Seasonal Variation in Hilla Municipal Solid Waste Composition

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Abstract

This study deals with seasonal variation in municipal solid wastes composition of Hilla city during one year period . Significant variations in quantities due to seasons variation were found especially , the variation of paper component . Solid waster have the lowest moisture content (42 %) at Autumn season's while , Summer season solid wastes have a highest density (184 Kg / m^3) and a lowest dry calorific value (12056 KJ / Kg) .

الخلاصة

تتناول هذه الدراسة التغيرات الموسمية في تركيبة النفايات الصلبة البلدية لمدينة الحلة خلال فترة سنة واحدة. تم العثور على اختلافات كبيرة في الكميات تزامنا مع اختلاف المواسم خاصة الاختلاف في كميات الورق. في فصل الخريف كان للنفايات الصلبة ادنى محتوى رطوبي فقد بلغ (42%) بينما كان للنفايات الصلبة في فصل الصيف اعلى كثافة واقل قيمة حرارية

2-Introduction

Solid waster are often called municipal solid waste (MSW) and consist of all the solid and semi solid material discarded by a community (Peavy , 1986) .

The fraction of MSW produced in domestic house holds is called refuse . The composition of refuse has been changing over the past decades . Much of the material historically has been food waste , but new materials such as plastics and aluminum cans have been added to refuse , and the use of kitchen garbage grinders has decreased the food waste component . Most of the new products created each year by industry eventually find their way into MSW and contribute to individual disposal problems .

Each town or city produces a different composition of waste since the inputs depend on socio-economic factory , type of industry and level of industrialization , geographic location , climate , level of consumption , collection system , population density , the extent of recycling , legislative controls and public attitude (Williams , 1998) .

Types of solid wastes consist of ; food wastes , rubbish , ashes and residue , demolition and construction wastes , special , treatment plant wastes , agricultural wastes and hazardous wastes . In all cases , these wastes must be handled and disposed of with great care and caution .

One of the most factor that influence the quantity of solid wastes generated is season of the year , as the quantities of certain types of solid waste are also affected by the season of the year . For example , the quantities of food wastes are affected by the growing season for vegetables and fruits (Tchobanglous , 1977) .

The season of the year can influence both the amount certain type of solid waste generated and the collection operation . Because of the variation in the quantities of certain types of solid wastes generated under varying seasons , special studies should be conducted when such information will have a Significant impact on the system .

3- Properties Of Solid Waste

Information of the properties of solid wastes is important in evaluating alternative equipment needs, system and management programs and plans.

3.1 : Physical Composition

Physical composition of solid wastes including identification of the individual components that make up municipal solid wastes, analysis of particle size, moisture content and density of solid waste.

3.1.1 : Individual Components

Components that typically makeup most MSW and their relative distribution are reported in Table (1).

3.1.2 : Particle Size

The size of the component materials in solid wastes is of importance in the recovery of materials, especially with mechanical means such as trammel screens and magnetic separators. A general indication if the particle size distribution (by longest dimension and ability to pass a sieve) may be obtained from the date presented in figs. (1) and (2).

3.1.3 : Moisture Content

Moisture content of solid wastes usually is expressed as the mass of moisture per unit mass of wet or dry material. In the wet – mass method of measurement, the moisture in a sample is expressed as a percentage of the wet mass of the material; in the dry – mass method, it is expressed as a percentage of the dry – mass of the material.

In equation from, the wet – mass moisture content is expressed as follows :

$$\text{Moisture content (\%)} = \left(\frac{a - b}{a} \right) * 100$$

where :
a: initial mass of sample as delivered.
b: mass of sample after drying.

To obtain the dry mass, the solid – waste material is dried in an oven at 77 C^0 (170 F^0) for 24 hr. This temperature and time is used to dehydrate the material completely and to limit the vaporization of volatile materials.

Typical data on the moisture content for the solid waste components are given in Table (2).

3.1.4 : Density

Typical densities for various wastes as found in containers are reported by source in Table (3). Because the densities of solid wastes vary markedly with geographic location, season of the year and length of time storage, great care should be used in selecting typical values.

3.2 : Chemical Composition

Information on the chemical composition of solid waste is important in evaluating alternative processing and energy recovery option. If solid wastes are to be used as fuel, the four most important properties to be known are :

a. Proximate analysis : moisture, volatile matter, ash and fixed carbon.
b. Fusing point of ash .
c. Ultimate analysis :- Percent of C (Carbon), H (hydrogen), O (oxgen), N (nitrogen), S (sulfur) and ash.
d. Heating value (energy value or calorific valuc) .

Typical proximate analysis data for the components in municipal solid waste are presented in table (4).

