Environmental impact and technical performance of recycled aggregate concrete containing municipal incinerated bottom ash

Summary

This study explores using municipal solid waste incinerator bottom ash (MIBA) as a partial cement replacement to reduce the environmental impact of concrete. Despite growing interest in sustainable alternatives, limited research exists on MIBA-containing mixes. The study evaluates concrete incorporating MIBA, both untreated and treated with sodium hydroxide, focusing on mechanical and durability performance in fresh and hardened states. MIBA contains metallic aluminium, which reacts in alkaline conditions to release hydrogen, causing expansion. The proposed treatment accelerates this reaction beforehand to mitigate issues in the final concrete. Alongside cement replacement, natural aggregates (NA) were fully substituted with recycled concrete aggregates (RCA) to enhance sustainability. Twenty mixes were tested: using MIBA (treated/untreated), fly ash (FA), or both (FM) at 20%, 35%, and 55%, with two reference mixes for comparison.

Durability and mechanical tests were followed by a Life Cycle Assessment (LCA), evaluating environmental and economic performance. Results showed reduced strength and increased porosity in MIBA mixes, particularly at high replacement levels. However, 20% MIBA mixes (with NA or RCA) demonstrated acceptable durability and environmental performance, comparable to conventional concrete.

Keywords

Construction and demolition waste, coarse recycled aggregates, municipal solid waste incinerator bottom ash, supplementary cementitious materials, recycled aggregates, concrete.

Samples of concrete (fly ash, reference concrete, MIBA).

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