

ACU1176



**MUNICIPAL WASTE CHARACTERISTICS  
AND MANAGEMENT IN  
PANTAI DALAM, KUALA LUMPUR**

**RATANAM ANDYTHAVEN**

Perpustakaan Universiti Malaya



A510232821

OK

DISSERTATION SUBMITTED TO THE INSTITUTE OF POSTGRADUATE  
STUDIES AND RESEARCH (IPSP), UNIVERSITY MALAYA IN PARTIAL  
FULLFILMENT OF THE REQUIREMENTS FOR DEGREE OF MASTER IN  
TECHNOLOGY (ENVIRONMENTAL MANAGEMENT)

INSTITUTE OF POSTGRADUATE STUDIES AND RESEARCH (IPSP),  
UNIVERSITY OF MALAYA,  
50603 KUALA LUMPUR

2001

## TABLES OF CONTENTS

---

ACKNOWLEDGEMENTS .....	i
ABSTRACT .....	ii
LIST OF TABLES .....	v
LIST OF FIGURES .....	x
LIST OF PLATES .....	xi
LIST OF MAPS .....	xiii
LIST OF ACRONYMS .....	xiv
<b>CHAPTER ONE: INTRODUCTION .....</b>	<b>1</b>
1.1 Introduction .....	1
1.2 General solid waste generation scenario .....	2
1.3 Solid waste generation rate in Malaysia .....	3
1.4 Solid waste composition in Malaysia .....	8
1.5 Solid waste management .....	9
1.6 Background information of the study areas .....	11
1.7 Present solid waste status and problems in the study area .....	14
1.8 Objectives .....	16
<b>CHAPTER TWO: LITERATURE REVIEW .....</b>	<b>17</b>
2.1 Definition of waste .....	17
2.2 Definition of solid waste .....	20
2.3 Definition of urban solid waste .....	24

## TABLES OF CONTENTS

---

2.4 Waste generation rate.....	29
2.5 Waste characteristic .....	35
2.5.1 Waste density.....	35
2.5.2 Moisture content .....	42
2.5.3 Waste composition.....	43
2.5.4 Sosio economic survey analysis .....	53
2.6 Waste management .....	55
2.6.1 Waste recycling.....	66
<b>CHAPTER THREE: METHODOLOGY.....</b>	<b>71</b>
3.1 Background information of the study areas.....	71
3.2 Methods.....	72
3.2.1 Field survey.....	72
3.2.2 Density .....	75
3.3 Waste composition determination .....	75
3.3.1 Nitrogen test.....	75
3.3.2 Determination of pH, Acidity and Alkalinity .....	77
3.3.3 Conductivity.....	78
3.3.4 Moisture.....	78

## TABLES OF CONTENTS

---

3.3.5	<i>Determination of water extractable nutrients in municipal solid waste</i>	79
3.3.6	<i>Other determination</i>	80
3.3.7	<i>Heavy metals determination</i>	80
3.3.8	<i>Microbiological testing</i>	81
<b>CHAPTER FOUR: RESULTS AND DISCUSSION</b>		<b>82</b>
4.1	Waste generation rate	82
4.2	Solid waste generation and economic status	83
4.3	Waste generation varies according to religion and culture	85
4.4	Waste characterization	87
4.4.1	<i>Composition of municipal solid waste</i>	87
4.4.2	<i>Physical analysis</i>	91
	1. <i>Moisture content</i>	91
	2. <i>pH/ Conductivity</i>	91
	3. <i>The percentage of particles size (sieving) of loose materials</i>	91
4.4.3	<i>Chemical analysis</i>	94
	1. <i>Carbon to nitrogen ratio</i>	94
	2. <i>Water extractable nutrients</i>	95
	3. <i>Heavy metal</i>	96

## TABLES OF CONTENTS

---

4.4.4 Biological analysis .....	96
1. Micro and Macrofauna analyses .....	96
4.5 Solid waste storage .....	97
4.5.1 Household solid waste storage .....	97
4.5.2 Communal storage .....	101
4.5.3 Natural yard waste composting .....	102
4.5.4 Illegal dump sites .....	103
4.6 Waste collection and transportation .....	114
4.6.1 Kind of transportation used .....	116
4.6.2 Number of workers involved .....	116
4.6.3 Frequency of waste collection .....	117
4.6.4 The conditions of communal containers .....	118
4.6.5 The opinion of public towards the state of waste collection and management in their areas .....	121
4.6.6 Cost of municipal solid waste management .....	122
4.7 Waste recovery .....	125
4.7.1 Recovery and the possibilities of waste use .....	126
4.7.2 Public attitude towards waste recycling .....	127

