

Sustainable Integrated Waste Management System

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Abstract : Waste management in Europe and North America is evolving towards sustainable materials management, intended as a systemic approach to using and reusing materials more productively over their entire life cycles. Various waste management strategies are prioritized and ranked from the most to the least environmentally preferred, placing emphasis on reducing, reusing, and recycling as key to sustainable materials management. However, non-recyclable materials must also be appropriately addressed, and waste-to-energy (WtE) offers a solution to manage them, especially when a WtE plant is integrated within a complex system of waste and wastewater treatment plants and potential users of the output flows. To evaluate the environmental effects of such system integration, Life Cycle Assessment (LCA) is a helpful and powerful tool. LCA has been largely applied to the waste management sector, dating back to the late 1990s, producing a large number of theoretical studies and applications to the real world as support to waste management planning. However, LCA still has a fundamental role in helping the development of waste management systems supporting decisions. Thus, LCA was applied to evaluate the environmental performances of a Municipal Solid Waste (MSW) management system, with improved separate material collection and recycling and an integrated network of treatment plants including WtE, anaerobic digestion (AD) and also wastewater treatment plant (WWTP), for a reference study case area. The proposed system was compared to the actual situation, characterized by poor recycling, large landfilling and absence of WtE. The LCA results showed that the increased recycling significantly increases the environmental performances, but there is still room for improvement through the introduction of energy recovery (especially by WtE) and through its use within the system, for instance, by feeding the heat to the AD, to sludge recovery processes and supporting the water reuse practice. WtE offers a solution to manage non-recyclable MSW and allows saving important resources (such as landfill volumes and non-renewable energy), reducing the contribution to global warming, and providing an essential contribution to fulfill the goals of really sustainable waste management.

Keywords : anaerobic digestion, life cycle assessment, waste-to-energy, municipal solid waste

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