Using Clay Tile Waste as an Internal Curing Aggregate (ICA) to Replace Aggregates in Roller-Compacted Concrete (RCC)

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Abstract

The high demand for natural resources has become a significant problem in the construction industry. Therefore, the construction industry is searching for sustainable and eco-friendly alternatives, leading to a burgeoning interest in incorporating waste materials into concrete production. Considering the strength gained from concrete, proper curing is a crucial aspect. Lack of proper curing causes disturbances to the hydration process of cement, and it leads to a lot of problems such as reduction in strength, shrinkage cracks, and durability issues. Conventional curing methods have some weaknesses in providing uniform curing throughout the full depth of concrete. Therefore, the industry is moving towards alternative methods. Among those alternatives, using an internal curing agent is an innovative approach being researched widely, especially for concrete with a low water/cement ratio. Roller compacted concrete (RCC) is a type of concrete that has a low water/cement ratio, and it is gaining prominence as a durable and cost-effective construction material for a wide range of applications, including pavements, dams, and industrial floors. Its composition typically comprises coarse aggregates, cementitious materials, and fine aggregates. Since it has a low water/cement ratio, curing is vital to the hydration process of cementitious materials. Considering the water absorption and desorption capacity of materials, attention has been focused on the use of waste materials as internal curing agents. This study explores the feasibility of utilizing clay tile waste as an internal curing aggregate (ICA) in roller-compacted concrete (RCC). The aim is to investigate the potential of clay tile waste as an ICA and evaluate its effect on the properties of RCC. Since the particle size of the clay tile waste can affect the concrete properties, two studies have been done. One study investigates the use of clay tile waste to replace fine aggregates in RCC, and another investigates the use of clay tile waste to replace coarse aggregates. In both studies, a series of experiments are done to check the potential of clay tile waste to be used as an internal curing aggregate. The physical properties of clay tile waste, such as water absorption and desorption capacities, specific gravity, pore structure, and chemical properties, are studied in these experiments. After checking the potential to use as an ICA, RCC mixtures are prepared with different clay tile waste replacement ratios. Then, the mechanical properties of concrete, such as compressive strength, splitting tensile strength, and durability properties, are checked using laboratory experiments. Finally, all the results will be analyzed and compared with the control mixture that does not contain clay tile waste. The optimum replacement ratio for fine and coarse aggregates will be determined using analyzed results. With the positive results of the study, the construction sector will significantly improve sustainability by replacing either fine or coarse aggregate with clay tile waste material. Additionally, the possibility of early-age cracking owing to autogenous shrinkage is addressed using clay tile waste as an internal curing agent in
RCC construction. This inherent quality of the waste material increases the durability and service life of the RCC structures, enabling long-term performance and cost-effective maintenance and repair. In the broader context of sustainable construction practices, integrating clay tile waste

into RCC applications is a significant stride toward achieving environmental, economic, and performance-related objectives.

Keywords: *Roller Compacted Concrete, Clay Tile Waste, Internal Curing, Sustainable Construction, Waste Utilization*

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