Influence of Additives on the Fracture Mechanical Properties of Reactivated Cement Paste

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Abstract:

In today's constructions in civil engineering, the challenge to reduce emissions is a main priority. Hence, alternative binders are on the rise since the production of cement is very CO2-intensive. The use after demolishing of concrete including its cementitious matrix is limited to being downcycled to gravel.

Studies show, that recycling of cement is possible. Current research focuses on a process that consists of the dehydration of hardened cement paste by thermal treatment, followed by a size reduction including crushing, milling and sieving resulting in a reactivated cement powder. When mixing with water that powder regains strength. A problem to solve is that so far, the mechanical strength is not as high as the one of the original binder.

Reasons for that are a new chemical composition with a different variety of strength giving phases and the morphology of the reactivated grains. The new powder shows high inner porosity and a much bigger specific surface area.

This work aims to increase the mechanical strength of reactivated cement by using additives. Two types of additives can be distinguished. First, milling agents that are added during the milling process. In this study ground blast furnace slag (GBFS), copper slags and electric arc furnace slags were used. Second, additives that are added during the mixing of cement and water, in this study micro silica, plasticizer, superplasticizer and retarder.

Parameters that were tested are compressive strength, porosity and fracture toughness after 28 days. The results show that GBFS gives the highest compressive strength due to a decrease in porosity. Plasticizers improve the strength, more likely due to improving the workability. The fracture toughness is a stable value indicating that the overall quality of the bonds in the matrix is good.