

VALORIZATION OF CORNCOB THROUGH TORREFACTION PROCESS

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INTRODUCTION

Production corn crop in Lampung very great \Rightarrow 2019 : 2.374.384 ton
(BPS, 2020)

Harvesting and post-harvest activities of corn



waste biomass

on the land

- + stalks,
- + leaves,
- + corn husks

post-harvest
(especially shelling):

- + corncobs
- + jenjet

Composition of corn waste biomass (Yuliana, 2020)

Location	Type of waste	Quantity (kg (%))	Energy value (MJ/kg)
Land	Stalks	864 (28.5)	15,66
	Leaf	672 (22.2)	15,20
	Husk	472 (15.6)	15,56
Shelling	Cobs	1.008 (33.3)	17,66
	Jenjet	10 (0.3)	17,22
TOTAL		3.026 (100)	

Currently, corn cobs are not used yet. They became waste. People not used and manage them well. Otherwise, corncobs are very useful. They can be used as fuel



corncob



can be used as fuel

DISADVANTAGES OF CORN COBS AS FUEL

- + Low energy density
- + low bulk density \Rightarrow complicate logistics and transportation
- + Hygroscopic \Rightarrow reducing storage time
- + High levels of volatile materials \Rightarrow low combustion efficiency and produce a lot of smoke
- + the high content of inorganic materials (Ca, Si, K) causes ash-related problems (sintering, fusion, agglomeration, slagging)

Quality of corn cobs fuel can be improved \Rightarrow torrefaction process

RESEARCH OBJECTIVES

- + To determine the effect of torrefaction on the quality of corn cobs fuel
- + To determine the effect of corncob size and torrefaction time to the quality fuel

MATERIALS AND METHODS

+ *Materials*

Corncoobs were obtained from PD Semangat Jaya in Bangunsari Village, Negeri Katon Sub District, Pesawaran Regency, Lampung Province.



Research Methods

corncoobs

Dried in
the sun
(1-2 day)

Chopped:
(1-3) cm

Torrefaction
18 RPM
200–300 °C.



PARAMETERS:

- moisture content,
- ash content,
- volatile content,
- calorific value,
- hydrophobicity of materials,

TREATMENT \Rightarrow TWO TREATMENT FACTORS:

1. Size of the corn cobs (S)

\Rightarrow 3 levels

- 1 cm (S1),
- 2 cm (S2)
- 3 cm (S3).

2. Time of torefaction

(T) \Rightarrow 3

- 30 minutes (T1),
- 45 minutes (T2)
- 60 minutes (T3).

Each treatment factor was repeated 3 times

RESULTS AND DISCUSSION

Characteristics of Corncobs before torrefaction

Characteristics	Unit	Value
Moisture content	% db	11.84
Total solid (TS)	% db	88.16
Ash content	% dk	2.20
Volatile content (VS)	% dk	97.80
Bulk density	kg/L	0.533
calorific value	MJ/kg	17.66
Hemicellulose	%	33.85
Cellulose	%	33.31
Lignin	%	26.03

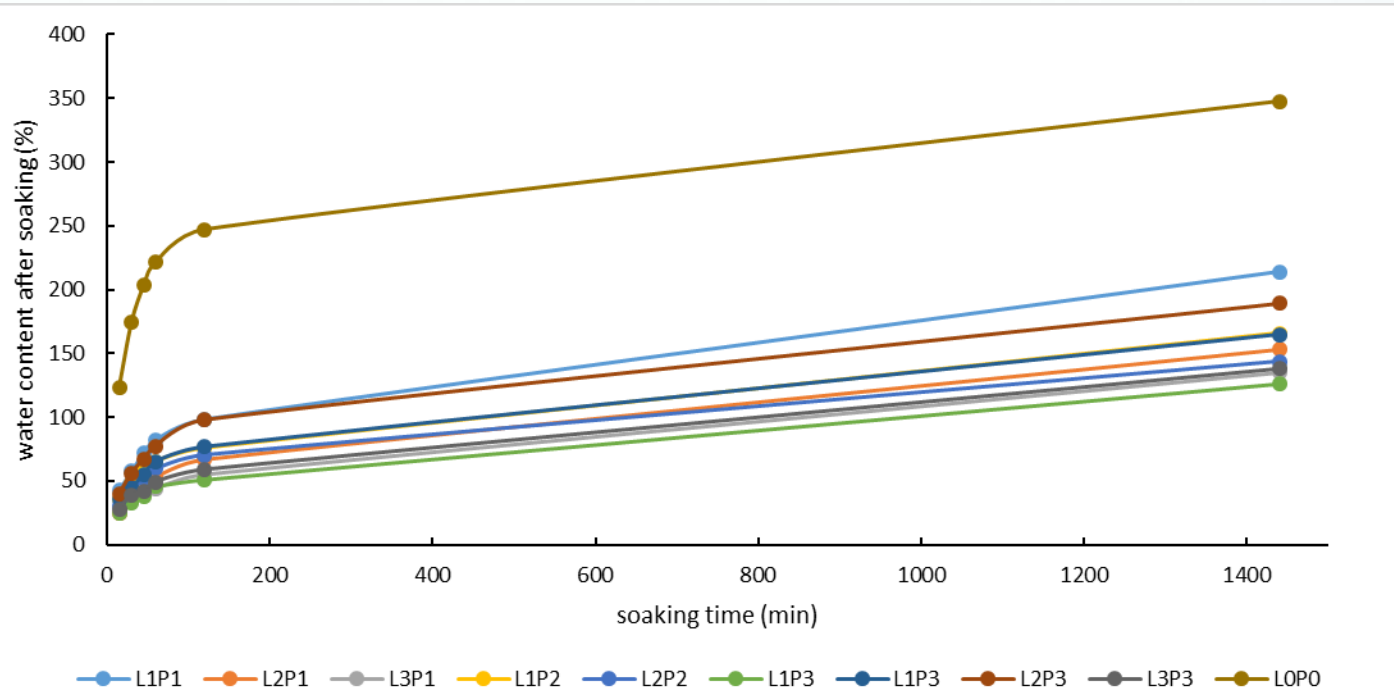
Effect of Torrefaction on Characteristics of Corncobs

