ULTRA-HIGH PERFORMANCE ALKALI ACTIVATED MATERIAL WITH SILICA FUME AND NANOSILICA

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Based on the principles of ultra-high performance concrete a cement free, alkali-activated system was optimized in order to enhance the strength and durability. This system is based on a ground granulated blast furnace slag and the activator is a combination of potassium water-glass and potassium hydroxide. Furthermore, inorganic fines were used for enhancing the packing density. As aggregates, quartz sand (0-2 mm) and quartz powder are added. The rheological properties could be improved by adding a certain amount of silica fume. A water/binder ratio of 0.25 was realized using a certain mixing procedure on a high-intensity mixer. The compressive strength reaches 150 MPa after 14 days, which lies in the range of an ultra-high performance concrete. The rheology was measured by using a rotation rheometer depending on time and silica fume content. Different silica fumes were tested in order to vary the grain sized distribution and the chemical composition. Beneath silica fume with a d50-value of 2 µm also nanosilica with a d50 value of 0.2 µm was tested in terms of gaining higher strength and durability and as well in terms to enhance the rheological properties. The silica fume could be substituted by nanosilica, which proofs that the improving rheology is not only due to the ball bearing effect of silica fume. The microstructure of the hardened AAM was investigated using SEM, FTIR, XRD and MIP.

This material was used as basic material in different applications: as face concrete of paving slabs, chemically foamed light weight concrete (600 kg/m³ - 4 MPa) and high performance lightweight concrete (1800 kg/m³ – 100 MPa).

Figure 1 – Compressive strength of UHPAAM