Energy Content

Typical data on the energy content and inert residue solid wastes are reported in table (5). Energy values may be converted to a dry basis by using this equation :

$$\text{KJ / Kg (dry basis)} = \text{KJ / Kg (as discarded)} * \frac{100}{100 - \text{\% moisture}}$$

4- Determination Of Components In The Field And Sampling Procedure

The study area of this survey was Hilla city where data were collected over one year . The sampling procedures consist of :-

a. A truck lead of wastes in a selected area was unloaded .
b. The wasted load was quartered .
c. One of the quarters was selected and quartered .
d. One of the quartered quarters which had a sample size of 100 kg was selected and all of the individual components of the waste was selected during each season of the year .

e. The separated components ware placed in a container of known volume and trae mass and the volume and mass of each component were measured . The separated components were compacted tightly to simulate the conditions in the storage containers from which they were collected .
f. The percentage distribution of each component by mass and as discarded density was determined .

5- Results And Discussion

The significance of changes in composition over one year period can be seen in figure (3) which shows the municipal solid waste composition in Hilla city during each season . It is easy to note some variation in food wastes through the seasons which affected by the growing season for vegetables and fruit . The biggest variations in percentage of mass have been found at paper component , reflecting the change of use it through the seasons . Figure (4) shows that no significant variation in moisture content of solid wastes through winter , Spring and Summer season , However , Autumn have the lowest moisture content .

The densities of solid wastes vary markedly with the season of the year as it is shown at figure (5) .

The composition of municipal solid waste also has other factors to be considered , particularly where the waste is to be combusted in an incinerator , one of these factors is calorific value (energy value) which may reported as shown in figure (6) or corrected for the moisture content (net or dry calorific value) as at figure (7) . This factor is important in the design , operation and pollutant emissions of the incinerator .

These figures also show that the calorific value of solid waste components at Summer season is the lowest while solid waste components at Autumn Season has a highest calorific value .

6. Conclusions

1- Significant variation in quantities due to seasons variation were found especially, the variation of paper component.
2- There is some variation in food wastes through the seasons of the year.
3- Municipal solid wastes have a lowest moisture content (42 %) at Autumn season .
4- Municipal solid wastes have highest calorific value (12056 KJ/ Kg) Autumn season.
5- These wastes have high percentage of organic matter (food wastes) at all seasons of the year .

References

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Table (1) : Typical Composition of Municipal Solid Waste

Components	Percent by mass	
	Range	Typical
Food waste	6 – 26	14
Paper	15 – 45	34
Cardboard	3 – 15	7
Plastics	2 – 8	5
Textile	0 – 4	2
Rubber	0 – 2	0.5

Leather	0 – 2	0.5
Garden trimming	0 – 20	12
Wood	1 – 4	2
Misc. Organic	0 – 5	2
Glass	4 – 16	8
Tin cans	2 – 8	6
Nonferrous metals	0 – 1	1
Ferrous metals	1 – 4	2
Dirt, ashes, brick, etc	0 - 10	4

Table (2) : Typical data on moisture content of municipal solid waste components .

Components	**Moisture, %**	
	Range	**Typical**
Food waste	50 – 80	70
Paper	4 – 10	6
Cardboard	4 – 8	5
Plastics	1 – 4	2
Textile	6 – 15	10
Rubber	1 – 4	2
Leather	8 – 12	10
Garden trimming	30 – 80	60
Wood	15 – 40	20
Misc. Organic	10 – 60	25
Glass	1 – 4	2
Tin cans	2 – 4	3
Nonferrous metals	2 – 4	2
Ferrous metals	2 – 6	3
Dirt, ashes, brick, etc	6 – 12	8
Municipal solid wastes	15 - 40	20

Table (3) : Typical densities for solid wastes components and mixtures

Item	**Density, kg / m^3**	
	Range	**Typical**
Components		
Food waste	120 – 480	290
Paper	30 – 130	85
Cardboard	30 – 80	50
Plastics	30 – 130	65
Textile	30 – 100	65

Rubber	90 – 200	130
Leather	90 – 260	160
Garden trimming	60 – 225	105
Wood	120 – 320	240
Misc. Organic	90 – 360	240
Glass	160 -480	195
Tin cans	45 – 160	90
Nonferrous metals	60 – 240	160
Ferrous metals	120 – 1200	320
Dirt, ashes, brick, etc	320 – 960	480
Municipal solid wastes		
Uncompacted	90 – 180	130
Compacted (in compactor truck)	180 – 450	300
In landfill (compacted normally)	350 – 550	457
In landfill (well – compacted)	600 - 750	600

*data for components is on as – discarded

Table (4) : Proximal and Ultimate Chemical Analysis of Municipal Solid Waste

Components	**Value, percent***	
	Range	**Typical**
Proximate analysis		
Moisture	15 – 40	20
Volatile matter	40 – 60	53
Fixed carbon	5 - 12	7
Noncombusibles	15 – 30	20
Ultimate analysis (combustible components)		
Carbon	40 – 60	47.0
Hydrogen	4 – 8	6.0
Oxygen	30 – 50	40
Nitrogen	0.2 – 1.0	0.8
Sulfur	0.05 – 0.3	0.2
Ash	1 – 10	6.0
Heating		
Organic fraction Kj, Kg	12.000 – 16.000	14.000
Total Kj / Kg	8.000 -12.000	10.500