Characteristics	Unit	Value	
		before	after
Moisture content	% db	11,84	2,52 – 3,21
Ash content	% dk	2,20	0,68 – 2,60
Volatile content (VS)	% dk	97,80	97,38 – 99,30
calorific value	MJ/kg	17,66	18,89 – 21,61
Hidrophobic (moisture content after soaking 24 hour)	% db	347,72	125,702 - 213,983

CALORIFIC VALUE

Sampel	Calorific value(MJ)
Dark brown	21.61
Light brown	18.89
Black	19.37
Yellow (without torrefaction)	17.66

The graph of the relationship between soaking time and corncob water absorption



Anova test of size of corn cobs and time of torrefaction to moisture content

Source	Sum of square	df	Mean square	F	Sig.
Corrected model	2041 ^a	8	0,255	1.229	0.338
Intercept	223.067	1	223.067	1074.6	0
Corn size	1.446	2	0,723	3.484	0.053
Time torrefaction	0.312	2	0,156	0.752	0.486
Corn size * time Torrefaction	0.283	4	0,071	0.341	0.847
Error	3.736	18	0,208		
Total	228.845	27			
Corrected total	5.778	26			

the size of the corn cob and time of torrefaction had no effect on the water content of the torrefaction corn cob

ANOVA TEST OF SIZE OF CORN COBS AND TIME OF TORREFACTION TO ASH CONTENT.

Source	Sum of square	df	Mean square	F	Sig.
Corrected model	10.812 ^a	8	1.352	1.276	0.338
Intercept	57,558	1	57.558	53.96	<0.001
Corn size	8.283	2	1.141	3,883	*0.04
Time torrefaction	2.06	2	1.03	0.966	0.4
Corn size * time Torrefaction	0.47	4	0.1117	0.11	0.977
Error	19.198	18	1.067		
Total	87.568	27			
Corrected total	30.01	26			

the size of corn cobs has a significant effect on the ash content of corn cobs. While time of torefaction did not have a significant effect on the ash content of corn cobs after torrefaction

Duncan's Test the effect of the size of the corncobs on the ash content

Size of corncobs	N	Subset	
		1	2
3 cm	9	0.8355a	
2 cm	9	1.3629ab	1.3329ab
1 cm	9		2.1817b
Sig.		0.293	0.11

the ash content torrefaction results with a size of 1 cm is higher than the sizes of 2 cm and 3 cm.

no difference in ash content between torrefactioned corn cobs with a size of 2 cm and 3 cm.

VOLATILE CONTENT

using the torrefaction process based on the size:

- + 1 cm size is 97.81%,
- + 2 cm size is 98.63%,
- + 3 cm size is 99.16%.

using the torrefaction process based on the length of the burning time:

- + 30 minutes is 98.89%,
- + 45 minutes is 98.49%,
- + 60 minutes is 98.22%.

Anova test of size of corncobs and time of torrefaction to Hydrophobicity

Source	Sum of square	df	Mean square	F	Sig.
Corrected model	5515.412 ^a	8	689.426	2.151	0.085
Intercept	131784	1	131784	411.128	<0.001
Corn size	63669	2	318.345	0.993	0.39
Time torrefaction	2856.76	2	1428.38	4.456	0.027
Corn size * time Torrefaction	2021.96	4	505.491	1.577	0.223
Error	5769.76	18	320.542		
Total	143069	27			
Corrected total	11285.2	26			

the size of the corn cobs has no significant effect on the hydrophobic properties of torrefaction of corn cobs.

The duration of torrefaction had a significant effect on the hydrophobic properties of torrefaction corncobs

Duncan's Test the effect time torrefaction of the corncobs on the hidrophobic

Size of corncobs	N	subset	
		1	2
60 minute	9	56.1601 ^a	
45 minute	9	72.4871 ^{ab}	72.4871 ^{ab}
30 minute	9		80.9428 ^b
Sig.			0.33

- + the hydrophobic of corn cobs with a torrefaction duration of 30 minutes is different from that of 60 minutes.
- + The hydrophobic properties of corn cobs with a torrefaction of 45 minutes did not differ from the time of 60 minutes and 30 minutes.

CONCLUSION

The corn cobs torrefaction process can improve the quality of corn cobs fuel and its hydrophobicity:

- a. The moisture content of corn cobs decreased from 11.84% to 2.52% – 3.21%
- b. The ash content decreased from 2.20% to 0.68% - 2.60%.
- c. The calorific value increased from 17.66 MJ/g to 18.89 - 21.61 MJ/g,
- d. The water absorption of corn cobs after 24 hours soaking decreased from 347.72 % to 125.70% - 213,98%

CONCLUSION

Corn cobs size affects the ash content, but does not affect the moisture content and hydrophobicity of the corn cobs after torrefaction

Time of torrefaction affects the hydrophobicity of the corn cobs, but does not affect the moisture content and ash content

