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Thermal Decomposition of Camel Grass and Lemon Grass

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

In this research, the combustion of two grass species (*Cymbopogon schoenanthus* and *Cymbopogon citratus*) was analyzed under thermogravimetric analysis; which is a common way for energy source at the different heating temperature of 20ºC/minute intervals from ambient temperature to a heating temperature of 600ºC. The results show that in camel grass the active temperature for the degradation was 392.74ºC which is the active heating range for the decomposition of the grass sample. The thermo-gravimetric temperature at 339ºC shows the highest degradation activity when compared to the first and second phase of the analysis. While in lemongrass the active temperature was 323-480ºC with the highest weight loss of 35.26–36.18%. This analysis shows the thermal decompositions of the plant biomass used, it fuel potentiality and highest temperature for the decomposition of the biomass.

Keywords: Thermo gravimetric analysis (TGA); decomposition; Cymbopogon schoenanthus and Cymbopogon citrates.

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1. INTRODUCTION

Plants have the potential of producing bio-energy, which serve as a good source of renewable energy due to the presence of some physical and chemical properties making it tangible and rich source of energy. According to Kumar et al. [1], biomass can be utilized directly by combustion or indirectly by transformation into the fluid product. The challenges of which biomass to go for can be solved by exploring some plant rich in hydrocarbon, volatile compounds and octane. The combustion of biomass is the most common and efficient way to energy resources [2]. In this research, the thermal decomposition of two grass species viz: *Cymbopogon schoenanthus* (Camel Grass) and *Cymbopogon citratus* (lemon grass) were analyzed under thermogravimetric analysis which is a common way for the energy source.

The TGA analysis has frequently been employed to determine the thermal decomposition of the biomass, assessment of the extend of weight loss and the temperature at which it occurs [3,4,5,6,7]. The weight loss of samples is recorded as the temperature rises. It can be used for engineering prediction and biofuel formation. This is used to investigate the thermal event, kinetics of pyrolysis and oxidation of solid materials [8].

The aim of this research is: to conduct thermogravimetric analysis on *Cymbopogon schoenanthus* and *Cymbopogon citratus* at different heating temperatures of 20ºC interval per minutes in an inert atmosphere and to determine the total weight loss or degradation rate of the samples.

2. METHODOLOGY

The grass samples (*Cymbopogon schoenanthus* and *Cymbopogon citratus*) were subjected to thermogravimetric analysis (TGA) to determine the thermal decomposition (fuel property) of each sample in an air furnace at a heating rate of 20ºC/minutes. The sample was placed in a pan separately and then carefully placed inside the thermogravimetric machine. A computer system was connected to the machine and the chart speed was programmed at 2.5 mm/min. The initial weight of each of the grass samples was taken and the heating temperature was set at the ambient temperature to 600ºC. The decomposition process and weight loss of each sample were observed at a various interval from onset time and temperature to the end point of each step of the analysis. The thermogravimetric loss curve for each sample was plotted against temperature and time.

3. RESULTS AND DISCUSSION

The result of total weight loss (thermal degradation) of camel grass is shown in Table 1. The onset time and temperature show an increase at the different phase of the degradation with weight loss at different interval. From the onset time, end-set time and temperature of the analysis, the percentage weight loss was taken. At 2.26-5.85 minutes and temperature of 52.11-88.93ºC of the thermo-gravimetric analysis 0.1777mg of camel grass was decomposed having a percentage weight loss of 0.930. While in the second interval of the degradation processes, at 26.56-29.95 minutes and temperature of 303.59-339.81ºC of the analysis 3.763 mg (19.775%) weight was the loss in the thermal decomposition of the samples. However, at 46.07-53.07 minutes within the temperature range of 30.27-392.74ºC the percentage weight loss was 4.567%.

However, Table 2 shows the total weight loss of lemon grass at different temperature and time. At the first phase of the thermal decomposition from onset and end-set time and temperature shows that at 6.64-6.89 min. under a temperature 100.84-103.40ºC, a total weight loss of 0.681(4.22%) was observed. In the second phase of the decomposition of the grass sample at 34.13- 27.60 minutes of the analysis under a temperature of 375.29-375.96ºC shows a total weight loss of 5.833 mg with a percentage of 36.187%. In the last phase of the decomposition at 38.48-42.72 minutes of the analysis under the temperature range of 421.17-480.54ºC with a weight loss of 5.833 and total weight loss percentage of 35.26%.

It was observed from the analysis that the decomposition of the samples does not start at the initial set up temperature for all the samples. In camel grass the active temperature for the degradation was 392.74ºC which is the active heating range for the decomposition of the grass sample. The thermo-gravimetric temperature at 339ºC shows the highest degradation activity when compared to the first and second phase of the analysis. While in lemon grass the active temperature was 323-480ºC with highest weight loss of

Table 1. Total weight loss of camel grass at different temperature and time

Onset time (minutes)	End-set time (minutes)	Onset temperature (ºC)	Endset temperature (ºC)	Weight loss (mg)	Percentage weight loss (%)
0.00	0.00	32.00	32.00	0.00	0.00
2.26	5.85	52.11	88.93	0.18	0.93
26.56	29.95	303.59	339.81	3.76	19.78
46.07	53.07	306.27	392.74	0.87	4.58

Table 2. Total weight loss of lemon grass at different temperature and time

Onset time (minutes)	End-set time (minutes)	Onset temperature (ºC)	End-set temperature (ºC)	Weight loss (mg)	Percentage weight loss (%)
0.00	0.00	0.00	0.00	0.00	0.00
6.64	6.89	100.84	103.46	0.68	4.23
34.13	27.60	323.29	375.96	5.83	36.18
38.48	42.72	421.17	480.54	5.68	35.26

35.26–36.18%. From the analysis it was observed that the decomposition of the species differs slightly between the species. The percentage of weight loss is higher in *Cymbopogon citratus* than in *Cymbopogon schoenanthus*.

The maximum weight loss is attributed to the fact that the content of volatile matters presents in the plant species as indicated by [8,9]. The weight loss increases with increase in temperature for all the samples of grasses used. The differences in thermal decomposition of the biomass in the analysis are attributed to the strength of the molecular structure fuels. However, due to the presence of aromatic hydrocarbon and bonds present in the compounds even though, it is contrast to the hemicelluloses, cellulose and lignin which constitute the macromolecules structure of biomass and other woody materials that are linked together by relatively weak bonds [10,11].

4. CONCLUSION

The TGA study gives an information about the thermal decomposition and thermal property of the biomass samples. From the analysis it was analyzed that the decomposition is high at the active point or zone of the biomass, this is in line with the observation made by Culcuoglu et al. [3]. However, the thermal decomposition of the species weas closely related from the starting to the end point though with little variation in the weight loss of the samples.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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