***By mass**

Table (5) : typical data on inert residue and energy content of Municipal solid waste

Components	**Inert residue, percent**		**Energy****	
	Range	Typical	Range	Typical
Food waste	2 – 8	5	3.500-7.000	4.650
Paper	4 – 8	6	11.600-18.600	16.750
Cardboard	3 – 6	5	13.950-17.450	16.300
Plastics	6 – 20	10	27.900-37.200	32.600
Textile	2 – 4	2.5	15.100-18.600	17.450
Rubber	8 – 20	10	20.900-27.900	23.250
Leather	8 – 20	10	15.100-19.800	17.450
Garden trimming	2 – 6	4.5	2.300-18.600	6.800
Wood	0.6 – 2.0	1.5	17.450-19.800	18.600

Mics. Organic	2 – 8	6	11.000-26.000	18.000
Glass	96 – 99*	98	100-250	150
Tin cans	96 – 99*	98	250-1.200	700
Nonferrous metals	90 – 99*	98	-	-
Ferrous metals	94 - 99	98	250-1.200	700
Dirt, ashes, brick, etc	60 - 80	70	2.300-11.650	7.000
Municipal solid wastes			9.300-12.800	10.500

* After combustion
** As – discarded basis

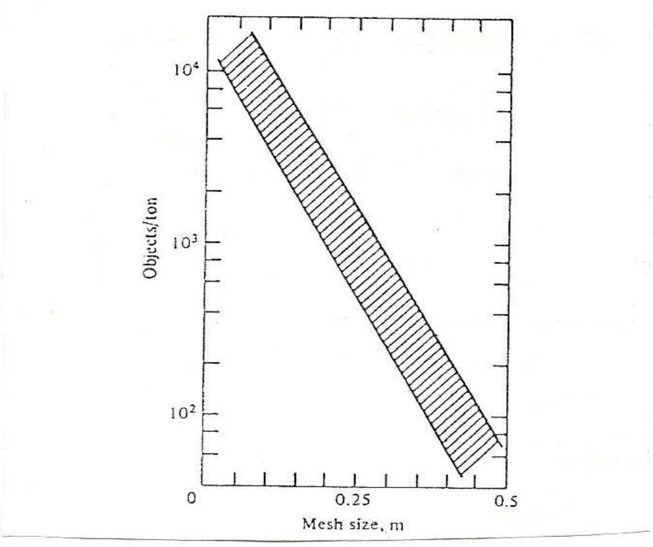

Fig (1) : Typical size of individual components comprising solid waste

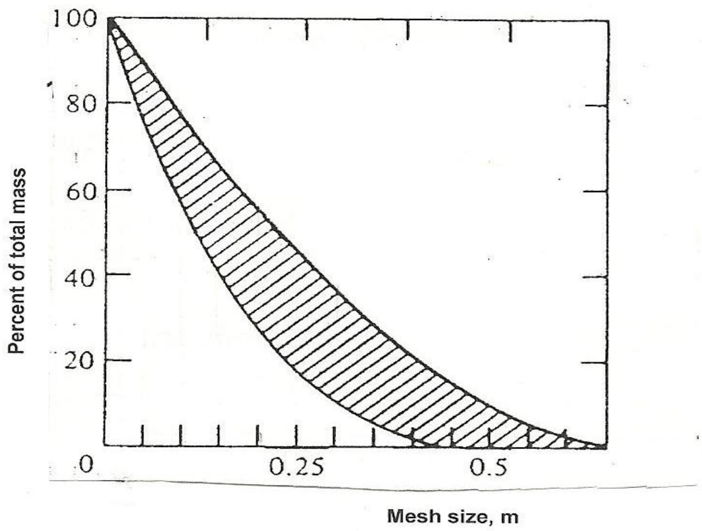

Fig (2) : Number of individual components of a given size per tonne of municipal solid wastes.

