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Performance of Untreated Fly Ash and Glass Powder for Ecological Ternary Mortars – An Overview

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Extended Abstract

Cement-based mortars are widely used as construction material for society´s infrastructure due to its convenient manufacturing to be used in sewage systems, ferrocement, pre-cast structural elements and to repair concrete structures. The main component of mortars is Portland cement. However, cement production is a high energy-intensive process and has been reported that each ton of cement emits approximately 0.8-1.0 ton of anthropogenic CO_2 into the atmosphere [1]. Focused on sustainability, researchers have been used different by-products as alternative materials for partial cement replacement for the preparation of environmentally-friendly mortars. Fly ash (FA), silica fume (SF) and blast-furnace slag are the most common used pozzolanic materials for that purpose which improve the microstructural, mechanical and durability properties in mortars. Nevertheless, these materials are not widely available in some regions increasing the cost for mortar´s manufacturing. According to the above, the use of local wastes as an alternative for those materials is aimed on this research. FA from a local thermal plant in Mexico and glass powder (GP) are proposed for that purpose. A previous research report that this FA does not have the same quality as commercial FA [2]. The authors recommend a sieving process through the 75 µm ASTM mesh for the ash, and they called it as untreated fly ash (UtFA). Nonetheless, not significant advantages (when compared to a control mixture) on the mechanical and durability properties of binary mortars containing the UtFA were found. Based on the reported in that research, the addition of GP in binary mortars containing UtFA is proposed on this ongoing research. In the first stage, which is reported in this paper, the chemical composition by XFR and loss on ignition of the UtFA and GP were obtained. After that, the strength activity index (SAI) of binary mortars containing 20% UtFA and 20% GP as cement replacement were evaluated at 7, 14 and 28 days. Likewise, the SAI of a mortar mixture containing 20% SF as cement replacement was evaluated at the same ages as a reference to compare the performance of the UtFA and GP. The results show that the UtFA and GP provides SAI values higher than 75% of the control mortar specified by the ASTM C 618. SAI values of 92% and 154% at 14 and 28 days were obtained in the mortars containing GP. These values were higher than those obtained in the mortars added with UtFA and SF. Researchers affirm that GP has beneficial effects on improving the mechanical, microstructural and durability properties of binary mortars and its performance might be comparable than the reported by using other supplementary materials such as commercial FA and SF [3, 4, 5]. According to the results from this research and the reported in the literature, it is expected that the combination of the UtFA and GP is going to improve the microstructural, mechanical and durability properties of mortars. Following on sustainability, this research is encouraged to reducing energy demand during cement production, reusing untreated fly ash and recycling glass powder [6].

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