

## DETERMINATION OF GRINDING ENERGY THROUGH METHOD OF DYNAMIC TESTS AT FRUITS WITH VARIABLE TEXTURE

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### ABSTRACT

*A part of solid raw materials used in different industries but especially in food industry, assume this grinding according to the technological requirement.*

*View the fact that grinding operation are complex how and the fact that products submissive to grinding have property variable in time and space, method proposed for study was conceive so to take in consideration a lot of parameters.*

**Keywords:** grinding, energy, texture

### 1. THEORETICAL CONSIDERATION

Dynamic test of vegetable products with variable texture have a quickly evolution, full of an important impact on products processing [1, 2, ].

An important function at this type of test are constitute at determination of products abnormality darkling under dynamic forces effect. To this effect was necessary to realizing cutting equipment with the help which study the energy consumption for different working conditions.

Cutting equipment (fig. 1.a) are constitute from carcass 1 in that interior are knife clip disc 2, mounted so that to permit edge cutting setting to certain height over disc creating a controlled slot through which go pieces of ripper products. Distance between edges cutting of knives and knife clip disc determine thickness of ripper pieces. On knife clip disc exist possibility to regulation the knives angle of incidence(fig. 1.b).Rotation of knives disc are choice in function to product texture submissive to grinding by cutting, the movement being transmit to one asynchrony motor with static frequency changer 6, through the agency of driving belts 5. The cut products are feeding in equipment through removed lid 7 as which are attach pressure plate 8 which has roll to pressing product to knife surface, operation how can be realized with the help of springs 9, [5, 6, 8].

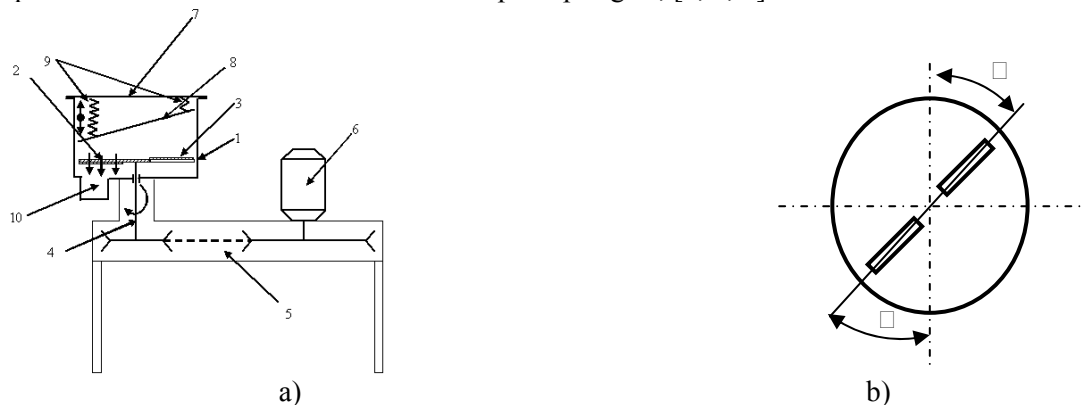


Fig. 1. The scheme of cutting equipment.  
a) the cinematic scheme of equipment; b) knife clip disc

The parameter studied – grinding energy – are determined indirectly through measuring the torsion moment which itself developed in shaft of cutting device, with the help of relation 1, demonstrate theoretic [8]:

$$F_m = \frac{M_t}{R} \quad (1)$$

in which:

$F_m$  represent the grinding force, N;

$M_t$  – torsion moment, N·m;

$l$  – distance between force direction and rotation axle (centre), m.

With value of this force, can be determined the grinding energy using the Rittinger relation, particularized for vegetable products with variable texture:

$$E_R = F_m \cdot S_n \cdot \left( \frac{1}{d} - \frac{1}{D} \right) \quad (2)$$

when:

$S_n$  represent the surface new created for ideal particle, grinding after maxim diameter, m<sup>2</sup>;

$D$  – particle dimension between the grinding, m;

$d$  – particle dimension after the grinding, m.

View fact that grinding energy depends at surface new created, give to relation:

$$S_n = S_i + N_p \cdot S_c \quad (3)$$

when:

$S_i$  – particle surface submissive to grinding, m<sup>2</sup>;

$N_p$  – number of particles new formated

$S_c$  – circle surface, m<sup>2</sup>.

Replacing relation 3 in relation 2, the equation of grinding energy become:

$$E_R = F_m \cdot (S_i + N_p \cdot S_c) \cdot \left( \frac{1}{d} - \frac{1}{D} \right) \quad (4)$$

## 2. EXPERIMENTAL RESULTS

The experimental researches follow determination of grinding energy at vegetable products with variable texture (fruits) through measuring the torsion moment which are developed in developed in shaft of cutting device, [3, 4, 7, 9].

In viewer realization the experiences was choices different sorts of fruits, in tables 1 and 2 are presented the characteristics of sorts analyzed.

*Table 1. Species and sort of fruit analyzed through torsion moment method.*

Nr. crt.	Species	Sort	Maturity	Observation
1.	Apple	Jonangold	Completely	With peel
2.	Apple	Idared	Completely	With peel
3.	Apple	Grany Smith	Completely	With peel

The grinding was realized with different type at knives (right knife, sickle, type Z), was choose three value of working revolution (300 rot/min, 450 rot/min, 650 rot/min) for which was calculated the grinding energy.

Table 2. Middle hardness and humidity at fruits analyzed.

Nr. crt.	Species	Hardness (Fff)	Humidity (%)
1.	Applle	65	83,32
69		82,27	
73		81,44	

In figures 2 ÷ 4 are presented the variation of grinding energy function at working revolution for sorts analyzed through different knives type.

