

Primary Chopping for Sugarcane Leaves for Shredding and Pelleting Biomass

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Abstract

The objective of this study was to study the primary chopping for sugarcane leaves for shredding and pelleting biomass. The tests were carried out only in the chopper unit on chopping and pelleting Prototype. Sugarcane leaves moisture content of 19.74 % (wet basis) was used. Three chopped speeds of 380, 630 and 880 rpm (3.18, 5.28 and 7.38 m / s) and 4 blades cutter-head were studied. The test results of percent weight receiving of chopped leaves was increase with increase in chopped speed and length of chopped leaves was decrease. The chopped speed of 880 rpm were found to have percent weight of chopped leaves of 98.53 % and average length of chopped leaves was 13.85 mm.

Keywords: Sugarcane Leaves, Chopper, Shredding

1 Introduction

Thailand has 11,051 thousand tons of renewable energy crude oil equivalent 9.7% increase from last year. As a result, the reduction of water intake was 118,292.13 million baht it was found to be used in the form of heat accounted for 65.0 % of total energy consumption, followed by electricity and biofuels accounted for 19.2% and 15.8% respectively (Department of Alternative Energy Development and Efficiency, 2016) The production and export of biogas pellets to overseas about 2 million tons per year (Nimit Nipatthamkum, 2015) the demand for raw materials to produce biomass pellets is sufficient to support domestic consumption and export, the agricultural waste of the country has the potential to produce. In the survey, it was found that the amount of sugarcane leaves left in the field was about 17.0 million tons from the sugarcane cultivation area of about 10 million rai, yielding 100 million tons. (Department of Alternative Energy Development and Efficiency 2016) The advantages of sugarcane leaves features are high heat 5744.74 Kcal./Kg. have density (bulk density) up to 853.34 Kg./m³, hardness of 799.00 KN./m² moisture content lower than 21% is cylindrical, diameter 6 -12 mm, length about 1-3 cm. (Chanin Auppatum, 2012) By the process of producing pellets there are steps as, collection, procedures for reduction, dehumidification, mixing, compression, cooling and packaging (Energy production technology Fuel from wood chips, 2014) reducing size is an important step, because if the sugarcane is not suitable, it will be difficult to

compress and low efficiency. The reduction of sugarcane leaves required through the shredder first and then hit the sub to achieve the appropriate size of sugarcane leaves, there are several important factors. Therefore, the reduction of the sugarcane leaf size it is necessary to study the factors affecting sugarcane leaf shredding. This is the information for the design and development of shredder and sugarcane cutters for the production of pellets.

2 Materials and Methods

2.1 Sample

The chopper set used in the test consists of the material feeder feeds the material into the chopper head, with a length of 100 cm. and a feed slot of 14 x 26.5 cm. The sugarcane is cut into two chopped bushes of 22.5 cm. in diameter 10 cm. in diameter The chopper head is a removable blade holder with four blades attached to the chopper head at 10 degrees with chopped head shaft the diameter of the chopper head is 16 cm. (Figure 1)



Figure1 Chopping and pelleting Prototype, chopper unit

2.2 Experimental

The experimental was conducted on sugarcane leaves of Khon Kaen 3 gene the moisture content of sugarcane leaves was 19.74% (w.b.). The chopper speed was 380 630 and 880 rpm (3.18, 5.28 and 7.38 m / s) used 4 blade cutter-head and a constant feed rate of 200 Kg/hr. the power of the test set is a tractor connected to the power take off, the speed of rotation around the engine.

Preparation of sugarcane leaves for testing with sugarcane leaves, moisture content of 19.74% (w.b.). The sugarcane leaves were chopped at 380 630 and 880 rpm. respectively feed sugarcane leaves with constant feed rate sample of sugarcane leaf after chopper and time record ability to chopped. The data point value result. As follows: working capacity (Kg / hr) length of sugarcane leaf after chopped (mm.) percent weight of chopped leaves and sugar leaves size separation by using sieve machine (Figure 2)



Figure 2 sieve (a) By sight (b) Number #1 Size 9.50 mm. (c) Number #2 Size 4.75 mm. (d) Number #3 Size 2.50 mm. (e) Trays

3 Results and Discussion

Preparation of sugarcane leaves for testing by studying the moisture content of sugarcane leaves 19.74% (w.b.) the speed of the chopper blade 3 levels is 380, 630 and 880 rpm. when the blade speed increases, the chopper capacity increases. The working capacity was in range 148.50-151.05 Kg/hr. the average percent weight of chopped leaves was 96.11-98.53 % (Table 1 and Figure 3,4)

Table 1 Working capacity and percent weight of chopped leaves at each Blade cutting speed.

