Development of a Mathematical Model to Calculate Accumulated Solid Waste: An Experiments and Statistical Sampling.

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**Development of a Mathematical Model for Calculating Accumulated Solid Waste: An
Experimental and Statistical Sampling**

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1.0 Abstract

In newest development, waste is being refined into a biofuel or recycled. Waste management has being an important factor in community development. The transformation of waste into useful materials has received much work. Therefore, database must be developed to know the amount of waste accumulated or generated over a given period of time. Taken into consideration the burning and recycle reduction factor, incremental factor and degradable waste ratio.

This paper look for a mathematical formula that can be used to generate data for amount of solid waste accumulated over time for geographical location in respect of mass.

Keywords: Waste management, solid waste collection, data collation, mathematical model

1.1 Introduction

Estimation has been given of waste generated in a geographical location per day (Alare, 2020). The formula works with the estimated figures of waste generated per day geographical location using statistical models sampling (Castle, 1993).

The importance of data in this present age cannot be overemphasized. It is important because it provide useful information for institutions, organizations and researchers of past record.

The aim of this research is to develop a formula that will help companies, institutions and researcher of biofuel, bioenergy system and other waste transformation related fields determine the amount of solid waste available to them in a geographical location based on the data derived from the formula and waste chart.

2.0. Methods

To determine the estimated accumulated waste of a geographical location for a given time interval. Three factors were considered and these factors varies from different geographical locations. Therefore, geographical locations should be experimental samples. The factors are:

Waste incremental ratio (i)

Degradable waste ratio (c)

Burning and recycle reduction factors

These factors tend reduce or increase the accumulated waste from expected waste generated. The availability of waste to waste companies can be examined using these

factors. To determine these factors, statistical model and experimental sample methods will be employed.

2.1. Statistical Model of Waste Incremental Ratio (i)

$$i = \frac{1}{t} \sum_{k=1}^{\infty} \left(\frac{N_k - N_{k-1}}{N_{k-1}} \right) i = \frac{1}{t} \sum_{k=1}^{\infty} \left(\frac{N_k - N_{k-1}}{N_{k-1}} \right) \text{ (Dass, 2008)}$$

where, N is amount of waste generated per

day and k is the number of days

t is number of days used which is $k_{\max}$

2.1.1. Experimental Method Procedure

Create an open boundary space samples of dumpsites A,B,C,D,E,..... ∞

Determine the mass of solid waste of each samples

Check the increment in mass of each samples per day for given period of days

Sample	Day1	Day2	Day3..... Day k
A	N_1a	N_2a	N_3a
B	N_1b	N_2b	N_3a
C	N_1c	N_2c	N_kaN_ka
D	N_1d	N_2d	N_3b
E	N_1e	N_2e	N_3b
.	.	.	N_kbN_kb
.	.	.	N_3c
.	.	.	N_3c
.	.	.	N_kcN_kc
∞	$N_{1\infty}$	$N_{2\infty}$	N_3d
			N_3d
			N_kdN_kd
			N_3e
			N_3e
			N_keN_ke
			.
			.

			.
			.
			$N_{3\infty}$
			$N_{3\infty} \dots\dots\dots$
			$N_{k\infty} N_{k\infty}$

Waste incremental ratio for each samples

$$i_A = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{ka} - N_{(k-1)a}}{N_{ka}} i_A = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{ka} - N_{(k-1)a}}{N_{ka}}$$

$$i_B = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{kb} - N_{(k-1)b}}{N_{kb}} i_B = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{kb} - N_{(k-1)b}}{N_{kb}}$$

$$i_C = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{kc} - N_{(k-1)c}}{N_{kc}} i_C = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{kc} - N_{(k-1)c}}{N_{kc}}$$

$$i_D = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{kd} - N_{(k-1)d}}{N_{kd}} i_D = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{kd} - N_{(k-1)d}}{N_{kd}}$$

$$i_E = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{ke} - N_{(k-1)e}}{N_{ke}} i_E = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{ke} - N_{(k-1)e}}{N_{ke}}$$

.

.

$$i_{\infty} = \frac{1}{t} \sum_{k=\infty}^{\infty} \frac{N_{k\infty} - N_{(k-1)\infty}}{N_{k\infty}} i_{\infty} = \frac{1}{t} \sum_{k=\infty}^{\infty} \frac{N_{k\infty} - N_{(k-1)\infty}}{N_{k\infty}}$$

2.1 2. Average waste incremental ratio

$$i = \frac{\sum_{k=A}^{\infty} i_k}{\text{number of samples}} i = \frac{\sum_{k=A}^{\infty} i_k}{\text{number of samples}}$$

In order to avoid or minimize mathematical and computational error, a small number of samples and minimum duration of days is advice.

