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Experimental Analysis of Energy Generation and Characteristics of Municipal Solid Waste

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ABSTRACT-

Municipal solid waste (MSW) management presents a significant challenge for all countries. To exploit them as a source of energy, knowledge of their calorific value is essential. In fact, it can be measured experimentally by an oxygen bomb calorimeter. However this process is expensive. In this light, the aim of this paper was to develop an empirical model for the prediction of MSW high heating value (HHV) from ultimate analysis. Researched on eco-friendly, eco-efficient and sustainable civil engineering work with emphasis on adoption of by-products of solid waste recycling and reuse to achieve infrastructure activities with low or zero carbon emissions . Solid waste handling and management around the world, and especially in developing countries, has contributed enormous amounts of carbon dioxide (CO2) and carbon monoxide (CO) emissions and has resulted in the threat of global warming.

Key Word- Vegetable wastes; Reuse of solid waste; Energy generation.

1. Introduction

There are a lot of human activities involved in this negative contribution to the environmental hazard which include; Manufacturing activities that use portland cement Industrial activities that release oxides of carbon and other volatile gases Agricultural activities that release biomass and biopels Mechanical activities for example engine-fuel combustion that release CO/CO_2 , etc. leaves. Municipal solid waste rates have been steadily increasing due to rapid urban population growth and technological advances. The collection and disposal of municipal solid waste (MSW) causes serious environmental problems, making its management one of the important challenges facing the world (Nordi et al., 2017). In this context, waste-to-energy (WTE) by thermochemical processes appears to be a promising solution (Cucciella et al., 2016; Xi et al., 2016). Also, in light of their diversity and heterogeneity, knowledge of the composition of wastes is essential. In fact, there are three types of composition determination: physical, proximate and ultimate analysis (Cheng and Hu, 2010). Physical characterization classified MSW as degradable components derived from biomass, such as food, wood, cotton, paper, cardboard, etc.; or non-degradable ones from fossil fuels such as plastic, rubber, etc. (Cheng and Hu, 2010). Proximate analysis includes determination of percentage of moisture, fixed carbon, volatile matter and ash. The final analysis informs about the amount of carbon (C), hydrogen (H), nitrogen (N), sulfur (S) and oxygen (O). Furthermore, thermal characteristics such as heat value, especially high heat value (HHV), are an important factor for the design of WTE plants (Kalogirou, 2017). however, experimental determination is costly (Esti et al., 2016).

2. Literature review

Maraj et al. (2003) neglected inorganic carbon in their model, which makes it less reliable in the case of a critical concentration. Shi et al. (2016) used 193 experimental data for the development and validation of a new equation. He employed multiple regression analysis as a method of modeling. Generally, these models were based on classical regression, except for Meraz et al. (2003), who used thermochemical concepts at the expense of computational intelligence methodologies such as genetic programming formalism. In fact, this latter type is capable of solving problems using evolutionary strategies (Oliveira et al., 2018). Plus, MSW is a heterogeneous mix of materials. Consequently, HHV prediction based on one type of waste seems difficult and cannot be generalized to all categories. This paper proposes a new equation for the estimation of HHV based on elemental composition of several municipal solid waste categories using multiple regression analysis and genetic programming formalism. The accuracy of the developed computational model was evaluated against the developed regression model and previously published literature. Genetic programming is an automated technology inspired by the mechanism of natural selection established by Charles Darwin. The aim is to find programs that are best suited for a given task without pre-fetching feedback (Shankar et al., 2015).

This study was interested in symbolic regression as one of the main genetic programming applications. The objective is to fit a function to a multiple input-single output (MISO) dataset that is determined by as (Ghugare and Tambe, 2016) a compressing test device and gas permeability test device for MSW were introduced and laboratory tests were carried out. , e test results showed that the ultimate strains at vertical loads of 100 kPa, 200 kPa, 300 kPa, and 400 kPa were 35.8%, 45.1%, 49.2%, and 55.1%, respectively. The natural logarithm of the void ratio and pressure were linearly correlated at different times. The internal permittivity measured without considering gas compressibility was smaller than that measured considering gas compressibility. The intrinsic permeability of the MSW decreased with an increase in the inlet pressure. It was suggested that the inlet pressure should be set at 3 kPa for indoor gas permeability testing of MSW. The intrinsic permeability of MSW decreases with an increase in water content and compressive displacement. Sanitary landfill is a widely recognized and effective treatment method of MSW in the world because of its simple operation, large treatment capacity, low investment and rapidity.