## TABLES OF CONTENTS

---

4.7.3 <i>Public response on drop-off center</i> .....	131
4.7.4 <i>Public attitude towards enforcing an extra pay for environmental friendly product</i> .....	136
4.7.5 <i>Public opinion on whether packaging and container materials make their life more easier and comfortable</i> .....	126
4.7.6 <i>Public attitude towards imposing of a product charge on plastic carrier</i> .....	138
4.7.7 <i>Public awareness towards environmental problem caused by municipal solid waste</i> .....	140
4.8 Waste sorting .....	141
<b>CHAPTER FIVE: RECOMMENDATIONS</b> .....	<b>146</b>
5.1 Introduction .....	146
5.2 The role of municipal council.....	148
5.3 The role of private municipal waste management sectors .....	149
The role of the government.....	151
5.4 The role of the public .....	152

## TABLES OF CONTENTS

---

CHAPTER SIX: CONCLUSION.....	156
REFERENCES : .....	158
<i>APPENDIX 1</i>	
QEUSTIONNAIRE .....	169

## ACKNOWLEDGEMENTS

*My sincere thanks goes to my supervisor Associate Professor Dr. P Agamuthu, who actively guided me throughout the course and initiating this project. Without his encouragement, I might not have completed this thesis. I really appreciate his speed in coming back to me with his comments.*

*I thank, all the authorities responsible of municipal solid waste management in Pantai Dalam for allowing me to do field observation and data collection. Because this research owes so much interaction with public, I owe a deep debt of gratitude to the residents of Taman Bukit Angkasa, squatter area, and long house, who contributed their full support and cooperation to conduct the survey. My sincere gratitude is also extended to Miss Fathiah form Local Government Department to all assistants and support.*

*I would like to express my and gratitude to my parents (Mr. and Mrs. Andythaven), my aunty, uncle and my beloved daughter Dharyshina Thever for their endless motivation. I know that the completion of my studies means very much to them. Last but not least, thanks are due to Mr. Letchumanan for assistance with the experiments and for valuable discussion. Finally, I also would like to thanks Ms Shamala Devi d/o Krishnan for all the help.*

**RATANAM ANDYTHAVEN**  
**2001**



## ABSTRACT

The primary purpose of this research was to study comprehensively the municipal waste generation (rate, quantity), waste characterization including (physical, chemical and biological parameters), heavy metal content, waste recovery and recycling, and socio economic aspects of municipal solid waste (MSW) generation and management in Taman Bukit Angkasa, Pantai Dalam, Kuala Lumpur and the surrounding areas. The waste characterization and management was determined with actual field observations coupled with questionnaire survey from a random sample of 250 households (200 flats houses, 25 long houses and 25 squatter residences). The quantification and other parameters (heavy metals, water extractable nutrients, nitrogen, pH, acidity, alkalinity, conductivity) were determined using standard methods (X-ray Fluorescence Spectrometry, Flame Spectroscopy, Kjeldahl Auto Analyser, Radiometer Electrical Conductivity measuring Instrument and pH meter).

An average of 1.8 kg of municipal waste was generated by residents' daily, which is higher than the national average generation rate of 1.0 kg per person. Almost 95% of the household waste was mixed waste. It was found that an improvement in the living standard not only results in an increase in the volume of waste generation, but also alters the characteristics of the waste disposed. The findings indicate that, the municipal waste had a C/N ratio of 28:1 for flats, 30:1 for squatter and 26:1 for long house. The average amount of water extractable elements in the waste, such as, Nitrate was 147 mg/L, Phosphorous 107.5 mg/L, Potassium 940.5 mg/L, Magnesium 155.5 mg/L,

Calcium 797.5 mg/L, Aluminium 18 mg/L and Chloride 120 mg/L. The composition of municipal waste generated varied depending on the human behavioral pattern and religious practices, festival seasons and status level. The moisture content in municipal waste from flats was very high (51.7%) because it contained more organic waste compared to waste from squatter (47.3%) and long house (43.8%). The mean pH of municipal waste was 5.98. The finding indicate that, the mean conductivity of municipal waste is  $1,375 \mu\text{S cm}^{-1}$  for flats,  $957 \mu\text{S cm}^{-1}$  for squatter and  $568.5 \mu\text{S cm}^{-1}$  for long house.

The study also revealed that, 93.2% of the total respondents were disappointed with the inefficient management of MSW by the waste management municipalities. Improper management of MSW had resulted in a number of environmental impacts and health implications. The study exposed that 72% of the respondents from flats supported the imposing of a payment on plastic bags, and majority of the respondents (86%) supported the need for a drop-off center for all recyclable items. Public participation was not encouraging in solving MSW problems in the study areas. It was found that, the proper place to separate waste materials for recycling and re-use is at the source of generation. Some of the householders are becoming more aware of the importance of source separating newspaper, plastic, glass bottles, aluminum cans and ferrous materials. Waste separation at source can be encouraged by financial rewards, legislation and raising environmental awareness among the public. Solid waste recycling programs should be integrated with other MSW management options to abate degradation in urban environment.

