ASPECTS ON OBTAINING THE RAW MATERIAL FOR PELLETIZING

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ABSTRACT

Energy willow is one of the most important energy crops. The problem is that it is hard to be used in its natural state, because it has low density, is hard to transport and store, thus requiring processing. Pelletizing offers a real possibility to valorise willow by transforming it into solid biofuels. The paper presents experimental researches on the process of obtaining raw material from energy willow in the view of transforming it into pellets.

INTRODUCTION

Energetic plants are considered renewable resources and are promoted through crops intended for obtaining energy, complying to economic rules, obtaining high yields with minimum inputs. [2]

Energy willow is an agricultural plant that can be grown both on high moisture soils and on clay soils, its calorific power being very large compared to other plants (4900kcal/kg). Energy willow can be processed, obtaining a significant quantity of solid biofuels (chippings for energy plants, briquettes, pellets). [6]

The high volume of biomass coming from energy willow crops represents an impediment for its final use in without processing, due to its low density and difficulties concerning handling, transport and storage, therefore the plant material can be transformed in pellets or briquettes.

One of the first steps in plant preparation happens in the field where energy willow is harvested using specially designed equipment that not only cut the willow stems, but also grinds them into large chippings. [3]

One of the most important technological processes in the pelletizing technology is the material preparation, the granulation of the raw material for pelletizing having a major impact on the formation of pellets, on their quality and their behavior during handling, transportation and storage. [1]

Usually, pellet density and durability is inversely proportional with the size of particles, because small particles have a higher contact surface area during densification.

Small and medium particle sizes are necessary in the pelletizing process, leading to better material binding and high equipment efficiency also helping decrease overall production costs. [4, 5]

MATERIAL AND METHOD

The experimental researches for obtaining raw material for pelletizing were conducted by grinding energy willow stems using a hammer mill - TCU (fig.1).

The chopper for plant waste – hammer mill TCU is an equipment that can be used for grinding cereal seeds, corn cobs and also for grinding agricultural and forestry waste (that has been previously shredded to larger sizes).

The machine is equipped with an inclined plan (material feeding chamfer), a bag for collecting the chippings, a two way evacuation system that directs the grinded material with the help of a shutter.

Biomass agricultural and forestry waste (that has been previously shredded) is fed manually in the feeding chamfer. The grinding of energy willow stems is achieved by hitting and shearing the material between hammers fitted on the hammer disk and counter-knives. The chopped material is transported by the ventilator into the cyclone fitted at the inferior part with two bag openings (having the possibility to discharge the material towards one of the two openings) and enters the bag for collecting the processed material.

Fig. 1 – Plant waster hammer mill [7]

The main characteristics of the hammer mill are:

- Electric motor power: 22 kW;
- Electric motor maximum speed: 3000 rot/min;
- Milling capacity: 900 m^3/h;
- Interchangeable grinder sieves with different sizes (7-25 mm);
- The possibility to change the position of the collecting bag depending on the necessities of each user.

For conducting the experiments,the sieve with 7 mm holes sizes was used, equipped in turns with four types of knives (A, B, C and D – fig. 2).The speed was varied using a frequency converter from 50 Hz (at a speed of 3000 rpm) to 47.5 Hz (at a speed of 2850 rpm), 45 Hz (at a speed of 2700 rpm), 42.5 Hz (at a speed of 2550 rpm) and 40 Hz (at a speed of 2400 rpm).

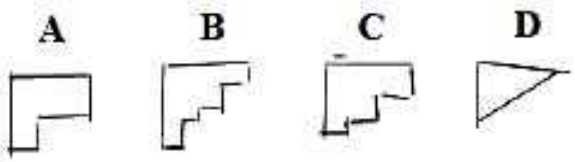

Fig. 2 – Types of knives used for experiments
A – 1 step knife; B – 3 step knife; C – 2 step knife; D – triangle knife

RESULTS AND DISCUTIONS

The results obtained from experiments conducted for energy willow material using a 7 mm sieve are shown in table 1 and figures 3-6.

It can be noticed that overall, the highest percentage is registered for the 4÷7 mm fractions, for all knife types.

The largest amount of particles larger than the sieves meshes (7 mm) was obtained using the triangle shaped knives, making them the most uneffective type, from their use resulting an average of more than 35% material larger than 7 mm.

