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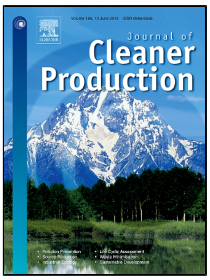

Composition Design and Performance Characterization of a Novel Backfilling Concrete Derived from Urban Construction Waste

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Composition Design and Performance Characterization of a Novel Backfilling Concrete Derived from Urban Construction Waste

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Highlight:

- The additional water consumption of recycled concrete was quantified for high red brick content aggregate on the basis of the experimental study.
- The design method for the mixture ratio of ultra-low strength recycled concrete was proposed by modifying Bolomey formula parameters.
- Construction-waste-based recycled concrete could effectively protect underground pipeline and road structure according to the results of finite element analysis.

Abstract: In recent years, the production of construction waste is increasing, and its composition is complex, especially the high content of red brick, which leads to the obvious higher water absorption rate of recycled aggregates compared to natural aggregates. Therefore, the original concrete mix design method isn't applicable any more. On the other hand, there is no safe and cheap backfill material for the trenches after laying underground pipelines. In order to solve these problems, the present study utilizes Construction and Demolition Waste to develop a fully-recycled concrete, namely backfilling concrete, which is specially used for supporting the backfilling of trenches. The water absorption of recycled aggregate soaking in water for different durations is tested. Based on the growth law of the water absorption of recycled aggregate, the additional water consumption is determined for the recycled concrete mixing process. The workability, including slump and bleeding rate, and compressive strength of the backfilling concrete with 16 compositions with different cement-water ratio and sand rates are studied in the paper. An empirical formula pertaining to the consumption of mixing water is proposed, and the parameters in the Bolomey formula concerning the performance of aggregate are modified based on the method for designing the regular concrete. At last, the finite element analysis is carried out with ABAQUS for the new type of recycled concrete. Experimental and simulation results show that slump of the mixtures using 30-minutes water absorption of recycled aggregates as additional water is around 10cm, and the workability meets the practical requirements. The compressive strength of the construction-waste-based concrete is between 1~3 MPa. And backfilling concrete can effectively protect the underground pipelines and road structure under the vehicle load according to the finite element analysis. Consequently, in this paper, the original concrete mix design method is improved and completed, which can be applied to ultra-low strength recycled concrete. The newly proposed backfilling concrete has good workability and mechanical properties for backfilling of trenches. Moreover, cement consumption