DEVELOPMENT OF MUNICIPAL SOLID WASTE GENERATION AND RECYCLABLE COMPONENTS RATE OF KUALA LUMPUR: PERSPECTIVE STUDY

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ABSTRACT

This paper presents a forecasting study of municipal solid waste generation (MSWG) rate and potential of its recyclable components in Kuala Lumpur, the capital city of Malaysia. The generation rates and composition of solid wastes of various classes such as street cleansing, landscape & garden, industrial & constructional, institutional, residential and commercial are analyzed. The past and present trends are studied and extrapolated for the coming years using Microsoft office 2003 Excel spreadsheet assuming a linear behavior. The study shows that increased solid waste generation at Kuala Lumpur is alarming and recommends that the concerned authority (DBKL) should view this issue seriously. It has been found that the city is still lacking in terms of efficient waste treatment technology, sufficient fund, public awareness, maintaining the established norms of industrial waste treatment etc.

Keywords: MSWG; DBKL; Waste composition; Recycling; Residential waste.

INTRODUCTION

The waste generation rate in Kuala Lumpur, the capital city of Malaysia is continuously rising up every year due to the uncontrollable consumption owing to the increasing population, the attitude towards shopping and the high living standard. It is expected that the amount of solid waste generated in Kuala Lumpur reach double in the next twenty years; from 3.2 million tons a year today, to 7.7 million tons a year [1, 2]. Today SWM is the biggest environmental problem is Malaysia. The amount generated of the waste continues to increase in response to rapid increase in Population, accelerated urbanization and industrialization process [3]. The amount of solid waste management in Malaysia has put pressure on local authorities making them continually seek new management strategies to deal with these wastes generation i. e. demand management, as well as, find new sites for landfill i.e. supply management [4]. In 2006, about 7.34 million tones of solid wastes were generated in Malaysia, enough to fill up 42 buildings [5].

The current study is to assess the generation rate of MSW at Kuala Lumpur, and the potential of its recyclable components. The past and present trends are studied and by means of a prediction model which is solved by MS Excel 2003 worksheet the future trend is predicted. As far as the authors are aware, in the open literature this kind of a study has not been reported from Malaysia so far.

SOLID WASTE GENERATION IN MALAYSIA

The official estimated Kuala Lumpur's population in 2007 is 1.604 million according to statistic department 2007. The quantity of waste generation in Kuala Lumpur alone is projected to increase from 2,620 tons in 1995 up to 3,070 tons in 2000 [6]. In Kuala Lumpur alone, the estimated solid waste generation was 4000 tons per day in the year 2000 [7].

Solid waste management in Malaysia is governed under concurrent list of the 9th schedule of the federal constitution [8]; under this list public health and sanitation can be carried out by the Federal government, state and also the local authorities that include collection, transportation, treatment and disposal of wastes. Economic growth in Malaysia has brought prosperity; it has started to impose costs of industrial pollution and degradation of the urban environment [4]; in Malaysia planning and management of solid waste are under the responsibility of local government and its departments that deal with urban cleansing and services. Solid waste management can be defined as the discipline associated with the control of generation [9].

Despite the aggressive economic development in Malaysia, the solid waste management is relatively poor and haphazard [10, 4]. Waste minimization strategy and control for the coming few years in Kuala Lumpur is the objective, to achieve the UN Agenda 21 which emphases on human and environment. Table 1 shows solid waste composition of selected locations in peninsular Malaysia and figure 1 shows the corresponding graphical representation.

Table 1: Solid Waste Composition of Selected Locations in Peninsular Malaysia [11]

Waste Composition	Kuala Lumpur	Saha Alam	Petaling Jaya
Garbage	45.7	47.8	36.5
Plastic	9.0	14.0	16.4
Bottles/Glass	3.9	4.3	3.1
Paper/Cardboard	29.9	20.6	27.0
Metals	5.1	6.9	3.9
Fabric	2.1	2.4	3.1
Miscellaneous	4.3	4.0	10.0

Kuala Lumpur alone in 1991 spent roughly about RM 25.2 million cost of managing solid waste; the comparative figures of the damage costs of haphazard open damping landfill practice were RM 178.30 per ton [4].

In 1979 Environment Protection Society Malaysia EPSM called for an official policy for recycling and recovering solid wastes; moreover, Environmental Protection Society Malaysia EPSM statement recommended separation of wastes component at its generation point, separated waste must be placed in separate containers and organic waste should be used in biogas plant for composting and or for energy generation. Domestic rubbish collection was far from satisfactory [4]. The industrial sites are mainly concentrated at Kuala Lumpur, Penang and Johor [12]. With the increase in municipal waste generation from 5.6 million tonnes in 1997 up to 8.0 million tonnes in 2000, there is an urgent need for a better managed disposal option [13]. MSW generated in Kuala Lumpur in 2002 is given in table 2. Kuala Lumpur's solid waste composition from 1975 to 2000 is given in table 3 and figure 2 shows the corresponding graphical illustration.

