STUDY THE BROKEN MAIZE GRAIN ON TANGENTIAL THRESHER

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SUMMARY

The threshing drum (TD)supplies power isolating the grain at the same time it makes the grain broken. This causes the difficulty for grain storage. The traditional threshing unit has very high velocity, especially when threshing paddy it increases up to 30 m/s. It appears that the number of blows received head of grain as it passes between the TD and concave caused seriously broken grain especially when threshing corn. The determining broken velocity and reduce the degree of broken grain. Experiments indicated that freely beating velocity is approximate 24 m/s and is the critical velocity. Reducing the velocity of threshing drum is not only to decrease the broken grain but also the power for TD.

1. INTRODUCTION

European and American threshers are mostly tangential types for threshing wheat and maize. One of the reasons for existing this thresher and use widely is that it has very high threshing capacity. When using tangential threshers, we can not solve the inherent contradition between broken grain (α) and omit-threshed grain (β) completely, to threshing velocity. In order to separate the grain completely, the suitable velocity must be chosen, normally it velocity is very high. But, when increasing velocity to thresh completely, at the same time the percentage of broken brain will increase rapidly. Many experiments have shown that the velocity must be 27 - 33 m/s when threshing paddy to attain omit-threshed grain below 1% and the broken grain is 2 - 4% (figure 1).

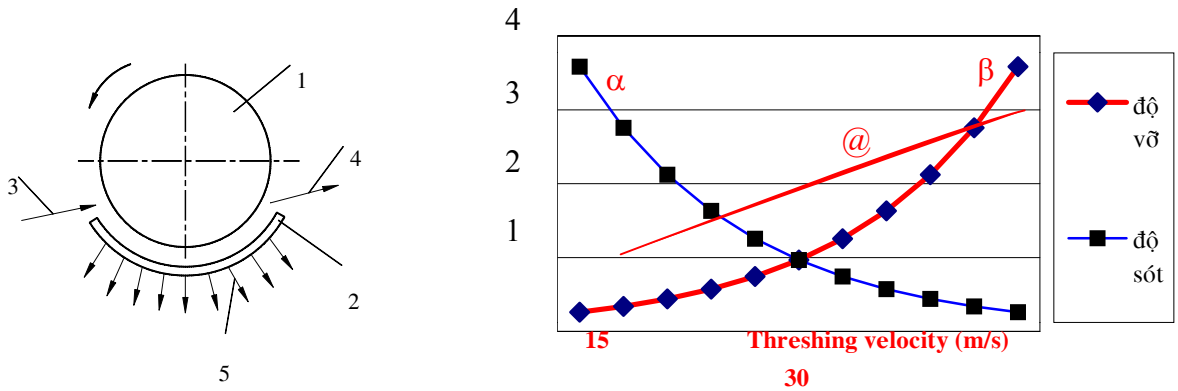

Fig.1: Omit-threshed,broken grain verus on the velocity of tangential thresher drum (TD)
1.Thresher drum; 2.Concave; 3.Thresher material coming to beating gap;
4.Straw; 5.Mixture of grains passing through concave
α- Broken grain; β- Omit-thresher grain ; @- Grains fly following straw

When using tangential thresher to thresh corn, the broken grain increase very high so the velocity of cylinder must be reduced. However, based on the performance of tangential thresher, if we want to thresh unomit-thresher completely, the thresher drum should be maintained a suitable velocity.

Experiments indicated that the broken grain is very high, at last 25% when separating corn grain by tangential thresher. In order to limit the minimum broken grain, it is necessary to study optimum velocity. And are of scientific foundations is to determine the critical velocity when beating freely, then, the maximum velocity for threshing maize.

2. Experiments on deterring the optimal velocity with beating freely

In separating process, the direct impacts of beater bar to grain can hardly avoid from breaking . However, if the impact has oposition hardly material body, the grain will be broken completely at any threshing velocity.

We supposed that process of impact between grain and beater bar had not had oposition hardly material body , the cobs moves together threshing velocity in thresher spacing. This assumption allowed us considering the impact between beater bar and grain like free beating.

