Economic and Environmental Life Cycle Analysis of Construction and Demolition Waste Management System

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Abstract: Construction and demolition waste (C&DW) is a major challenge in the European Union, emphasizing the urgent need for appropriate waste management processes. Selecting these solutions is challenging, as it requires identifying efficient C&DW management techniques that balance acceptable practices, regulatory compliance, resource conservation, economic viability, and environmental concerns. Techniques for analyzing many kinds of criteria allow for the use of multi-criteria analysis in life cycle assessment (LCA). Although LCA is commonly used to analyze environmental effects, the economic factor has not been fully integrated into the LCA approach in C&DW management. The life cycle costing (LCC) approach was designed to assess economic performance in the C&DW management process. The choice of an effective multi-criteria decision-making (MCDM) technique is critical for the C&DW system. This study seeks to propose a model that employs MCDM by considering LCA and LCC results, thereby augmenting both environmental and economic sustainability. A widely used compensatory MCDM technique, TOPSIS, has been chosen to identify the most effective C&DW management scheme by comparing and ranking various scenarios. Four waste management alternatives were examined in the Lombardy region of Italy, namely, (i) landfill; (ii) recycling for concrete production and road construction, incineration with energy recovery; (iii) recycling for road construction; (iv) recycling for concrete production and road construction. We determine that, with the implementation of various scenarios, the most suitable scenario emerges to be recycled for concrete production and road construction, with a score of 0.711/1; recycling for road construction, with a final score of 0.291/1, ranks second; recycling for concrete production and road construction, incineration with energy recovery scores 0.002/1, ranks third; and landfill (scores: 0/1) is the worst choice, indicating it has the highest environmental impact. Finally, suggestions were developed to improve the system's environmental performance.

Keywords: life cycle assessment, life cycle costing, construction and demolition waste, multi-criteria decision making

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