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Tuning the Microstructure and Mechanical Properties of Fine Recycled Plastic Aggregates in Concrete Using Ethylene-Vinyl Acetate

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Abstract : Recycling waste plastics in the form of concrete components, i.e. fine aggregates, has been an attractive topic among the society of civil engineers. Not only does the recycling of plastics reduce the overall cost of concrete production, but it also takes part in solving environmental issues. Nevertheless, the incorporation of recycled plastics into concrete results in an increasing reduction in the mechanical properties of concrete as the percentage of replacement of natural aggregates increases. In order to overcome this reduction, Ethylene-vinyl acetate (EVA) was used as an additive in concrete with recycled plastic aggregates. The aim of this additive is to: 1) increase the interfacial interaction at the interfacial transition zone (ITZ) between plastic pellets and cement matrix, and 2) mitigate the loss in mechanical properties. Three different groups of samples (i.e. cubes and prisms) were tested according to the plastics substituting fine aggregates. 5, 10, and 15% of fine aggregates were substituted for recycled plastic pellets, and 2 – 4% of the cement was substituted for EVA that produces a flexible agent when mixed properly with water. Compressive and tensile strength tests were conducted for the mechanical properties, while SEM and X-CT scan were implemented for further investigation of calcium-silicate-hydrate (C–S–H) formation and ITZ analysis. The optimal amount of plastic particles with EVA is suggested to get the most compact and dense matrix structure according to the results of this study.

Keywords : the durability of concrete, ethylene-vinyl acetate (EVA), interfacial transition zone (ITZ), recycled plastics
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