In order to determining the critical velocity with free beating, we use a device (figure 2). This is a device that are arranged to cause the impact of one object defined the velocity of freely flying grain in the air.

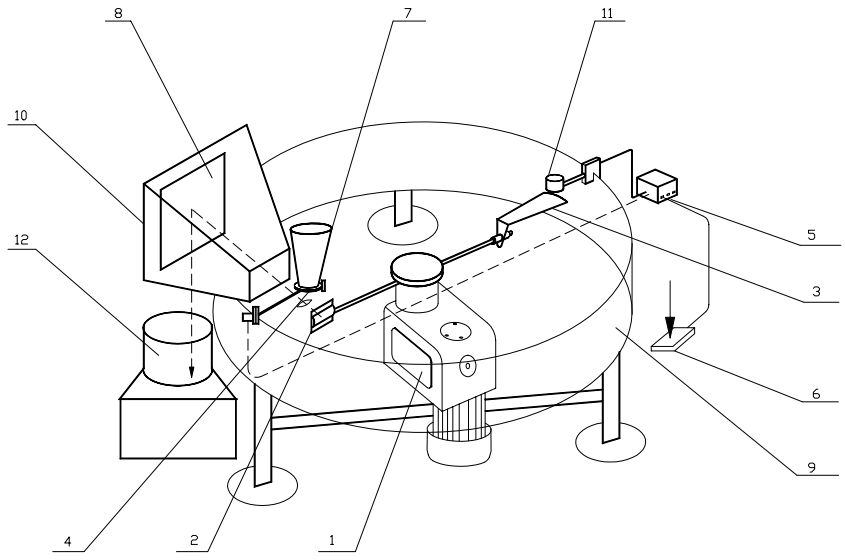

Fig.2: Schema defining machine for determining broken speed when freely impacting
1.Gearbox; 2.Impacting surface; 3.End of arm; 4.Lip; 5.Sensor; 6.Switch of sensor;
7.Grain tube; 8.Grain cutain; 9.Steel circle; 10.Photo electric cell; 12.Grain collector.

The gearbox (1) permit to change the revolution of arm and so it is easy to change the speed of impact surface (2) to freely flying grain in the air. Due to the end of arm (3)

scanning photo election cell (11), the sensor (5) makes the lip open quickly for one grain falling from the grain tube corresponding to the rotating of impact surface that beats to the falling grain. Different speeds will make the position of sensor (11) far or close to the position of dropping pipe (7) on the steel circle (9).

Experiments will be performed with various parameter:

- Types of grain : corn
- Moisture content of grain : 18 – 26%
- Velocity of arm : 20 – 26 m/s
- Machine is rotated with determined velocity to test. The number of grain for every experiment is 50

After determining accurately the position of photo election cell (11) on steel circle (9) proportion with the velocity of impact surface. 50 grains are loaded into the grain tube (7). Operated the machine and turn on the switch (6) . When connecting the switch (6), sensor (5) will define opening time of the lip (4) as the end of arm passed through photo electronic cell (11). This position corresponds with impact surface (2) that contacts with one grain faller from the grain tube (7) across the lip (4). Just then the lip (4) is closed and units the control of sensor (5) to repeat the threshing process grain. The grain that are flied later and impact to the end of arm will be collected in box (12) to define the percentage of broken grain verus velocity and moisture content 20 – 26% are shown on table 1 .

Table 1: The broken grain depending on velocity of arm and moisture content when beating freely.

M.C of grain (%)	Velocity of impact surface(m/s)							
	20		22		24		26	
	Broken grain (%)							
	Micro.	Macro.	Micro.	Macro.	Micro.	Macro.	Micro	Macro
18	25	56	14	86	8	92	0	100
20	23	52	19	87	10	90	0	100
22	18	46	19	72	7	93	0	100
24	13	45	21	69	9	91	0	100
26	10	30	35	52	5	95	0	100

