FREEZING AND THAWING RESISTANCE OF SLAG ALKALI ACTIVATED CONCRETE WITH DIFFERENT ACTIVATORS

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The frost resistance of alkali activated materials is often considered very good. But some opposing results have also been recorded. Despite the good mechanical properties of some slag-alkaline concretes their frost resistance was found bad for field application. One of the reason for the explanation of the discrepancy of the results may be a different composition of the alkaline activator. Very often the content of Na_2O (N) or K_2O (K) is mentioned as the basic characteristic of an activator. But if water glass is used as an activator the content of SiO_2 (S) is also very important.

Alkali activated mortars were designed with water to slag ratio 0.50 and (N+K) content 6 $\%_{mass}$ with regard to slag content. Sodium water glass was used with M_s = 2 , which contains 34 $\%_{mass}$ of N and 66 $\%_{mass}$ of K - in this paper, the ratio N/S is expressed as 34/66. The composition of water glass was modified with an addition of KOH for the next ratios (N+K) / S = 40/60 , 50/50, 60/60, 70/30 and 100/0 (only KOH). The level of N+K was kept at the value 6 %, which means that the dry content of the activator was 17.6 $\%_{mass}$ for only water glass and this decreased continuously to 6% for KOH only. The mechanical properties and frost resistance were tested. The frost resistance index is the ratio of the bending strength of prisms after 125 F-T cycles to the bending strengths of comparative prisms. One F-T cycle represents 4 hours in the freezer in temperature -20°C and 2 hours in water +20°C. Before testing F-T resistance the prisms were stored in a laboratory enveloped with PE foil, at the start of F-T testing, the comparative prisms were put into water 20°C.
Other mortars were prepared for ratios 34/66, 60/40 and 100/0 in order to have all of the mortars with dry mass content 17.6, 14 and 10%.

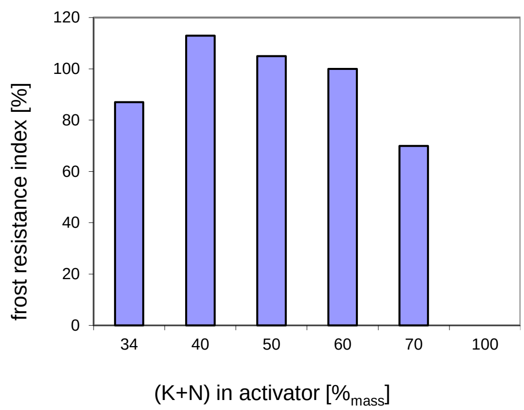

Figure 1 – F-T resistance indexes for mortars with different composition of activator and (N+K) = 6%

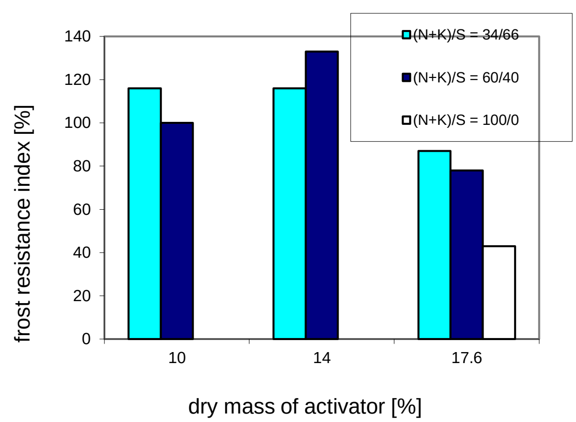

Figure 2 – F-T resistance indexes for mortars with different content of dry mass of activator and (N+K)/S = 34/66, 60/40 and 100/0

The results of the frost resistance for 6 % of (N+K) are presented in Figure 1. It shows very good results for F-T resistance, especially for mortars with the ratios of 40/60, 50/50 and 60/40. Prisms with ratio 100/0 were disintegrated during the first 45 cycles. It is interesting that F-T indexes are higher than 100 % in some cases. It means that frosted prisms show better strengths than those cured in +20°C. This phenomenon is also known from Portland cement based high performance concrete. The explanation may be in terms of a better structure of C-S-H gel which arises in a lower temperature, but there will probably also be some other influences.
Figure 2 shows the results of F-T resistance of mortars with (K+N)/S ratios 34/66, 60/40 and 100/0 for dry mass of activator content 10 %, 14 % and 17.6 %. Water to slag ratio was 0.50. The results are interesting and they do not show any simple course except for bad frost resistance for ratio 100/0 (disintegration of prisms for 10 and 14%).
The results of this paper show that the frost resistance is not only influenced by the amount of activator or its composition, but probably the type of hydration products plays an important role. The general opinion about good or excellent frost resistance of alkali activated materials is not correct.