

Title: Sustainable Concrete Mixes Incorporating Precipitated Calcium Carbonate (PCC) and Upcycled Aggregate (UA)

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Abstract:

The main purpose of this study is to replace the portions of cement from concrete with precipitated calcium carbonate (PCC). The PCC is a finer material and a waste product generated from the sugar beet industry after producing sugar. The study also involved replacement of regular aggregate with upcycled aggregate and cement with PCC in the same mix. Upcycled aggregate is the recycled concrete aggregate that has been gone through calcium extraction process and is produced by Blue Planet System in Las Gatos, California. Specimens of regular concrete (benchmark) and those containing PCC were tested in the laboratory. The test results show that the optimum PCC content to achieve a target compressive strength of 4000 psi (28 MPa) is 25% and 30%. The compressive strength of concrete with replacing 100% of natural aggregate with 100% of upcycled aggregate is about 7000 psi at water to cement ratio of 0.44. The compressive strength of benchmark concrete mix is also about 7000 psi at water to cement ratio of 0.44. The other engineering properties such as tensile strength, flexural strength, deflections, and shear strength were determined in accordance with the American Society for Testing and Materials (ASTM) procedures. The PCC samples were also analyzed using x-ray diffraction (XRD) to study the crystalline nature, scanning electron microscopy (SEM) to study the microstructure, and energy dispersive x-ray spectrometer (EDX or EDS) to identify the elements/chemical compounds present in the PCC product. Chemical compounds such as calcium carbonate and silica were identified using XRD and EDX. The SEM image showed that PCC has irregular microstructure.