Based on existing solid waste management practices in the study area, six issues were identified: very little emphasize on municipal waste management practices (planning, organizing, and controlling), poor legislative control, lack of public awareness and commitments to keep the environment clean, lack of public participation in decision-making process and lack of environmental considerations in development plans and programs.

## LIST OF TABLES

---

Table 1.1	Waste generated via various activities and needs.....	1
Table 1.2	Solid waste generation per person in selected countries.....	2
Table 1.3	Estimated solid waste generated in Malaysia.....	6
Table 1.4	Solid waste generation rates in Malaysia.....	6
Table 1.5	The average waste generation rate in Petaling Jaya based on source.....	7
Table 1.6	Solid waste composition in Malaysia.....	8
Table 2.1	Waste category subdivision.....	19
Table 2.2	Materials categorized under broad heading of solid waste.....	21
Table 2.3	Difference in definition of MSW in Europe.....	24
Table 2.4	Squatter units in the Federal Territory of Kuala Lumpur.....	31
Table 2.5	The average calorific values of waste materials in MSW.....	34
Table 2.6	MSW composition in Japan.....	34
Table 2.7	MSW composition and calorific value by different level of income in Malaysia.....	36
Table 2.8	A comparative data of MSW composition and calorific value by residence type in Kuala Lumpur.....	37
Table 2.9 (a)	Calorific value of MSW (wet basis) for different areas in Kuala Lumpur.....	38
Table 2.9 (b)	Calorific value of MSW (wet basis) for different areas in Kuala Lumpur.....	39
Table 2.10 (a)	Calorific value of MSW (wet basis) for office and commercial areas in Kuala Lumpur.....	40
Table 2.10 (b)	Calorific value of MSW (wet basis) for office and commercial areas in Kuala Lumpur.....	41

## LIST OF TABLES

---

Table 2.11	The putricibles and moisture content.....	42
Table 2.12	Typical distribution of components in residential MSW for low-income, middle income and upper income countries (excluding recycled materials).....	45
Table 2.13	The composition and parameter of MSW in Kuala Lumpur.....	46
Table 2.14 (a)	The percentage and composition (wet basis) of solid waste in Kuala Lumpur.....	47
Table 2.14 (b)	The percentage and the composition (dry basis) of solid waste in Kuala Lumpur.....	48
Table 2.15	Waste generation and composition in different socio-economic areas of Accra, Ghana.....	49
Table 2.16	Municipal waste stream (wet basis) in different areas in Spain.....	50
Table 2.17	Waste composition in Israel (1997).....	51
Table 2.18	Municipal solid waste in various parts of world.....	52
Table 2.19	The remaining capacity of waste disposal sites in Federal Territory and Selangor.....	69
Table 4.1	Average number of family members and waste generation rate by residents in flat.....	84
Table 4.2	Average number of family members and waste generation rate by residents in long house.....	84
Table 4.3	Average family members and waste generation rate by residence in squatter.....	85
Table 4.4	The compositions and quantities of solid waste from selected Malay and Indian families in flats, squatter and long house settlements.....	86

## LIST OF TABLES

---

Table 4.5	The percentage of solid waste for three different level of groups.....	87
Table 4.6	Solid waste composition and generation by residents in flats on three different days.....	88
Table 4.7	Solid waste composition and generation by residents in long house on three different days.....	89
Table 4.8	Solid waste composition and generation by residents in squatter on three different days.....	90
Table 4.9	Moisture content of solid waste.....	92
Table 4.10	pH and conductivity of municipal waste.....	93
Table 4.11	The particles size of loose materials.....	94
Table 4.12	Carbon to Nitrogen ratio and Calcium to Magnesium ratio.....	95
Table 4.13	Water extractable elements of mixed waste .....	95
Table 4.14	Heavy metals in municipal solid waste.....	96
Table 4.15	Some of micro fauna in municipal solid waste.....	97
Table 4.16	Macro fauna in municipal solid waste.....	97
Table 4.17	Public opinion towards the state of waste collection and management in their area.....	121
Table 4.18	Percentage of respondents' use of components of MSW in a year.....	125
Table 4.19	Flats residents support for waste recycling (based upon educational level).....	128
Table 4.20	Long house residents support for waste recycling (based upon educational level).....	128