Table 2: MSW Generated in Kuala Lumpur in 2002 [14]

Years	K. L. Population	Solid Waste Generated (tones/day)
1998	1,446.803	2,257
2000	1,787.000	3,070
2005	2,150.000	3,478

Table 3: Kuala Lumpur's Solid Waste Composition (1975-2000)

Composition of waste	1975[5]	1980[4]	1990[7]	1995[4]	2000[4]
Organic	63.7	78.05	40.8	61.76	68.67
Paper	11.7	11.48	30.0	12.16	6.43
Plastic	7.0	0.57	9.8	5.27	11.45
Glass	2.5	0.57	3.0	5.27	1.41
Metals	6.4	3.16	4.6	6.89	2.71
Textile	1.3	3.16	2.5	2.84	1.50
Wood	6.5	2.58	3.2	0.00	0.70
Others	0.9	0.43	6.1	5.81	7.13

Source: 4) [8], 5) [15], and 7) [16]

METHODOLOGY

The assumptions regarding the solid waste generation for various classes is given in table 4 and other basic assumptions are given in table 5

Table 4: MSWG rate (Tons/day) [17]

Sector	Percentage
Street Cleansing	11%
Landscape & Garden	07%
Industrial & Constructional	04%
Institutional	06%
Residential	48%
Commercial	24%

Table 5: Miscellaneous Assumptions

Parameter	Assumption
Rate of population increase	4% per year [12]
MSWG per person	1.50 kg per day[17]
Rate of increase of SWG per person	2% per year [17]
Total waste per house with 3.5 person per house	5.25 (1.5x3.5)kg per house per day
Volume of waste per house per day with bulk density = 100 kg/m^3	100.00 m^3
Frequency of MSW Collection	3 times per week
Total MSW in Kula Lumpur per week	7 tons
Population of Kuala Lumpur in 2004	2 million (including foreigners) [12]
The share of recyclable material	20% [18]

The official census data of 2000 considered 2% increase in population of Kuala Lumpur. However, in the present study 4% of increase is assumed to incorporate the excess population

(owing to daily working people, jobseekers, resident foreigner's etc.) in Kuala Lumpur as the capital city. In this model, 52 weeks are considered in one year. A flexibility of ±10% in the total yearly solid waste generation is also incorporated due to predicting literally and management weakness.

RESULTS AND DISCUSSION

Solid Waste Generation. Table 6 shows the predicted results of total solid waste generated (per day and per year). For instance, the MSWG in column 4 for a population of 2.43 millions in 2009 is 4029.85 tons/day. This figure is similar to pervious data which states that, if the current waste generation trends continue increasing at 2% rate per/year the waste generation will reach 3478 tons in 2005 [17].

These trends can be used to predict the future tendency and also help with the design of the treatment facility and landfill size [13]. Table 7 shows the prediction of SWG of various sectors under study. The solid waste (based on 48% proportion) only from residential sector is 13540.31 tones/week. This means 1823.46 tons/day as shown. This result matches with the data of municipal authority of Kuala Lumpur (DBKL), 1993.The second highest is commercial which indicates enhanced business activity in the city. The third highest is street cleansing which indicates the tropical nature of Kuala Lumpur.

Table 6: Prediction of Total MSWG of Kuala Lumpur

Year	Population of K.L. city Millions	MSWG Kg/Cap./day	MSWG Tons/day	MSWG Tons/year
2009	2.43	1.66	4029.85	1470895.25
2011	2.63	1.72	4534.78	1655194.70
2013	2.85	1.79	5102.97	1862584.05
2015	3.08	1.87	5742.35	2095957.75
2017	3.33	1.94	6461.85	2358575.25
2019	3.60	2.02	7271.50	2654097.50
2021	3.90	2.10	8182.59	2986645.35
2023	4.21	2.19	9207.84	3360861.60

Table 7: Prediction of Sectoral SWG of Kuala Lumpur (Tons/day)

Year	Residential (48%)	Street Cleansing (11%)	Commercial (24%)	Institutional (6%)	Construction & Industry (4%)	Landscape (7%)
2009	1934.33	443.28	1025.97	241.79	161.19	282.09
2011	2176.69	498.83	1088.35	272.09	181.39	317.43
2013	2449.42	561.33	1224.71	306.18	204.12	357.21
2015	2756.33	631.66	1378.16	344.54	299.69	401.96
2017	3101.69	710.80	1550.84	387.71	258.47	452.33
2019	3490.32	799.86	1745.16	436.29	290.86	509.00
2021	3927.64	900.09	1963.82	490.96	327.30	572.78
2023	4419.77	1012.86	2209.88	552.47	368.31	644.55

