

Optimizing the Fresh and Hardened Properties of Eco-Friendly Materials Containing Waste Plastic Fiber and Ceramic Waste Aggregate

Abdelkadir Makani

Laboratory of Eco-Materials: Innovations & Applications (EMIA), Department of Civil Engineering & Hydraulic, TAHRI Mohamed University, Bechar, Algeria

Ahmed Hamidi

Laboratory of Eco-Materials: Innovations & Applications (EMIA), Department of Civil Engineering & Hydraulic, TAHRI Mohamed University, Bechar, Algeria

Abdelmadjid Alouani

Laboratory of Eco-Materials: Innovations & Applications (EMIA), Department of Civil Engineering & Hydraulic, TAHRI Mohamed University, Bechar, Algeria

Izzeddine Bekkar

Laboratory of Eco-Materials: Innovations & Applications (EMIA), Department of Civil Engineering & Hydraulic, TAHRI Mohamed University, Bechar, Algeria

Fatma Saidat

Laboratory of Civil Engineering & Environnement (LCGE), Mohamed Seddik Benyahya University, Jijel, Algeria

Abstract

Waste generated from ceramics and plastics grows rapidly, causing many problems for the environment, including landfills, loss of natural resources, and greenhouse gas emissions. At the same time, the construction sector produces a large amount of CO₂ emissions due to the high usage of natural resources required for construction. The research aims to find ways to reuse ceramic waste as a substitute for fine aggregate and recycle plastic waste as a fibre to improve the sustainability and performance of concrete. The modified concrete was tested for dry density, ultrasonic pulse velocity, rebound hammer strength, and compressive strength. The test results showed that using ceramic waste as a substitute for fine aggregate and using plastic fibres as reinforcement increased the mechanical properties of the concrete. Specifically, when 50% ceramic waste and 1% plastic fibres were included in the concrete, the compressive strength improved by approximately 20% compared to the control mix. In addition, strong correlations were found between the fresh concrete characteristics and the hardened concrete characteristics, which will allow for accurate prediction and optimisation of concrete performance. The results of this work demonstrate the potential for using industrial waste in concrete production, reducing the negative impacts on the environment, and developing more sustainable and resource-efficient methods of construction.

Index Terms

Eco-Friendly Materials, Fresh And Hardened Properties, Waste Plastic Fiber, Ceramic Waste Aggregate