## LIST OF TABLES

---

Table 4.21	Squatter residents support for waste recycling (based upon educational level).....	129
Table 4.22	Waste recycling (all samples taken together).....	130
Table 4.23	Support for a drop-off center for recyclable items.....	131
Table 4.24	Flats residents support on drop-off center.....	132
Table 4.25	Long house residents support on drop-off center.....	133
Table 4.26	Squatter residents support on drop-off center.....	133
Table 4.27	Flats residents responses towards enforcing an extra pay for environmental friendly product based on educational level.....	134
Table 4.28	Squatter residents responses towards enforcing an extra pay for environmental friendly product based on educational level.....	135
Table 4.29	Long house residents responses towards enforcing an extra pay for environmental friendly product based on educational level.....	136
Table 4.30	Flats residences opinion on whether packaging and container materials makes their life more easier and comfortable.....	137
Table 4.31	Squatter residences opinion on whether packaging and container materials makes their life more easier and comfortable.....	137
Table 4.32	Long house residences opinion on whether packaging and container materials makes their life more easier and comfortable.....	138
Table 4.33	Flats residence attitude towards imposing a product charge on plastic carrier.....	139
Table 4.34	Squatter residence attitude towards imposing a product charge on plastic carrier.....	139

**LIST OF TABLES**

---

Table 4.35 Long house residence attitude towards imposing a product charge on plastic carrier.....140

Table 4.36 Public awareness towards environmental problems caused by municipal solid waste.....141



## LIST OF FIGURES

---

Figure 2.1 Functional elements and productive outputs of municipal solid waste management system.....	57
Figure 2.2 The waste management hierarchy.....	61
Figure 3.1 Summary of the two surveys.....	73
Figure 3.2 Models the sequence of the research process .....	74
Figure 4.1 Types of household municipal solid waste storage containers...	98

## LIST OF PLATES

---

Plate: 4.1	Traditional yard waste composting method.....	104
Plate: 4.2	Dumpsite in front of a squatter house.....	104
Plate 4.3	Dumpsite at the back of the long house .....	105
Plate: 4.4	Hazardous and non- hazardous waste dumped at the back yard.....	105
Plate: 4.5	A midnight dumpsite near the long house area.....	106
Plate: 4.6	Indiscriminate dumping of construction waste near the long house area.....	106
Plate: 4.7	Construction waste is the most visible pollutants of illegal dump site.....	108
Plate: 4.8	An unauthorized dump site near the road side.....	108
Plate: 4.9	Some of the garbage had been burned at the road side.....	109
Plate: 4.10	Bulky and solid waste dumped near a food stall.....	109
Plate: 4.11	Illegal dumping near a store.....	111
Plate: 4.12	Improper storage of municipal solid waste by residents near Station B.....	111
Plate: 4.13	Indiscriminate dumping of commercial solid waste .....	112
Plate: 4.14	Indiscriminate dumping in squatter area .....	112
Plate: 4.15	Solid waste had been stored near road side for collection.....	112
Plate: 4.16	Illegal dumping into a monsoon drain.....	113
Plate: 4.17	Types of vehicles used to transport the municipal solid waste.....	119

## LIST OF PLATES

---

Plate: 4.18	The waste disposal services provided are far below the expectation of the community served.....	119
Plate: 4.19	Runoff from dump site into the waterway.....	120
Plate: 4.20	Heaps of bulky waste create an ugly environment.....	120
Plate: 4.21	Mixed waste had been deposited in heaps at communal collection point.....	144
Plate: 4.22	Sorting been carried out by scavengers.....	144
Plate: 4.23	Setting a side non-recyclable waste at the point of collection.....	145
Plate: 4.24	Some of the valuable items stored.....	145

**LIST OF MAPS**

---

Map 1.1 Location of the study area in Federal Territory of Kuala Lumpur...12

Map 1.2 Detailed lay out of the housing schemes in the study area.....13

## LIST OF ACRONYMS

1. PPFBS -prefer pack food buy from shop
2. HMHWCGA -how much household waste currently generating can avoided
3. HOGKW -household organic garden and kitchen waste
4. STYDARU -store your daily rubbish
5. KWSCONT -kind of waste storage containers used
6. LYSSWYH - long you store your solid waste in house
7. DROFCEN -support drop-off center
8. OWNSOR -own sorting
9. FERWACO - frequency of waste collection in a week
10. SAFWCO - satisfied with the frequency of waste collected in your area
11. SAESTS - satisfied service provided by street sweepers
12. WEPEEP -willing to pay extra for environmentally friendly products
13. HMEYWP -how much extra you are willing to pay
14. SIPCPSB - support imposing of a product charge on plastic carrier bags
15. HMPCYP -product charge you prefer
16. WHBYACT -what will your action be
17. SCCOF -sometimes communal containers over flow
18. PMOLMEC -packaging makes life easier and comfortable
19. YDTMCY - you depend too much on others to clean your back yard