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Generation and Composition of Municipal Solid Waste (MSW) in Muscat, Sultanate of Oman

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Abstract

The success of waste management requires accurate data on generation and composition of waste which is pivotal for the decisions towards the appropriate waste management system. At present there is no data available on Municipal Solid Waste (MSW) generation and composition collected systematically in Oman. Hence, this preliminary study was conducted in Al-Multaqaa landfill, the only engineered landfill functioning in Oman. The main objective of this study is to determine the generation rate and composition of municipal solid waste with the intention of providing base line data for development of municipal solid waste management system. The samples were collected from the landfill in two different seasons, in summer and winter. The collected sample was sorted out into various components. Subsequently, the weight and volume of each component were measured and recorded. The daily generation of MSW works out to be 0.97 Kg/day/person by weight, $3.113 \times 10^{-3} \text{ m}^3/\text{day}/\text{person}$ by volume with a density of $311.73 \text{ Kg}/\text{m}^3$. The study results reveal that the MSW stream has the largest proportion of biodegradable and recyclable waste. If waste management options such as composting, recycling and energy recovery are to be practiced in the future, there is a greater possibility of reducing substantial amount of waste stream getting disposed to the landfill.

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1. Introduction

Due to the fast economic development and urbanization, the generation of municipal solid waste (MSW)

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has rapidly increased worldwide and the composition of MSW has also changed significantly. These changes bring more pressure on the existing environment, human health and also to the management of MSW system [1], [2]. Generally, increased population growth and rising consumer choices have resulted in a larger production of waste worldwide [3]. The sources of MSW are primarily classified in to residential, institutional and commercial waste [4], [5]. The characteristics and composition of MSW depends on the topography of the area, seasons, food habits and commercial status of the city etc. [6]. Solid waste needs to be characterized for source, generation rates, type of wastes produced and composition, in order to monitor, control and to improve prevailing waste management systems. All the important information related to sources, quantity and composition are very important for the design and operation of the functional elements related to waste management. The functional elements include waste generation, on-site handling and storage, collection, transfer and transport, processing and recovery, recycling and reuse, treatment and final disposal. The reliable estimates of MSW generation are vital for effective waste management planning and help taking better financial, regulatory and institutional decisions [7].

The gulf regions have the highest per capita waste generation across the world. The total volume of solid waste generated in GCC region is approximately 120 million tons per year, in which MSW is the second largest waste category by source [8]. Muscat is the capital and most important city in the Sultanate of Oman. The modern developments in the residential, commercial and industrial sector have extended the city limits into surrounding areas. Recently townships connected with highways and modern utilities witnessed growth on economic development, industrialization, urban sprawl and commercial activities [9]. The increase in population had created an increase in waste generation by more than 4 folds from 257,004 tons in 2001 to 1,343,486 tons in 2009 [10]. At present, there is no systematically collected data or information available in Oman regarding solid waste composition and characteristics. Hence, it is essential to study the composition and characteristics of solid waste, which will help in improving solid waste management strategies and consequently reducing many environmental impacts. Hence an attempt was made to study the generation and composition of MSW from Al-Multaqaa landfill, the only engineered landfill functioning in Oman.

2. Materials and Methods

2.1. Study area and design

The samples were collected from Al-Multaqaa landfill in two different seasons. Sampling was carried out three times on a fortnight interval for each season, i.e., January & February during winter and May & June during summer to represent respective seasons. The Al-Multaqaa landfill for MSW disposal is situated in the Wilayat (District) of Al-Amerat, Muscat governorate, Sultanate of Oman. Initially, the Municipal solid waste sample was collected from four different directions at randomly selected locations of the waste piles, where waste was offloaded by the heavy trucks from transfer stations. Following an earlier work [6], approximately 20 kg of so collected sample was subjected to reduction of the sample quantity to 5 kg using quartering technique without compromising the prevailing composition of solid waste components. Then the reduced sample was sorted out manually into various components. Subsequently, the weight and volume of each component were measured and recorded. The total density is calculated by dividing total weight by total volume which amounts to the average density of MSW.

2.2. Determination of rate of generation of MSW

The per day generation rate was calculated from the daily quantity of waste arriving at the landfill facility which was obtained from the concerned municipal authority. Based on the total weight of waste disposed in

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