Capacity. The essence of the landfill is a biochemical reactor interconnected with a stress-strain zone, a biological zone, a concentration zone and a temperature zone. In this reactor, the main input material is municipal solid waste, and the main output material is leachate and landfill gas. Understanding the basic engineering characteristics of MSW has important implications for the design, construction, safety management and stable operation of landfills. One of the main environmental geotechnical engineering problems involved in landfills is the decontamination and disposal of MSW. Sanitary landfill is a widely recognized and effective treatment method of MSW in the world because of its simple operation, large treatment capacity, low investment and fast efficiency. The essence of the landfill is a biochemical reactor composed of a stress-strain zone, a biological zone, a concentration zone and a temperature zone. In this reactor, the main input material is municipal solid waste, and the main output material is leachate and landfill gas. Understanding the basic engineering characteristics of MSW has important implications for the design, construction, safety management, and stable operation of landfills. One of the main environmental geotechnical engineering problems involved in landfills is the decontamination and disposal of MSW.

3. Materials and methods

The main technical parameters are as follows: The inner diameter of the sample tube was 250 mm and the height was 300 mm. The first level had a leverage ratio of 1:5, and the second had a leverage ratio of 1:2. A lot of lab space could be saved by this loading method. , e was the weight

Changed the quality of each piece through the weight applied. The vertical load can be calculated by the levitation principle and the area of the specimen. , the main functions of the screw jack were to exert vertical pressure on the specimen and to move the weights provided by the levers to adjust the lever balance during the experiment. , The fastener was made of stainless steel, which could hold two support rods, in order to prevent the rigidity of the support rod from being too high, and to avoid the support rod from tilting horizontally due to excessive pressure. , e The top hoop and the middle hoop can prevent lateral deformation and ensure that the specimen only deforms in the vertical direction.

4. Sampling, monitoring, and analyses

Samples were collected (300 g per sample) from the center and two ends (top, middle and bottom) for each respondent. After that, each sample was divided into two parts. A portion of the kiln was dried, the soil passed through a 212 µm soil filter and deposited on a removable table. Oven-dried samples are used to determine body composition, pH, conductivity (EC), particle size and solid content (VS), organic carbon.

.5 Composting specific heat capacity

Thermal factors such as the heat storage capacity, or a given temperature of many materials, often affect the amount of material needed to maintain a reasonable tem.perature rise. Some of the thermal energy is also a function of the moisture content. As expected, an increase in ash content was observed with a decrease in VS content. An increase in the direct ash content during the composting process affects the increase of a certain amount of heat. Furthermore, Rahman has revealed a direct relationship between moisture content and certain thermal conductivities. In the present study, an increase of 16% was observed in a fixed temperature range during the thermophilic phase.

6 Results and discussion

The temperature of the compost and moisture is one of the most important indicators of insect activity during the composting process. It affects the reaction rate, and helps kill harmful germs, and seeds during the composting process, thus maintaining the hygienic efficiency of the process.

Table 1 Vegetable wastes based heat generation

Sl. No.	Days	Ambient Temperature (°C)	Vegetable Wastes Temperature (°C)
1	1	36	38
2	2	38	39
3	3	40	44
4	4	41	45
5	5	42	46
6	6	48	52
7	7	43	46