Table 1

Result from experiments using the 7 mm sieve

Sample no.	Frequency [Hz]	Speed [rpm]	Grind size / quantity [%]											
			Knife A			Knife B			Knife C			Knife D		
			< 4 mm,	4÷7 mm,	> 7 mm,	< 4 mm,	4÷7 mm,	> 7 mm,	< 4 mm,	4÷7 mm,	> 7 mm,	< 4 mm,	4÷7 mm,	> 7 mm,
1	50	3000	14.75	50.00	34.57	31.38	47.23	20.78	18.70	54.50	26.10	23.94	43.34	32.12
2	47.5	2850	23.84	51.26	24.18	23.84	42.80	32.69	28.87	49.54	20.96	18.32	41.77	39.24
3	45	2700	22.75	48.83	27.82	25.97	44.82	28.50	27.49	48.48	23.34	22.94	37.16	39.30
4	42.5	2550	20.11	52.86	26.33	23.75	43.52	31.99	19.92	55.66	23.80	20.66	41.29	37.37
5	40	2400	36.45	40.95	21.82	19.38	47.94	32.00	19.99	49.78	29.58	31.01	39.50	28.85

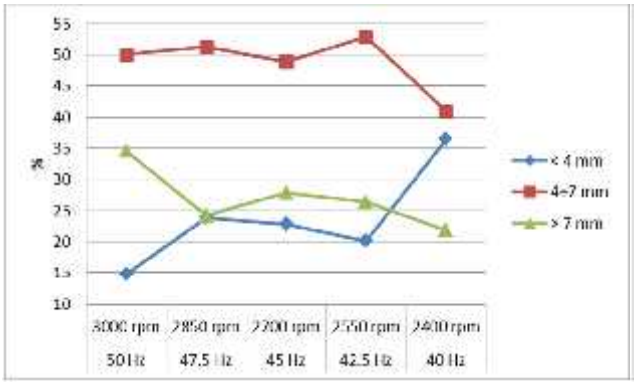

Fig. 3 – Result using A type knives

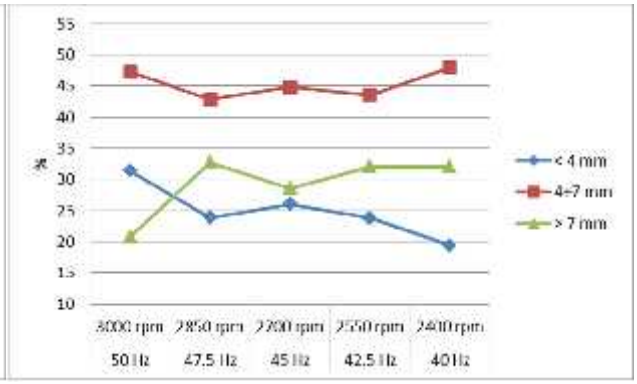

Fig. 4 - Result using B type knives

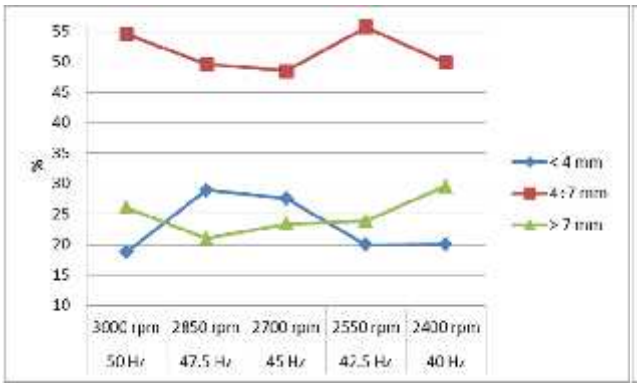

Fig. 5 – Result using C type knives

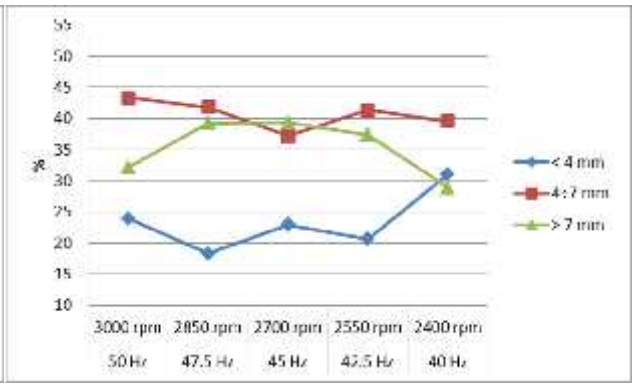

Fig. 6 – Result using D type knives

CONCLUSIONS

Biomass material preparation for pelletizing is one of the most important activities in the whole technology for pellet production. It influences pellet formation and it determines the final pellet quality in terms of handling, storage and resistance in time.

It is necessary to have a good balance between small, medium and large particle sizes, each of the three categories having an impact on the final pellets. It is ideal to have a large percentage of small particles, but the material mixture needs to be balanced with larger particles. If only small particles are used, they can severely affect the production capacity, and even jam the equipment.

By using the TCU equipment for grinding the biomass material, was obtained a good balance between medium, small and large particles, making the mixtures obtained fit for compression.

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