LIFE CYCLE ASSESSMENT OF AN INTEGRATED SOLID WASTE MANAGEMENT SYSTEM IN JOHOR BAHRU

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I dedicated this entire work to my beloved family and friends who were always be my side…

For all their selfless love, support, inspiration and encouragement

Thanks...
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The disposal of municipal solid wastes in landfill resulted in significant emissions of greenhouse gases (GHGs), predominantly methane (CH₄) and causes greenhouse effect leading to global warming. The aim of this study is to assess the environmental impacts of municipal solid waste management in Johor Bahru, Malaysia. It is also aimed at reducing the GHGs emission from the related waste-disposal activities based on several scenarios by utilizing the concept of integrated solid waste management (ISWM). This approach has been applied to optimize the management of the wastes with the main targets of GHGs emissions reduction and its impacts to the environment. In this proposed scenarios, wastes were being fractioned for different waste management options which include source separation, recycling, composting, incineration and landfilling. Subsequently, comparison of the existing and alternatives wastes management scenarios was performed based on their respective impacts to the environment via cradle-to-grave approach known as life cycle assessment (LCA). Scenario 1 is an integrated system which involves recycling, composting, incineration and landfill. Meanwhile, only three treatments involved in scenario 2 (composting, incineration, landfill) and scenario 3 (recycling, incineration, landfill). Scenario 4 is the current situation which involve recycle and landfill. Even though scenario 4 shows an emission of 2.04 kg CO₂-eq of CH₄ and 31.63 kg CO₂-eq of carbon dioxide but by taking integrated system into account, scenario 1 gave less impact compared to others (scenario 2; 1404.99 kg CO₂-eq and scenario 3; 1837.64 kg CO₂-eq) with emission of 10.59 kg CO₂-eq and 1292.7 kg CO₂-eq for CH₄ and CO₂ respectively. ISWM system, with a combination all treatments of recycling, composting, incineration and landfill (scenario 4) has shown best result in general and less emissions compared to the others. A combined facility or integrated solid waste management would be ideal for Johor Bahru.
ABSTRAK

Pelupusan sisa pepejal di tapak pelupusan telah menyebabkan kesan rumah hijau hasil pelepasan gas rumah hijau (GHG) yang kebanyakannya adalah gas metana (CH$_4$) dan seterusnya membawa kepada pemanasan global. Tujuan kajian ini adalah untuk menilai kesan terhadap alam sekitar hasil daripada pengurusan sisa pepejal perbandaran di Johor Bahru, Malaysia. Ia juga bertujuan mengurangkan pelepasan GHG daripada aktiviti pelupusan sisa yang berkaitan berdasarkan beberapa cadangan senario dengan menggunakan konsep pengurusan sisa pepejal bersepadu (ISWM) demi mengoptimumkan pengurusan sisa pepejal. Berdasarkan cadangan senario, pembahagian sisa telah dilakukan untuk pengurusan yang berbeza seperti pengasingan di sumber, kitar semula, kompos, pembakaran dan pembuangan di tapak pelupusan. Setelah itu, perbandingan dilakukan terhadap pengurusan sedia ada dan senario alternatif berdasarkan kesan masing-masing kepada alam sekitar melalui kajian penilaian kitar hayat iaitu daripada awal sehingga akhir proses. Senario 1 adalah satu sistem bersepadu yang melibatkan kitar semula, kompos, pembakaran dan tapak pelupusan. Hanya tiga rawatan terlibat dalam senario 2 (kompos, pembakaran, pelupusan) dan senario 3 (kitar semula, pembakaran, pelupusan). Senario 4 adalah keadaan semasa yang melibatkan kitar semula dan tapak pelupusan. Walaupun senario 4 menunjukkan pembebasan CH$_4$ sebanyak 2.04 kg CO$_2$-persamaan dan karbon dioksida (CO$_2$) 31.63 kg CO$_2$-persamaan tetapi dengan mengambil kira sistem bersepadu, senario 1 memberi kesan yang kurang berbanding yang lain (senario 2; 1404.99 kg CO$_2$-persamaan dan senario 3; 1837.64 kg CO$_2$-persamaan) dengan pelepasan 10.59 kg CO$_2$-persamaan dan 1292.7 kg CO$_2$-persamaan untuk CH$_4$ dan CO$_2$. Senario 1, sistem ISWM menunjukkan hasil yang terbaik secara umum dan kurang pembebasan GHG berbanding yang lain. Pengurusan sisa pepejal secara bersepadu adalah sesuai untuk Johor Bahru.