Blade cutting speed (rpm)	Working capacity (kg/h)	percent weight of chopped leaves
380	148.50	96.11
630	150.01	96.39
880	151.05	98.53

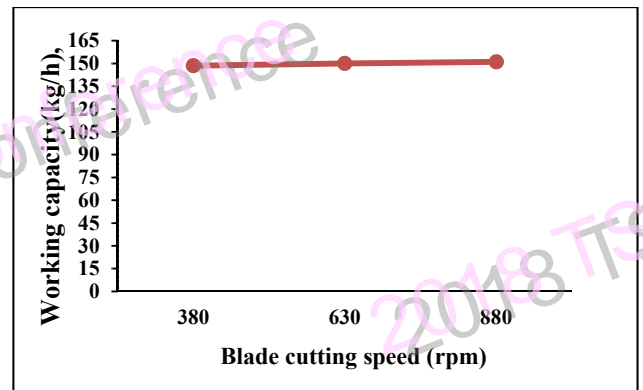


Figure 3 Relationship between Blade cutting speed and Working capacity

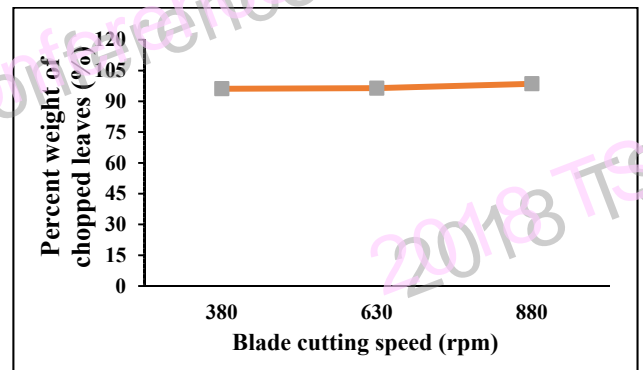


Figure 4 Relationship between Blade cutting speed and Percent weight of chopped leaves

Form table 2, when the sugarcane leaves were obtained by shredding to size separation using a sieve machine, it was found that the speed of chopper blade increased. The length of sugarcane leaves after chopped on the screening sieve had average length decrease. At chopper speed of 380 and 630 rpm, the highest percentage weight of sugarcane leaves left on the 1st grid was 44.33 and 42.11 % the average length was 33.18 and 31.78 mm, respectively. The chopper speed of 880 rpm was the highest, the maximum weight of cane leaves was 43.84 % the average length of 13.85 mm was determined by the weight of the sieve, the length of sugarcane leaves was reduced from Figure 5. The chopper speed was 880 rpm. by sighting Number # 1 Number # 2 Number # 3 and Trays Length range 173.0-230.0, 12.0-23.0, 6.0-10.0, 7.0-11.0 and 5.0-6.0 mm. the highest cumulative percentage is 30, 45, 51, 44. And 37 %, respectively.

Table 2 Average Weigh on Sieve, Length range and Average length at each Blade cutting speed and Number of Sieve.

Moisture content (% wb)	Blade cutting speed (rpm)	Number of Sieve	Sieve hole Size (mm)	Average Weigh on Sieve (%)	Length range (mm)	Average length (mm)
19.74	380	By sight	-	3.90	120-432	246.53
		1	9.50	44.33	12-98	33.18
		2	4.75	33.52	6-52	15.55
		3	2.50	15.46	3-19	8.12
		Trays	-	2.80	2-17	7.04
	630	By sight	-	3.61	101-520	187.74
		1	9.50	42.11	10-98	31.78
		2	4.75	35.34	6-50	14.37
		3	2.50	16.52	4-28	9.44
		Trays	-	2.42	2-13	6.61
	880	By sight	-	1.47	115-520	225.20
		1	9.50	32.04	12-95	28.00
		2	4.75	43.84	6-37	13.85
		3	2.50	18.86	3-33	9.12
		Trays	-	3.81	2-12	5.38