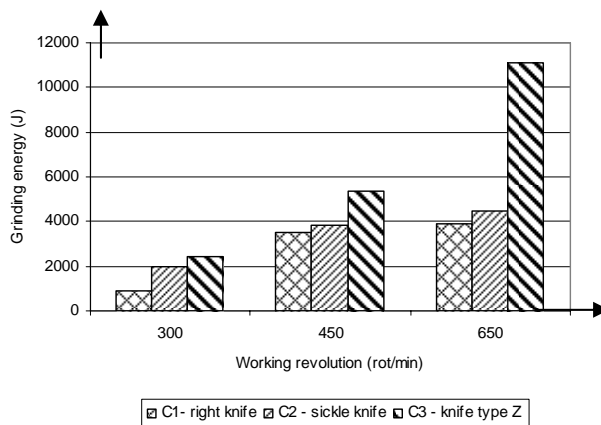


Figure 2. Grinding energy variation in function of revolution working for apples from Grany Smith sorts for different type of knives.

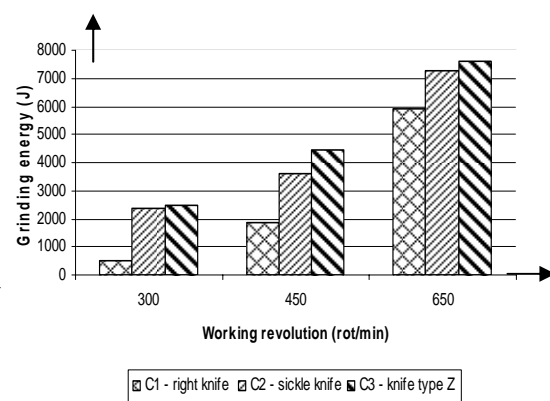


Figure 3. Grinding energy variation in function of revolution working for apples from Idared sorts for different type of knives.

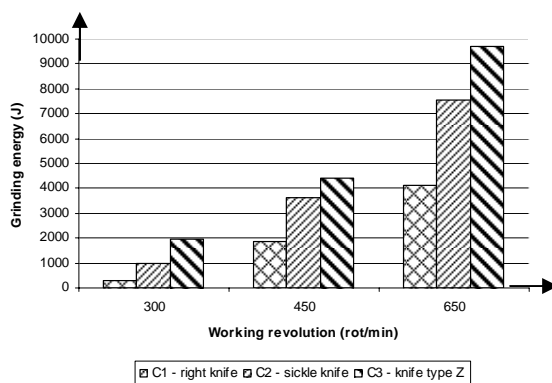


Figure 4. Grinding energy variation in function of revolution working for apples from Ionangold sorts for different type of knives.

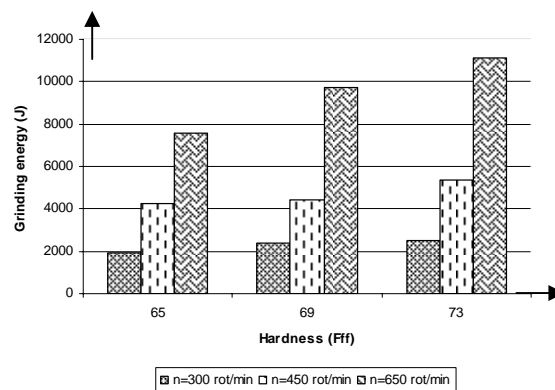


Figure 5. Grinding energy variation in function of hardness for fruit sorts analyzed at different values of revolution for sickle knife.

The grinding energy varying in function of product hardness at different values at revolution and for different knives type (fig. 5 ÷ 7).

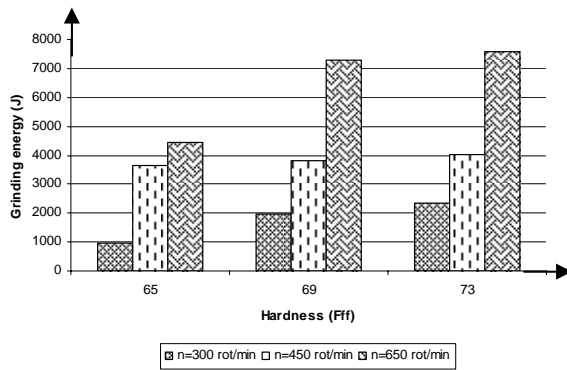


Figure 6. Grinding energy variation in function of hardness for fruit sorts analyzed at different values of revolution for knife type Z.

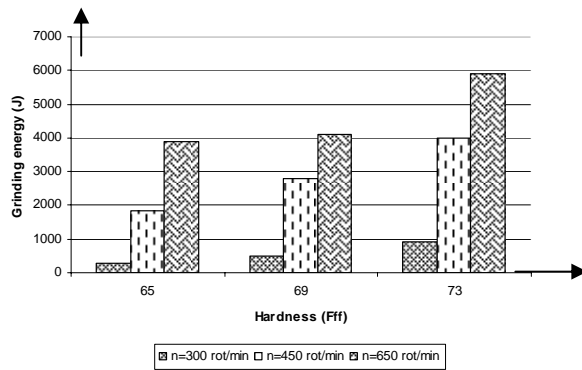


Figure 7. Grinding energy variation in function of hardness for fruit sorts analyzed at different values of revolution for right knife.

### 3. CONCLUSION

Behind of experimental experiences realized can be observed:

- grinding energy vary directly proportional with working revolution,
- grinding energy vary in function of knife type, so can be observed that bigger values at grinding energy was obtained at grinding with the help of knife type Z<
- grinding energy vary in case of the same species in function of sort and at textural characteristics of products.

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