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TABLE1: PROXIMATE ANALYSIS ON SAMPLE

S/N	PARAMETER	UNIT	BTU	MTU	UTU
1	MOISTURE CONTENT	%	18.67	13.62	15.14
2	ASH CONTENT	%	2.23	1.44	2.02
3	Volatile Matter	%	66.22	65.97	63.33
4	Fixed carbon	%	12.88	18.97	19.51

PROCEDURE

Percentage Moisture Content (PMC)

Moisture content of samples was determined based on mass loss after two hours at 105◦C under N_2 purge. Approximately 0.5 g of air-dried sample was weighed into a ceramic crucible.The samples were placed inside of a Lindberg muffle furnace, which was initially purged with N_2 gas for ≥20 min at a flow rate of 3 L min^{-1}, to ensure removal of all oxygen..After the 2 h heating, the furnace was turned off and samples were transferred immediately to a desiccator, left to cool for one hour and then weighed.

$$MC \quad \frac{Wc - Dc * 100}{Wc}$$

where, Wc is the Air dried weight of sample Dc is the Oven dried weight of sample at103 ℃ MC = Moisture content.

Volatile matter

Volatile matter was determined by heating the oven dry samples under N_2 purge at 850◦C. During heating, the crucibles containing the sample were covered with ceramic lids, placed in a stainless steel box inside of a muffle furnace. A N_2 purge line and thermocouple were inserted through the top of the furnace and down into the stainless steel box through a small hole in the box cover. The box was purged with N_2gas for about 5 min at a flow rate of 5 L min^{-1}. After the initial purge, the N_2 flow rate was decreased to 3 L min–1, the furnace was set to the desired peak separation

temperature, and turned on. The temperature inside of the stainless steel box was measured every 60 s during the heating treatments. Once the temperature inside of the stainless steel box reached 850◦C separation temperature, the furnace was switched off and furnace door opened. TheN_2 purge inside the stainless steel box was maintained (3 L min−1) during cool down (2–4 h), after which the crucibles were weighed.

Vm = $\frac{(B-C)*100}{}$

where, B is the Air dried weight of sample

C is the Furnace calcined weight of sample at 900 °C

Vm = Volatile matter

Ash content

Ash content of sample was determined by heating the same sample to 730◦C in an air atmosphere using the same muffle furnace. To ensure complete combustion, crucible lids were removed and a low flow of house air (1.5 L min^{-1}) was constantly flushed through the furnace. The furnace was heated to 730◦C and held at that temperature overnight (8–10 h). After ashing, the furnace was switched off and allowed to cool for one hour before the samples were transferred to a desiccator to cool. The crucibles were weighed and ash mass was determined by subtracting the empty crucible weight. All reported proximate analysis data were done in triplicate measurements.

$$AC \quad \frac{D * 100}{B}$$

where, D is New weight of sample

B is the Initial of sample at 103 °C

Ac = Ash content

Percentage Fixed Carbon (PFC)

The percentage fixed carbon, PFC was calculated by subtracting the sum of percentage volatile matter (PVM) and percentage ash content (PAC) from 100. The carbon content is usually estimated as a "difference", i.e., all the other constituents are deducted from 100 as percentages and the remainder is assumed to be the percentage of fixed carbon. This was determined using;

Fixed carbon (FC%) = 100 - (VM% +AC%)