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LIFE CYCLE ASSESSMENT (LCA) OF MUNICIPAL SOLID WASTE MANAGEMENT SYSTEMS IN CLUJ COUNTY, ROMANIA

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Abstract

Life Cycle Assessment (LCA) is a methodology that can be used to evaluate the environmental performance of municipal solid waste management systems (MSWMS). Despite of Waste Directive provisions, this methodology is insufficiently applied as a decision-support method able to identify the best option for the waste management in Romania. In this paper we applied LCA methodology to study of the municipal waste management system of Cluj County, supported by GaBi software. The aim of this study is to identify the most environmentally friendly waste management scenario. To fulfill this goal, four different MSWMS scenarios have been developed and applied for Cluj County. Scenario #1 represents the current MSW management status in the area of concern, involving the commingled collection systems, transportation and landfilling, while in case of the second Scenario assumes the inclusion of composting, which is applied for the wet part of the MSW, in order to obtain a similar product as the compost (SPC). The quality of SPC is not so good, but the product can be used at least as covering material for landfill rehabilitation (the existing old landfills) or other contaminated areas such as forests, mines, quarries. Scenario #3 integrates the recycling options for the recyclable materials. In Scenario #4 incineration was added for the residual waste defined as "other waste" (household hazardous waste). The Life Cycle Inventory analysis was carried out by using the GaBi4 software.
The environmental impacts of these four scenarios were analyzed with respect to the global warming potential (the highest value was 9.34E+20 kg equiv. CO_2 for Scenario 1 and the lowest value was -1.44E+21 kg equiv. CO_2 for Scenario 4, the negative value reflecting an avoided impact on the environment), acidification potential (the highest value was 2.68E+15 kg equiv. SO_2 for Scenario 1 and the lowest value was -9.63E+16 for the Scenario 4), eutrophication potential (the highest value was 6.30E+14 kg equiv. PO_4 for Scenario 4 and the lowest value was 1.60E+14 kg equiv. PO_4 for Scenario 1), human toxicity potential (the highest value was 4.26E+08 kg equiv. DCB for Scenario 1 and the lowest value was -2.00E+11 kg equiv. DCB for Scenario 4), freshwater aquatic ecotoxicity potential (the highest value was 9.86E+05 kg equiv. DCB and the lowest value was -2.00E+11 kg equiv. DCB) and photochemical ozone creation potential (the highest value was 1.57E+15 kg equiv. ethene and the lowest value was -7.50E+16 kg equiv. ethene). The results revealed that Scenario #4 can be identified as the most environmentally friendly one, due to the good results regarding all environmental impacts and higher energy recovery (1.90E+09 MJ for Scenario 4 compared to 7.78E+07 MJ for Scenario 2). In all scenarios, the generated impact for the global warming category has a dominant contribution and the impact on eutrophication potential play an important role. In this study the waste management scenarios were investigated only by the environmental point of view and for the economic and social effects of solid waste management will need to consider other decision-making tools.

Key words: environmental potential impact, landfilling, Life Cycle Assessment (LCA), Municipal Solid Waste (MSW), waste management

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