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Exploring the Potential of Recycled Waste Printed Circuit Boards (WPCBs) in Concrete Applications: A Comprehensive Review

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Abstract

The study evaluates the current methods of WPCB recycling, focusing on mechanical, chemical, and thermal processes that convert WPCBs into usable forms for concrete mix binder materials. This review investigates the potential of integrating WPCB recycling products into concrete, with the goal of improving the sustainability of construction materials and minimizing the environmental impact of e-waste WPCB-derived materials, including both metals and non-metals, in concrete mixtures are analyzed, with an emphasis on how they influence the concrete's mechanical properties, durability, and workability. The globally published data on recycled WPCB standards from past research work have been systematically analyzed and assessed to highlight some identified barriers. In this, studies reveal that WPCB materials can partially replace traditional concrete materials, such as fine aggregates and cement, without compromising strength of the concrete. The addition of WPCB products has shown potential benefits, including improved compressive and flexural strength, enhanced resistance to chemical attack, and reduced shrinkage. The review emphasizes the necessity for additional research to refine mix design, enhance long-term performance, and ensure environmental safety of concrete reinforced with waste-printed circuit boards (WPCB). In conclusion, recycling products of WPCB into concrete offers a promising approach to sustainable construction, providing the dual advantages of effective resource conservation and e-waste management.

Keywords: WPCB-Derived Materials; E-Waste; Concrete Materials; Fine Aggregates; Cement