Potential of Recyclable Components. Table 8 shows the recyclable components and their percentage share and recycling rate in tons per year. The graphical representation of percentage recyclables is shown in figure 1. The results indicate that, the MSW in Kuala Lumpur has a good potential of recyclable components. But unfortunately the attention paid by the authority towards this direction is not sufficient enough to tackle this issue. The Agenda 21 of the UNCED 1992, defined environmentally sound technologies protect the environment; moreover, recycling most of the wastes and handle residual wastes in more acceptable manner. Though recycling activity in Malaysia is rising up, the recycling industry still needs to be enhanced. The Malaysian's attitude towards recycling is higher, but only few practice it [18]. It is alarming that, due to lack of proper recycling activity, Malaysian Newsprint Industries Sdn. Bhd. is forced to import 50% of its materials and Kuala Lumpur Glass Manufacturers Sdn. Bhd. also import up to 20% (New Sunday Times, 20th Oct., 2002b). Since 1993 a major effort of recycling was lunched by the Ministry of Housing and Local Government but unfortunately limited recycling activities taken place [19]. In Kuala Lumpur, by 2005 the recycling of the waste generated planned to reach 16 % and 22% by 2020 [20].

Table 8: Recyclable Components and Their Percentage Share

Recyclable SW Components	**Mass (kg/Cap./year)**	**Percentage**	**Recycling rate Tons/year**
Food waste	387.63	56.80	155041.11
Mixed paper	35.59	16.50	26687.94
Mixed plastic	61.87	15.30	24747.00
Textile	07.12	01.30	2847.00
Rubber & leather	03.29	00.60	1314.00
Wood	02.19	00.40	876.00
Other combustible	00.00	00.00	00.00
Yard	25.73	04.70	10293.00
Fine	03.83	00.70	1533.00
Glass	06.57	01.20	2628.00
Ferrous	13.14	02.40	5256.00
Aluminum (al)	00.55	00.10	219.00

Based on supply and demand theory of recyclable materials, the market price is changeable. The potential higher demand is on mixed paper, mixed plastic and aluminum, however, nowadays, their costs (per kg) are roughly RM 0.25, RM 0.20 and RM 0.50 respectively. From table 8 the cost per year of mixed paper is RM 6,671985.00 mixed plastic is RM 4,949400.00 and of aluminum is RM 109,500.00. Consequently, the aluminum ring (pure aluminum) of soft drink can's costs still vary according to market fluctuation between RM 5-7!

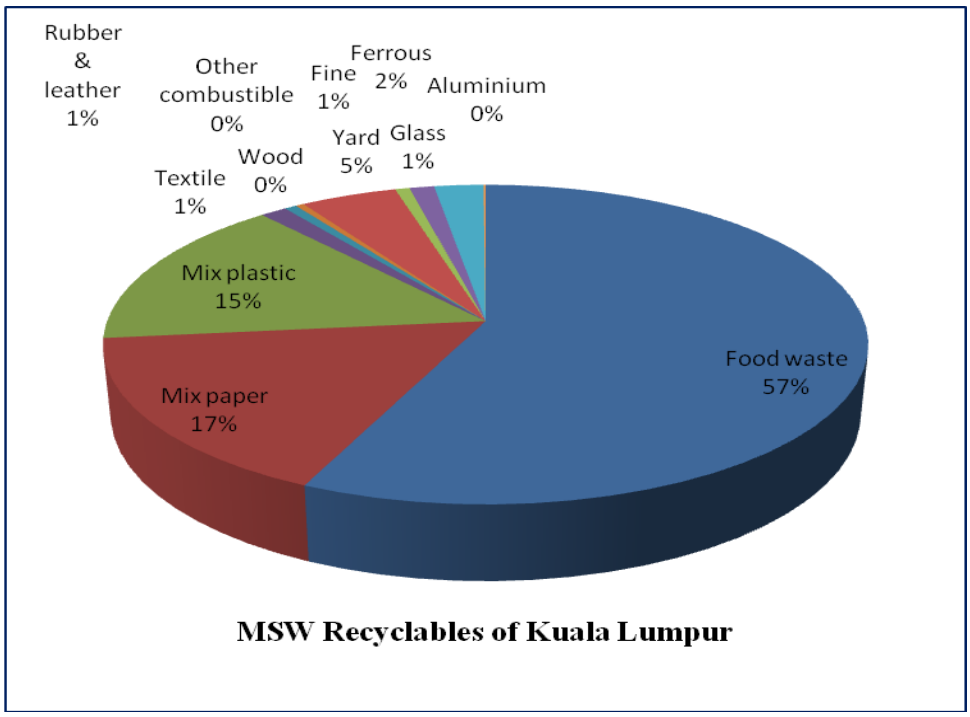

Figure 1: MSW Recyclables of Kuala Lumpur

CONCLUSION

A comprehensive survey on the solid waste generation of Kuala Lumpur city and the potential of its recyclable components has been examined. After common assessment and analyzing the past and present data a forecasting model is developed and solved using MS Excel 2003 worksheet to predict the future trend. It has been found from the predictions that the solid waste generation in the city is presently very high and may become worse in future therefore, DBKL should give attention toward this coming issue. Moreover, the MSW has a good potential of recyclable values. Hence it is recommended that the concerned authority should focus more on developing effective means of waste minimization and recycling. As extension to this study, a mathematical model may be developed and solved to have more realistic predictions.

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