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Physical, Chemical and Mineralogical Characterization of Construction and Demolition Waste Produced in Greece

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Abstract : Construction industry in Greece consumes annually more than 25 million tons of natural aggregates originating mainly from quarries. At the same time, more than 2 million tons of construction and demolition waste are deposited every year, usually without control, therefore increasing the environmental impact of this sector. A potential alternative for saving natural resources and minimize landfilling, could be the recycling and re-use of Concrete and Demolition Waste (CDW) in concrete production. Moreover, in order to conform to the European legislation, Greece is obliged to recycle non-hazardous construction and demolition waste to a minimum of 70% by 2020. In this paper characterization of recycled materials - commercially and laboratory produced, coarse and fine, Recycled Concrete Aggregates (RCA) - has been performed. Namely, X-Ray Fluorescence and X-ray diffraction (XRD) analysis were used for chemical and mineralogical analysis respectively. Physical properties such as particle density, water absorption, sand equivalent and resistance to fragmentation were also determined. This study, first time made in Greece, aims at outlining the differences between RCA and natural aggregates and evaluating their possible influence in concrete performance. Results indicate that RCA's chemical composition is enriched in Si, Al, and alkali oxides compared to natural aggregates. X-ray diffraction (XRD) analyses results indicated the presence of calcite, quartz and minor peaks of mica and feldspars. From all the evaluated physical properties of coarse RCA, only water absorption and resistance to fragmentation seem to have a direct influence on the properties of concrete. Low Sand Equivalent and significantly high water absorption values indicate that fine fractions of RCA cannot be used for concrete production unless further processed. Chemical properties of RCA in terms of water soluble ions are similar to those of natural aggregates. Four different concrete mixtures were produced and examined, replacing natural coarse aggregates with RCA by a ratio of 0%, 25%, 50% and 75% respectively. Results indicate that concrete mixtures containing recycled concrete aggregates have a minor deterioration of their properties (3-9% lower compression strength at 28 days) compared to conventional concrete containing the same cement quantity.

Keywords : chemical and physical characterization, compressive strength, mineralogical analysis, recycled concrete aggregates, waste management
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