8	8	39	42
9	9	38	41
10	10	36	40

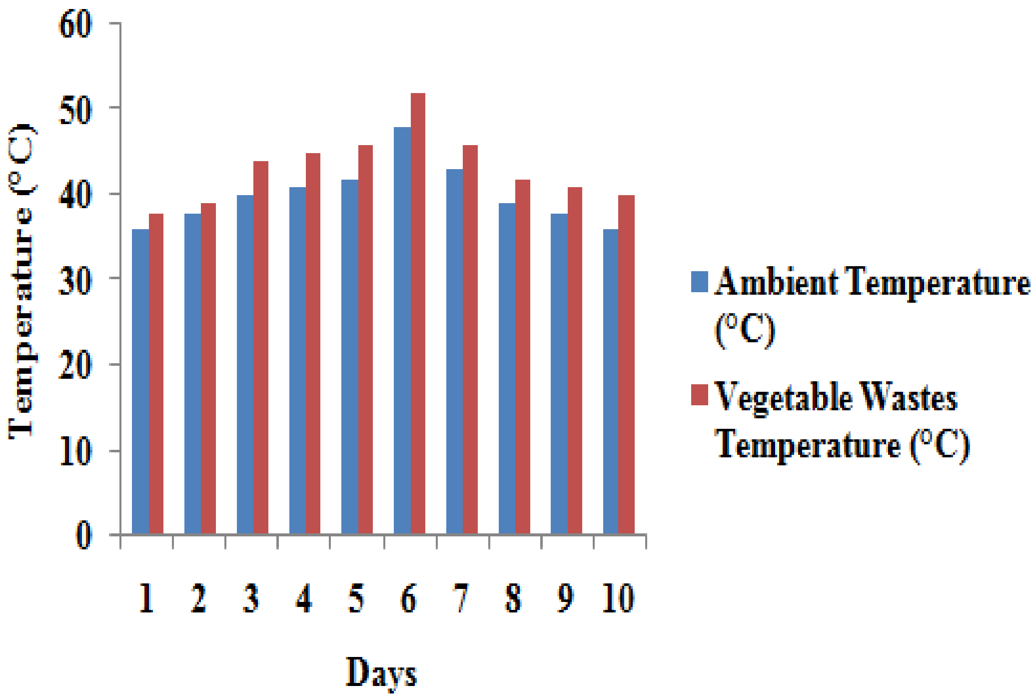

Figure 1 Vegetable wastes based heat generation

Table 2 Vegetable wastes based heat generation using composting of food wastes mixed with various bulking agents (wheat straw, hay and wood shavings)

Sl. No.	Days	Ambient Temperature (°C)	Vegetable Wastes Temperature(°C)
1	1	37	40
2	2	39	42
3	3	40	46
4	4	41	52
5	5	42	54
6	6	48	53
7	7	43	48
8	8	39	47
9	9	38	46
10	10	36	45

