EFFECT OF CHEMICAL STRUCUTRE ON THE EFFICIENCY OF SHRINKAGE REDUCING ADMIXTURES IN ALKALI ACTIVATED SYSTEMS

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Key Words: alkali activation, blast furnace slag, shrinkage, shrinkage reducing admixtures, chemical structure

Alkali activated binders, especially those based on alkali activated blast furnace slag (AAS), have the potential to become an alternative construction material to ordinary Portland cement binders. Nevertheless, AAS has some disadvantages which prevent its broader practical applications. An extensive shrinkage is one of the main limiting factors. Therefore, the study of chemical admixtures mitigating especially the drying shrinkage is necessary to be performed. The efficiency of suitable shrinkage reducing admixtures depends on the chemical structure of used surfactants. The study is consequently focused on the molecular architecture of amino alcohol surfactants which are closely associated with their ability to effectively reduce shrinkage. The molecular structure of used chemical compounds is shown in Figure 1. The influence of different substituents bounded to the secondary amine group was studied in terms of their effect on alkali activation, mechanical properties, microstructure arrangement and in particular on the enhancement of drying shrinkage reduction. It was determined that the addition of any tested admixture delayed the CASH gel formation which negatively influenced the flexural as well as compressive strengths in the early stages of hydration process (1 – 7 days). However, only slight decrease in strengths compared to reference sample was measured after 28 days of curing. The deeper insight into the microstructure (Figure 2) confirms previous results. It is obvious that in the case of reference sample the consistent matrix of binding phase is created after 24 hours. On the other hand, only thin layer of hydration products is formed in samples containing the admixture, which increases the porosity of material and tends to the deterioration of mechanical properties. Finally, the study confirms that the reduction of surface tension in pore solution occurs primarily with admixtures containing branched substituents, which further decreases the capillary tension responsible for the shrinkage according to Young-Laplace equation. The presented study highlights the essential role of molecular structure of shrinkage reducing admixtures contributing to the development of a new range of additives designed especially for alkali activated materials.

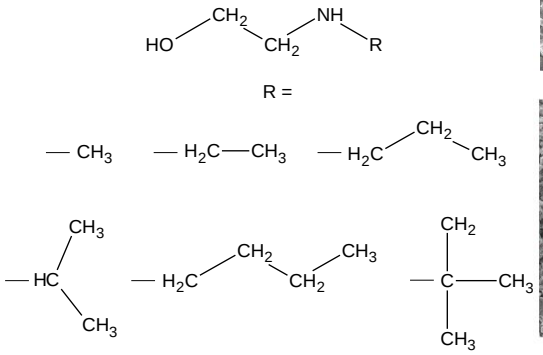

Figure 1 – Molecular structure of used amino alcohol surfactants

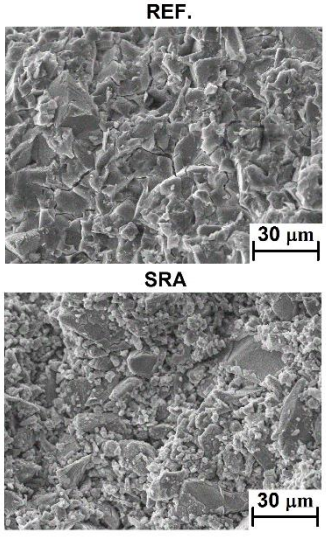

Figure 2 – SEM fracture areas of AAS without (REF.) and with shrinkage reducing admixture (SRA) after 1 day of alkali activation