gel that protects the remaining aluminosilicates and decelerates further corrosion was found to be the main reason for the good performance under acidic conditions. The addition of CaO-containing feedstocks enhanced hardening, but at a certain content the resistance against sulfuric acid decreased, due to the formation of gypsum on exposure to sulfate.

In addition, the mortars exhibited excellent shrinkage behavior as well as good bond to concrete substrates with pull-off strength up to > 3 MPa. The workability of the fresh mortars provided very good manual applicability; automatic applications such as sprayed and spun mortars will require further optimization regarding rheological properties. In summary, the studied OPG are promising materials for the construction and the repair of concrete structures, such as sewers, that are affected by biogenic sulfuric acid corrosion.

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