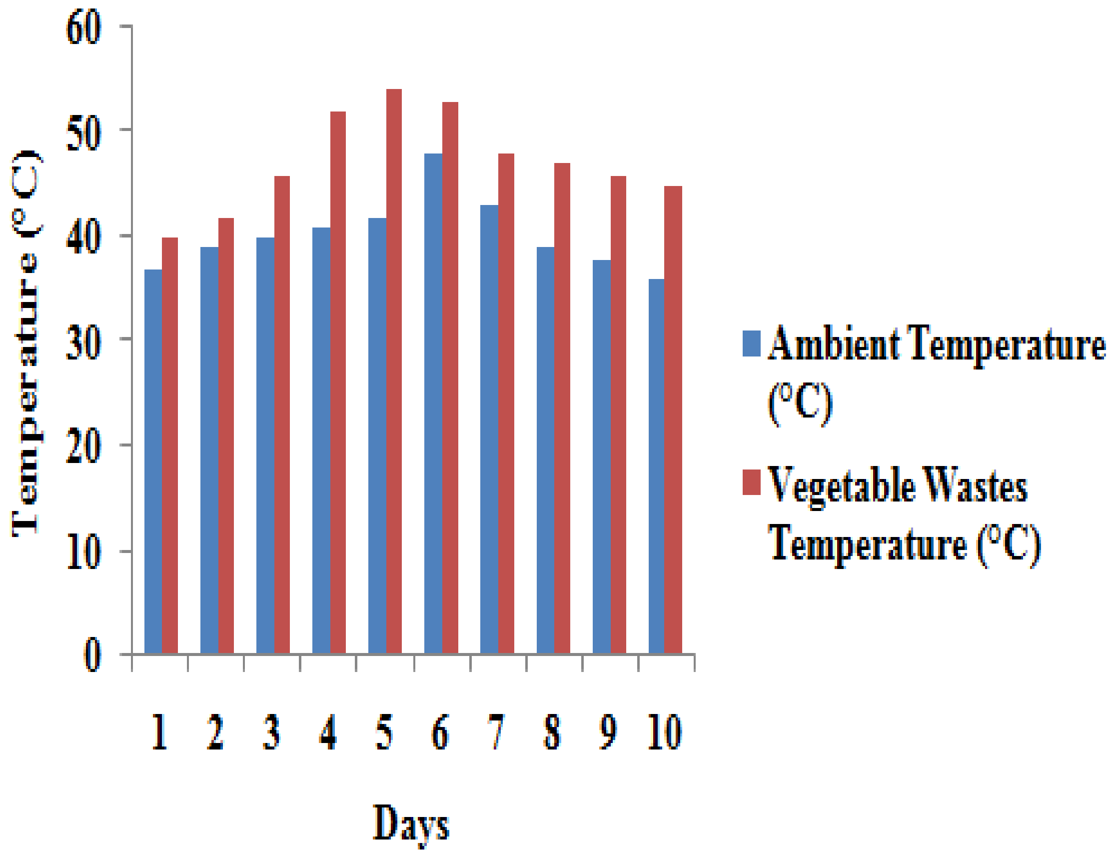

Figure 2 Vegetable wastes based heat generation using composting of food wastes mixed with various bulking agents (wheat straw, hay and wood shavings)

Table 3 Vegetable wastes based moisture content and volatile solids

Sl. No.	Days	Moisture content (%)	Volatile solids (%)
1	1	70	81
2	2	69	72
3	3	62	73
4	4	64	71
5	5	59	70
6	6	58	71
7	7	53	70
8	8	55	68
9	9	52	65
10	10	48	64

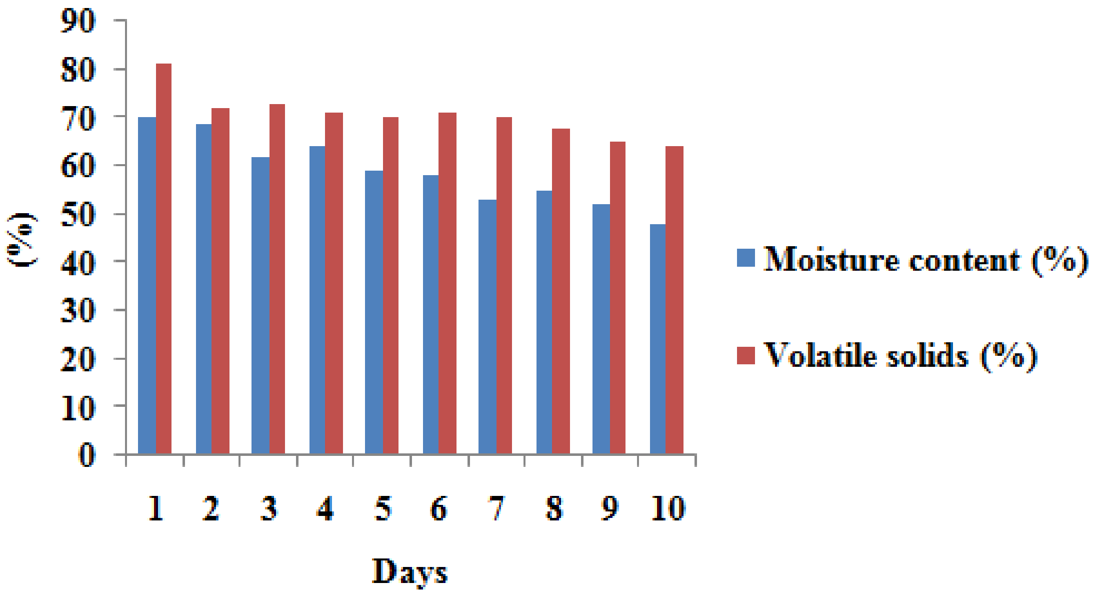

Figure 3 Vegetable wastes based moisture content and volatile solids

Table 4 Vegetable wastes based moisture content and volatile solids using composting of food wastes mixed with various bulking agents (wheat straw, hay and wood shavings)

