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Twenty-third Annual Conference

YUCOMAT 2022

&

Twelfth World Round Table Conference on Sintering

XII WRTCS

Program

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WRTCS 2022

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P.S.III.D.5.

Performance of ternary cement binders containing high volume of fly ash and fluid catalytic cracking catalyst residue

Jelena Rakić[1], Zvezdana Baščarević[1], Rada Petrović[2]
[1]*Institute for Multidisciplinary Research, University of Belgrade, Serbia*
[2]*Faculty of Technology and Metallurgy, University of Belgrade, Serbia*

The use of binders based on waste materials in construction industry has both ecological and economic advantages over the use of commercial Portland cements (PC). Preserving the natural resources needed for PC production, as well as reusing waste materials instead of disposing them in landfills, contributes significantly to the protection of the environment. Also, the price of waste materials is usually much lower than the price of raw materials used for production of PC.
Coal combustion in thermal power plants produces huge amounts of fly ash (FA). It is estimated that 500-750 million tonnes of FA are generated worldwide annually, with a global utilization rate of only 25 %. Due to pozzolanic properties of this aluminosilicate waste material, FA has been used as PC component for decades. However, the broad use of binders made of high volume of FA (>50%) is limited by their relatively long setting time and low early strength.
The other waste material of interest in this work was fluid catalytic cracking catalyst residue (FC3R), a by-product from petrol refineries, which primarily consists of zeolite and amorphous aluminosilicates and also shows pozzolanic activity. Due to relatively small quantities of FC3R produced (~160000 tonnes per year globally), landfilling is usually considered as the most economical option for its disposal.
The aim of this work was to investigate the performance properties of ternary binder containing high volume of the two different waste materials, FA and FC3R. The binder consisted of FA, FC3R, and PC (commercial CEM I) mixed in a 49:21:30 mass ratio. Both waste materials were mechanically activated prior to the binder synthesis. Characterization of raw and mechanically activated waste materials via determination of particle size distribution, morphology and mineral composition, was conducted. Analyses of the ternary binder properties showed that using FC3R as the binder component resulted in acceleration of cement hydration and pozzolanic reaction. The ternary binder had shorter setting time and higher early strength than the control binder synthesized with 70 mass% of FA and 30 mass% of PC.