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Compressive Strength Of Ground Waste Seashells In Cement Mortars For Masonry And Plastering

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Abstract. For environmental protection and sustainable development, many research studies have been carried out on the utilization of waste materials in construction such as fly ash, mine tailings, slags, construction and demolition waste, wood sawdust, rice husk ash, crumb rubber and etc. In this study, two types of waste seashells; green mussel and cockle were tested experimentally to replace fine aggregate in cement mortar. The compressive strength of the cement mortar with seashells were compared with those of a control mortar that was made of a conventional river sand. The main parameter of this study was the proportion of ground seashells used as sand replacement (25%, 50%, 75% or 100% by weight). Incorporation of cockle in cement mortar resulted in higher compressive strength as compared to conventional mortar up to 110 percent. However, incorporation of green mussel resulted in decrement in compressive strength by 67 percent. The results indicate that ground seashells can be applied as a sand replacement in mortar mixes and may improve the compressive strength of rendering and plastering mortar.

Intorduction

For environmental protection and sustainable development, many research studies have been carried out on the utilization of waste materials in construction such as fly ash, mine tailings, slags, construction and demolition waste, wood sawdust, rice husk ash, crumb rubber and etc. Nacre is defined as mother-of-pearl, also known as a hard biological composite which is found in the inside layer of many seashells such as oyster, cockle and mussel. Nacre is mostly made of microscopic ceramic tablets densely packed and bonded together by a thin layer of biopolymer [1]. Nacre is the material that composes the inner layer of many species of gastropods and bivalves, made of 95% of microscopic polygonal tablets of aragonite (a form of $CaCO_3$, close to calcite), bonded together by a small fraction (5%) of organic materials (proteins, chitin) [2]. The basic structural motif of nacre is the assembly of oriented plate-like aragonite crystals with a 'brick' ($CaCO_3$ crystals) and 'mortar' (macromolecular component) organization. As in most structural natural materials, nacre exhibits a hierarchical structure. Seashell contains major proportion of calcium carbonate ($CaCO_3$), which is more than 90% of its weight and small proportion of organic compounds [3]. The use of ground seashells as a substitute material to produce concrete and mortar has been studied previously. Falade [4] replaces freshwater snail as an alternative aggregate in concrete and found out that the compressive strength, tensile strength and workability of the concrete decreases when a replacement level of freshwater snail in the concrete mix increase. Yoon et al [5] study on the effect of oyster shell substituted for fine aggregate on concrete and mortar concluded that replacement of sand with ground oyster shell does not decrease the compressive strength of the mortar. Ballester et al [6] utilised the ground particles of mussel to produce mortars has observed that the internal morphology of mortar mixed with mussel shells has a structured mesh and smaller pores, thus results in higher compressive and bending strengths. The aim of this study is to study the use of green mussel and cockle type seashells as replacement of sand in the production of plastering cement.