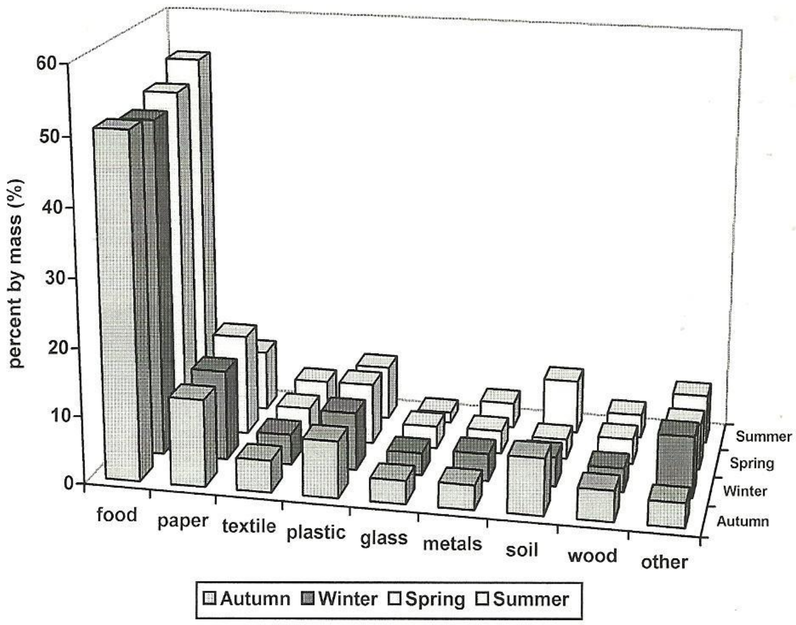

Fig (3) : Seasonal Variation in Hilla Municipal solid Waste Composition

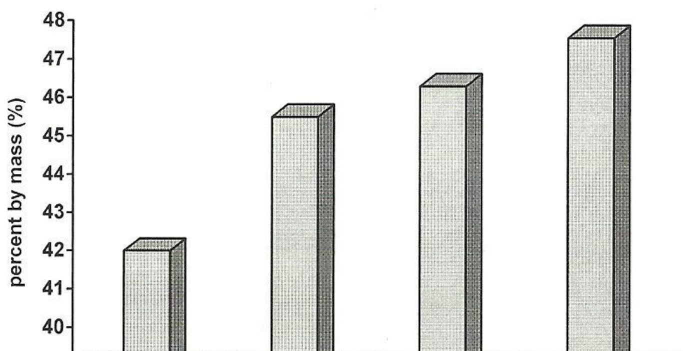

Fig (4) : Composition of moisture content of municipal solid waste through season

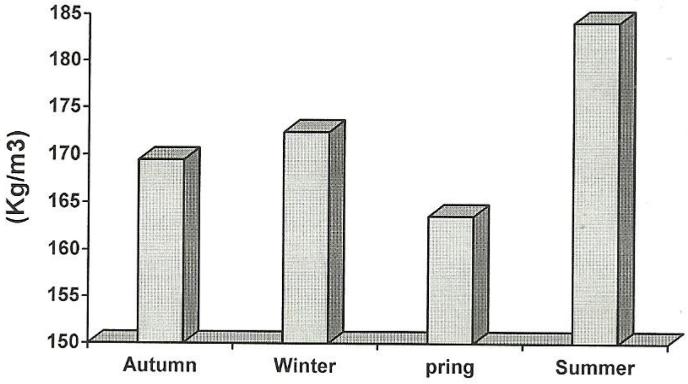

Fig (5) : Comparison of municipal Solid wastes densities through Seasons

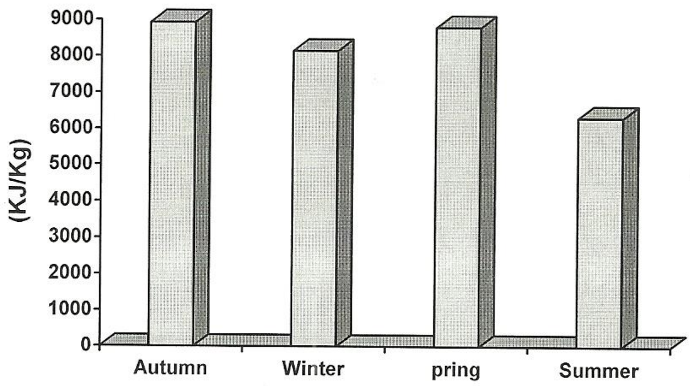

Fig (6) : Calorific values of Hilla municipal solid waste

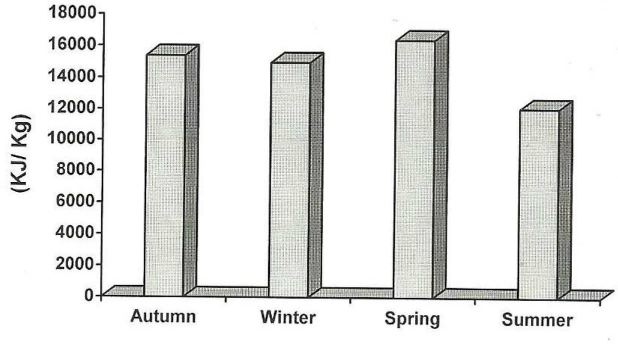

Fig (7) : Dry Calorific values of Hilla Municipal Solid Waste