2.2. Statistical Model of Degradable Waste Ratio (c)

$$c = \frac{1}{t} \sum_{k=1}^{\infty} \left(\frac{N_k - N_{k+1}}{(k+1) - k} \right) c = \frac{1}{t} \sum_{k=1}^{\infty} \left(\frac{N_k - N_{k+1}}{(k+1) - k} \right)$$

where, N is amount of waste generated per day and

where, N is amount of waste generated per day and

k is the number of days

t is the number of month of experiment

2.2.1 Experimental Method Procedure

Create space samples of dumpsite A,B,C,D,E,..... ∞ in a closed and isolated system

Determine the mass of solid waste of each samples

Check the decrement in mass of each samples per day for given period of days

Sample	Month 1	Month 2	MonthMonth 3k
A	N_1a	N_2a	N_3aN_3a
B	N_1b	N_2b	N_kaN_ka
C	N_1c	N_2c	N_3bN_3b
D	N_1d	N_2d	N_kbN_kb
E	N_1e	N_2e	N_3cN_3c
.	.	.	N_kcN_kc
.	.	.	N_3dN_3d
.	.	.	N_kdN_kd
.	.	.	N_3eN_3e
∞	$N_1\infty$	$N_2\infty$	$N_k\infty N_k\infty$
			.
			.
			.
			.
			$N_3\infty N_3\infty$
			$N_k\infty N_k\infty$

Waste incremental ratio for each samples

$$C_A = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{ka} - N_{(k+1)a}}{((k+1)-k)a} C_A = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{ka} - N_{(k+1)a}}{((k+1)-k)a}$$

$$C_B = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{kb} - N_{(k+1)b}}{((k+1)-k)b} C_B = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{kb} - N_{(k+1)b}}{((k+1)-k)b}$$

$$C_C = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{kc} - N_{(k+1)c}}{((k+1)-k)c} C_C = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{kc} - N_{(k+1)c}}{((k+1)-k)c}$$

$$C_D = \sum_{k=1}^{\infty} \frac{N_{kd} - N_{(k+1)d}}{((k+1)-k)d} C_D = \sum_{k=1}^{\infty} \frac{N_{kd} - N_{(k+1)d}}{((k+1)-k)d}$$

$$C_E = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{ke} - N_{(k+1)e}}{((k+1)-k)e} C_E = \frac{1}{t} \sum_{k=1}^{\infty} \frac{N_{ke} - N_{(k+1)e}}{((k+1)-k)e}$$

$$C_{\infty} = \frac{1}{t} \sum_{k=\infty}^{\infty} \frac{N_{k\infty} - N_{(k+1)\infty}}{((k+1)-k)_{\infty}} C_{\infty} = \frac{1}{t} \sum_{k=\infty}^{\infty} \frac{N_{k\infty} - N_{(k+1)\infty}}{((k+1)-k)_{\infty}}$$

Note

$$((k+1) - k) =$$

30 days *k should be in days*

$$((k+1) - k) =$$

30 days *k should be in days*

2.2.2 Average waste degradable ratio

$$C = \frac{\sum_{k=A}^{\infty} C_k}{\text{number of samples}} C = \frac{\sum_{k=A}^{\infty} C_k}{\text{number of samples}}$$

2.3 Burning and Recycle Factor

The assumed burning factor is in the range of 0.005 to 0.006 depending on the burning and recycling activities of the geographical area considered.

3.0 Result

A reduction constant k is developed from the mathematical combination of all the factors ensuring that reduction is at a reasonable range.

$$k = i^{bc} k = i^{bc}$$

The amount of solid waste accumulated over a given period in term of the mass is given as

$$M = kTN + NM = kTN + N$$

$$T = T_0 - 1$$

Where

M is accumulated waste over a period of time

K is reduction constant

T_0 is period of time taken in days

4 0 Conclusion

This paper has shown a method of calculating the amount of accumulated solid waste in mass. The factors consider varies from one geographical area to another. We employ researchers to further the research. with the aim of obtaining the factors for different geographical locations in the world. Develop a chart that will contain the data of all i, c and k for all experimented geographical area.

5.0 Reference

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