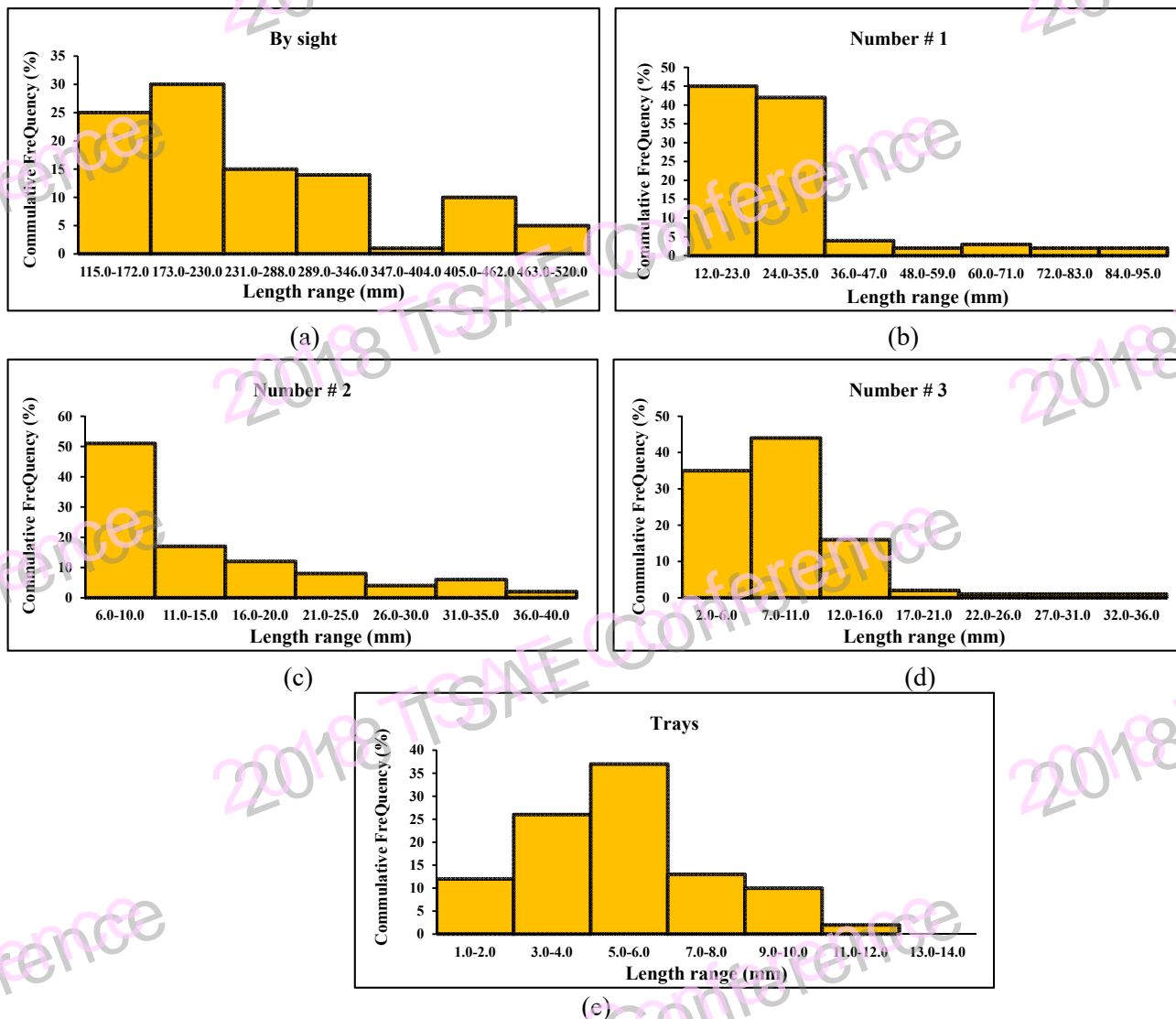


Figure 5 (a)(b)(c)(d)(e) Relationship between Length range and percent commulative frequency with different Number of Sieve

4 Conclusions

The chopper blade speed affects the size of sugarcane leaf after chopped and the percentage weight of sugarcane leaves after chopped. When sorted, the weight remaining on the grids will depend on the reduced length of sugarcane leaves the average weight of sugarcane leaves after chopped on the 1st and 2nd sieve was 33.18, 31.78 and 13.85 mm. with the length of 6.0-10.0 mm. and percent commulative frequency 51 %

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6 References

- Department of Alternative Energy Development and Energy Conservation. Report 33 Thailand's Renewable Energy [Online] 2016 [Quote of 34 December 2010] From http://www.dede.go.th/35_ewt_w3c/ewt_news.php?Nid=4079
- Chanin Auppatum, 2012 Study on factors affecting sugar cane compaction for pellet fuel production. Master of Engineering Thesis Agricultural and Food Engineering College Khonkaen University.
- Nimit Nipatthammakum 2015. Opportunities and Trends of Biomass Fuel Business. Nakhon Pathom Institute of Energy Research and Development Chiang Mai University.
- Energy production technology Fuel from wood chips. Biomass pellet fuel [Online] 2014 [Quote of 22 December 25560] From <http://rubber.oie.go.th/Elibrary.aspx?cid=93>