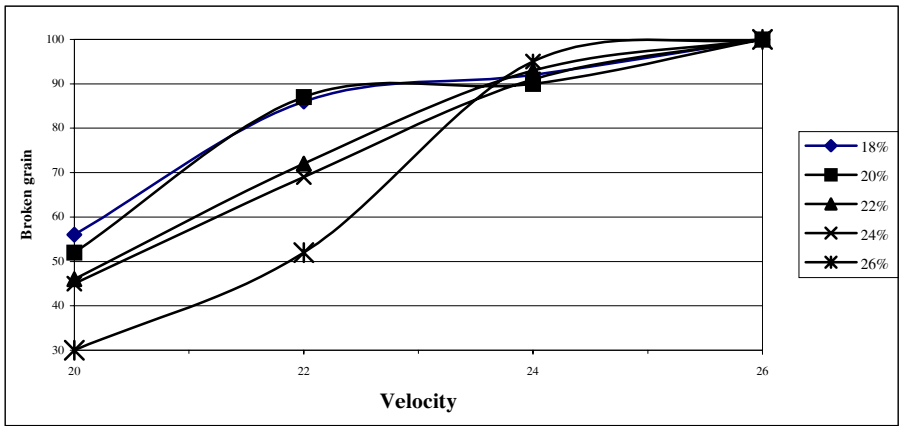

Figure 3: Broken grain(Mcro.) verus and velocity and moisture content of grain

By using software excel 7.0 to analyse regression, we find out the model of regression equation that represents the broken grain proportion will impacting velocity and nature content of grain such as:

Broken grain = 6.66* velocity – 3.31* moisture content – 26.17* (velocity/moisture content)

with R = 0.966

3. Threshing cobs directly in Tangential thresher:

While threshing cobs in tangential thresher, cobs are not husked and so the corn grain do not contact directly to the beater bars of drum. Experiments indicated that the degree of broken grain is must smaller compared to threshing husked cobs.

The experiments of Professors, faculty of Agricultural engineering, University Agriculture Nitra (Solvakia) have shown when threshing cobs the broken grain increases 30 – 40 %. This can be explained that the husk of cob is absorbing lager between beater bars of drum and grain.

The traditional method of removing corn grains out of the cobs in rather different from separating the paddy to the head. In paddy head, there is not interaction between grain, but in the cobs corn grain are arranged in lines, odd, from 8 to 18 rows. The length (a) and width (b) of corn grain are the same, but the thickness is much smaller compared to two dimensions (a) and (b) .

The corn grain is plugged approximately 1/3 a in corn cob, in lines and close together. At harvesting moisture (25 – 35%) there is not the gap of grain in lines. It is difficult to pull the grain out of the cob. But, if we removed one row and then a force is applied to push cross the next row into the gap of remove row, the removing force will be very small. So, the traditional method to separate the corn grain is to use the turning force touching the tangential line of cycle of cob .

If the whole cobs are dried, the moisture of corn grain and cob will reduce. Grain and cob are shriveled due to water loss. The clearance of grain in row and interrow increase, grain are stickled in corn cob by the portion laid in corn cob removing the grain after drying is very easy, the separating force is reduce considerably. When threshing dried cob, the linkage between grain and corn cob only is broken down. And when threshing fresh cob, we have to break down two linkages: grain - corn cob and grain - grain. This causes considerably broken grain.

The construction of corn tangential thresher is not different from baddy thresher. But the thresher materials are different so much. In some threshers, beater bars are replaced by beater bars, but the broken grain does not decrease. The threshed material are cluster of grains and close together. The accurate action of beater bar and the length of cob is a “blow” for one, two, three or four row of grain. This is an explanation of why the broken

grain of threshing corn is high. If the cob is a flesh state (moisture of grain 25 – 30 % or moisture of corn cob 35 – 45%) the broken grain will be must higher.

