Supplementary Data

Article

Characterization and thermal behavior study of biomass from invasive *Acacia mangium* species in Brunei preceding thermochemical conversion

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1. Proximate Analysis

Proximate analysis of biomass is the most frequently employed technique to determine the properties of biomass samples. Percentages of moisture contents, volatile matter and ash contents in all the parts were determined by following the ASTM E871-82, D 3175-07 and D 3174-04, respectively. The fixed carbon percentage was determined by subtracting the sum of moisture contents, volatile matter and ash contents from 100. The analysis were carried out in duplicate for each analysis and the average value was reported. To determine the moisture content, precisely 1 gram of each biomass sample was placed in pre-dried and weighed crucible and then the crucible was placed into the oven maintained at 105°C for 3 hours. The percentage moisture contents were determined using the Eq 1:

$$Moisture\ contents\ (wt\%) = \frac{W_o - W_1}{WSo} \times 100 \text{----------Eq 1}$$

Where, Wo is the weight of sample and crucible before drying and W1 represents the weight of sample and crucible after drying while WSo represents the initial weight of the sample.

Determination of volatile matter is important as it indicates the ease of combustibility and conversion of the biomass. High volatile matter contents in biomass indicate the ease of processing and more liquid product during the pyrolysis process. Volatile matter content in this study was calculated by the following Eq 2 and Eq 3.

$$\text{Weight loss (wt\%)} = \frac{\text{Wmdo} - \text{W}}{WSo} \times 100 \text{---------Eq 2}$$

Where, Wmdo is the initial weight of moisture dried sample plus crucible, W is the weight of sample and crucible after heating and WSo is the initial weight of the sample.

$$Volatile\ matter\ (wt\%) = weight\ loss\ (wt\%) - moisture\ contents\ (wt\%)\text{------ Eq 3}$$

Ash contents were calculated using the following equation:

$$\text{Ash contents (wt\%)} = \frac{\text{Wdo}-\text{W}}{WdSo} \times 100 \text{ ---------- Eq 4}$$

Where, Wdo is the initial weight of sample plus crucible, W is the weight of sample and crucible after heating and WdSo is the weight of the sample after drying moisture.

Fixed carbon contents in the samples were calculated by subtracting the moisture contents, volatile matter and ash contents from 100.

Fixed Carbon (wt %) = 100 – (Moisture content + Volatile matter + Ash content) -------- Eq 5

2. Ultimate Analysis

The ultimate analysis of the biomass samples was performed to determine the carbon, hydrogen, nitrogen, and sulfur content in the samples using a CHNS Analyzer (model Flash EA 1112 Series) from CE Instruments, Thermo-Quest, Italy. The percentages of Carbon (C), Hydrogen (H), Nitrogen (N) and Sulphur (S) were determined experimentally with the help of the analyzer while the Oxygen (O) contents were calculated by subtracting the sum of C, H, N and S contents from 100 by following Eq. 6.

$$Oxygen\ (O)contents(wt\%) = 100 - (C + H + N + S) \text{ ----------Eq 6}$$

3. Heating value analysis

The heating values of AM biomass samples were determined using a model C-200 calorimeter (P.A. Hilton Ltd. United Kingdom) following the procedure given in ASTM D 5468–02. Precisely measured 1 gm of the biomass sample was pelletized and used in the study to find the heating values. The pellet was placed over the cotton thread in the bomb of the calorimeter and then the bomb was pressurized with pure oxygen up to 25 psi to provide the excess supply of oxygen to ensure complete combustion of the biomass. The bomb was placed in the water-filled bucket and the sample was combusted and the rise in the temperature of the water bucket was monitored over the interval of every 30 seconds. Each experimental run was repeated twice and the average value was reported in the study.