Sl. No.	Days	Moisture content (%)	Volatile solids (%)
1	1	72	79
2	2	68	77
3	3	69	78
4	4	61	75
5	5	60	74
6	6	62	81
7	7	62	81
8	8	62	81
9	9	54	67
10	10	49	64

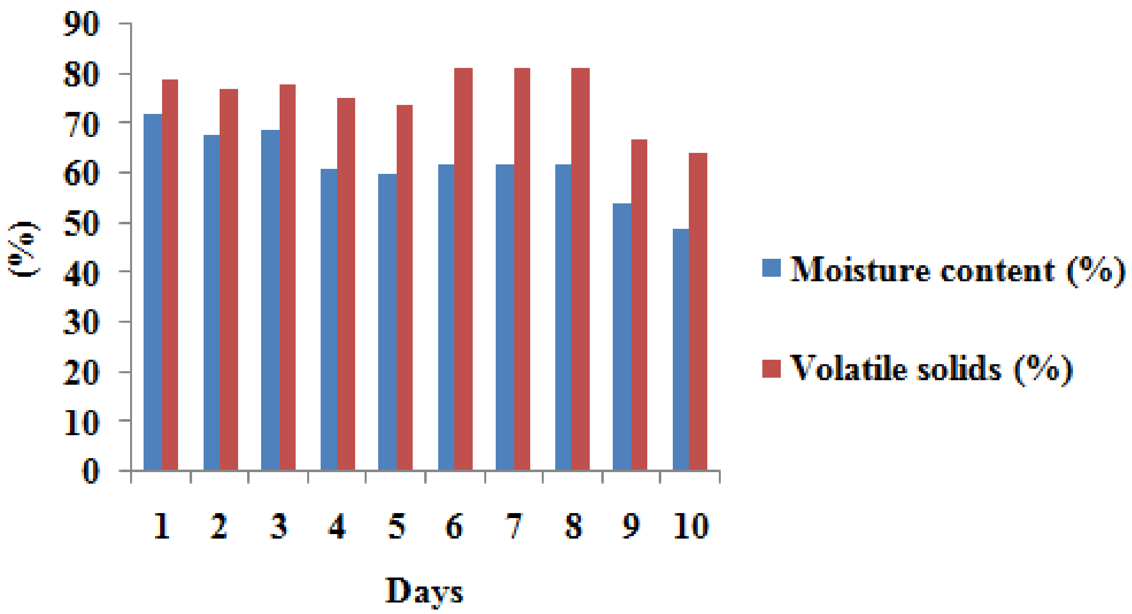

Figure 4 Vegetable wastes based moisture content and volatile solids using composting of food wastes mixed with various bulking agents (wheat straw, hay and wood shavings)

7. Conclusions

Solid waste recycling and reuse is reviewed as a center for achieving a more environmentally friendly, ecological and sustainable civil and mechanical engineering infrastructure for low or zero carbon emissions to our planet. This review work, inter alia, has developed a model for effective solid waste combustion, to trap CO_2 and CO released so far, and to produce baking soda ($NaHCO_3$), soda ash (Na_2CO_3) and hydrogen gas. Release of environmentally friendly residues of (H_2). Table 2 and Figure 2 shows that maximum Moisture Ambient Temperature (48°C) and Vegetable Wastes Temperature(54 °C) during day 6^{th} using Vegetable wastes based heat generation using composting of food wastes mixed with various bulking agents (wheat straw, hay and wood shavings). Table 4 and Figure 4 shows that stable Moisture content (62%) and Volatile solids (81%) during days 6^{th} to 8^{th} using Vegetable wastes based moisture content and volatile solids using composting of food wastes mixed with various bulking agents (wheat straw, hay and wood shavings)

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