When threshing paddy, a paddy longer with uniform thickness that was pressed by inclined elevator is supplied to threshe spacing . On the contrary, when threshing corn, one buy one cob come to the thresher spacing . There are 3 situation (fig. 4)

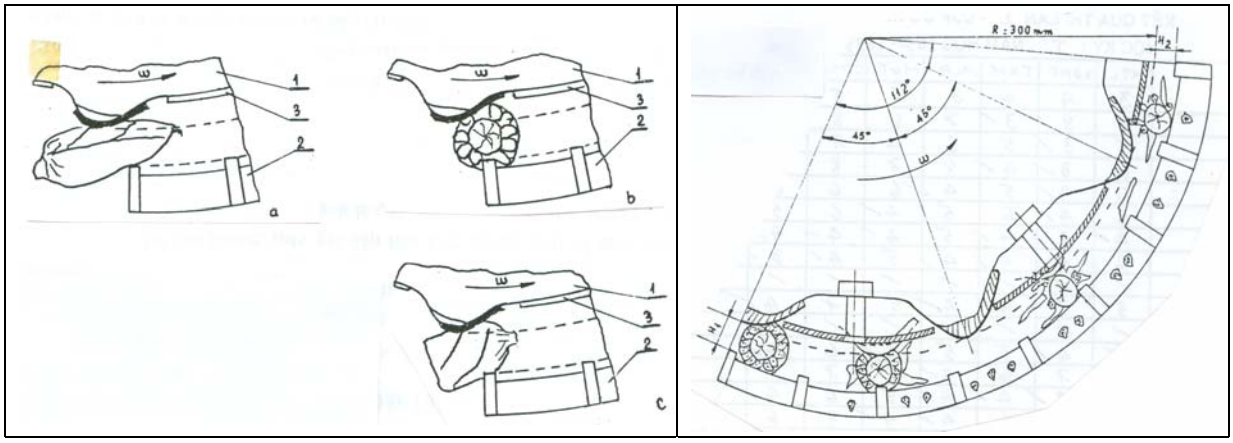

Fig.4: Cobs come to the spacing and isolating grain process in the thresher spacing

The quality of threshing corn depends greatly on the direction to spacing of cobs. Case (a) and (c) (fig. 4) will break the cobs into several sections without making the corn cob soft. With tearing the corn cob, the cut portion will separate several grain, and there is unseparated grain from these portion. So unthreshed grain increase. It is the most harmful for corn cob that has small diameter passing rapidly due to losing the husk and removed grains.

The main factor that makes the grain rapidly separate from the cob is the cushion of corn cob along the length. The corn cob has construction like coupled sector (4 – 6 sector) along the length of cob. If the cob passes through the beater bar in case b (fig 4), the breaking linkage of sectors will be optimum. When this linkage are broken, the grain is removed from the corn easily.

When threshing paddy, the broken grain does not exceed 2% with moisture content 18 – 22%, threshing velocity 27 – 32 m/s but when threshing corn, the broken grain increase very much (60 – 70%)

Therefore, we have to pay attention to drying procedure. The retard of reducing moisture content of grain to stored moisture content will damage the quality of products. The broken grain is acceptable since corn grain is made feedstuffs.

4. Commendation

- The above experiments indicated that, the degree of broken grain in freely beating decreases when the moisture content of grain increases at velocity below 26 m/s.

- Even at velocity 20 m/s with moisture content of grain 18 – 26 % the grain is broken from above 30%. However, in the process of increasing velocity of tangential threshing drum, grain is not broken to such large degree. This proved that the rubbing process between material layer in spacing was brought about threshing drum with layer main role in separating grain. The process performs indirectly, there are not so much impact of blows

- At beating velocity 24 m/s, over 20%, the remain grains is critical velocity when beating freely. But at 26 m/s almost 100% grain are broken.

- This matter corresponds to ultimate velocity when beating freely at velocity 24 m/s, moisture content of grain 16% .

- The separating process not only directly acts on the linkage of grain and chaffer, but also is the process of bringing the rubbing material is beater gap of thresher. This process pays a main role for separating grain. Thus, threshing concept is the providing energy for turning object, drawing threshed materials, creates velocity of different layers, rubs together to separate the grain and will be approximate essence of separating process.

- Reducing the velocity of threshing drum, strengthening the rubbing process, crushing up material in small beater gap to thresh completely and decrease the broken grain are needed to study separating grain effectively.

- Tangential threshing unit does not satisfy the above requirements therefore, the finding suitable threshing unit : reducing the velocity of turning object, increasing the capability of crushing, rubbing is required orientation to enhance the quality of separating grain.

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