

RESEARCH REGARDIN THE ENERGY CONSUMPTION AT GRINDING THROUGH BROKEN A LEGUMES WITH VARIABLE TEXTURE

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Abstract: The grinding process of vegetable products with variable texture it's complex, thing what is explain from fact that grinding action are submissive inhomogeneous body like size and with differences in physics feature of different parts.

In case of products with variable texture (fruits and vegetables), texture which variation from hard until as soft texture , so crumbling process then and actives work mechanism of grinding varied very much, thus can affirm that grinding operation it's one the most expensive operations from food industry.

Keywords: broken, texture, legume, grinding, energy consumption

1. GENERALITIES

The starting materials frequently have different forms, being too big so as to used accordingly and through sequel need grinding.

The grinding operations can be divided in two big categories, to take into account if the materials are liquid or solid. If the materials are solid the operations are named grinding or cutting function of hardness and consistency materials submissive at grinding, and if the materials are liquid operation is named emulsifying or pulverization. All depend to influence of shearing force in solids and liquids.

The grinding from cutting it is used so as to realize the bursting of big pieces by material in small pieces from next operation.

Bursting mechanism she isn't richly understands, but in process the material are straining at action of mechanics piece on the move at grinding machine, initially the tension are absorbed in interior of material as deformation energy.

When the local deformation energy outrun a critical level, how are in function of material, the breaking appear lengthways of contour line and so stored energy are free. A part from energy it's retain for creation new surfaces but the most it is lose likeness at heat.

2. EXPERIMENTAL RESULTS

The study regard determination of energy consumption in grinding process at agro-food products it perform in conditions of laboratory and itself report in principal to determinates the grinding force respective the shearing force.

Bursting test involve physical deformation at material submissive of application until are broken. The deformation is check just when the changes in material geometry can be measured.

In tested of broken mechanical property have in view the property of material. The energy supply must burden material in meaning of force application in this way are physical deforming.

Broken are due to propagation a fissure. So as to initiate a fissure must exist a exertion force and then through she propagation must be supply energy of propagation. This is energy what penetrate in fissure of materials bundle so as to generated new surfaces.

In all broken cases there is two extreme: brittle broken and ductile broken. The major broken have integrated the two aspects.

Because many vegetable products have a structure and a composition more complex the broken way can be a combination on any type of broken. Some products present very stable propagation of fissure, for example when it produces advance slowly (fruits and legume). Thus in place as force get up immediately to zero, she value will go down to slowly to zero. Moreover have to supply energy from to may produce the broken. If the force are removed, broken are stopped.

The machines used from determinate shearing force (fig.1) have at fundamentally the Elmendorf broken principles. The specimen of product, at certain dimensions its catch in jaws 1 of machine and through driving handle 2 its release pendulum 3 for specimen broken. Value of shearing force it's indicated by pointer 5 on graduated scale 4, mounted at pendulum.

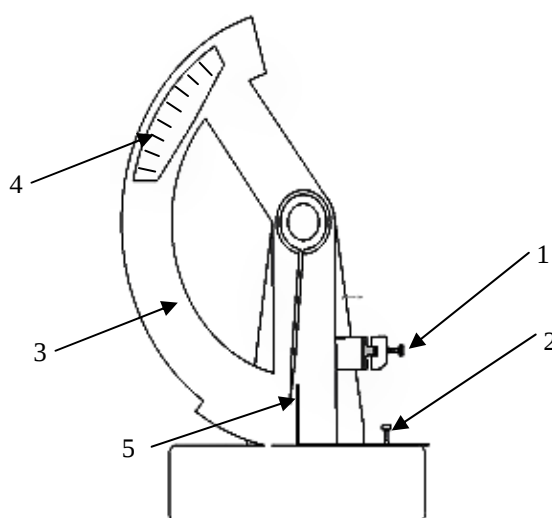


Fig.1. Machine scheme for realized the broken tests.

For realize the experiences was choice following species and sorts at legume (root crop), so represent a scale more large at vegetable products with texture praised through qualifying "hard" (table 1).

Species and sorts at legume analyzed

Table 1

No. crt.	Specie	Sort	Maturity	Observations
1.	Potato	Desirée	complete	with skin
2.	Carrot	Nassan	complete	with skin
3.	Celery	Victoria	complete	with skin
4.	Parsnip	Alb Negru	complete	with skin

The property of particles studied variation in function of specie and sort; in table 2 are presented the values of medium humidity and medium density at sorts analyzed.

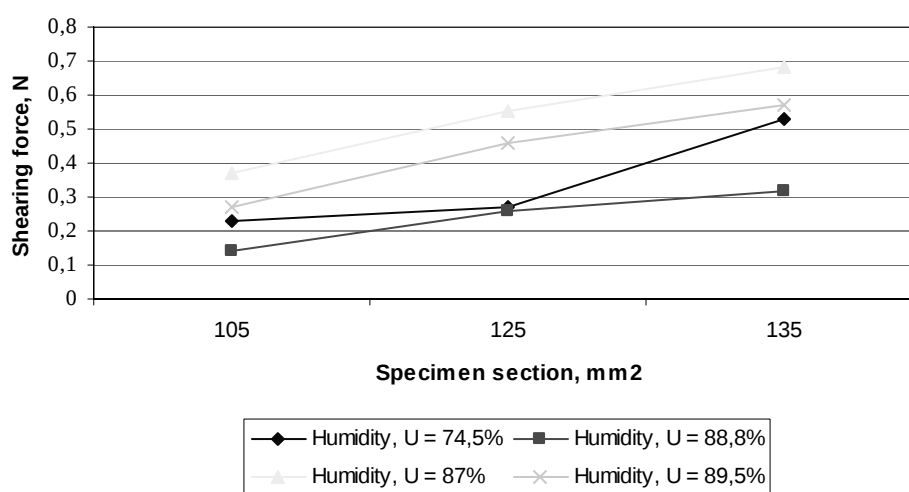
Medium density and humidity of legumes analyzed

Table 2

N0. crt.	Specie	Density, kg/m ³	Humidity, %
1.	Potato	1010	82,3
2.	Carrot	1040	88,8
3.	Celery	964	87,0
4.	Parsnip	994	89,5

The shearing force was determinate in laboratory with the help of machine to broken testing, on specimen by laboratory processing test piece type, realized from sorts processed in tables 1÷2. In time of experiences was varied the broken sections (respectively specimen thickness).

In figure 2 its processed variation of shearing force in function of specimen section at different humidity for sorts studies.



Shearing force variation in function at specimen section for sorts studies at different humidity values. Fig. 2.

With values of force obtained with the help of broken test itself determined the grinding energy using Rittinger relation.

Have in view that Rittinger think in his theory it the energy necessary to grinding its directly proportional with new surface creating in grinding process and not with particle dimensions, that is theory which allowance to all grinding phases in accordance with relation:

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

were:

k_R – its Rittinger constantly;

d – particle dimension after grinding, m;

D - particle dimension between grinding, m.

The Rittinger constantly allowance in principal by material sort who are grinding. If esteem the Rittinger constantly:

$$k_R = F_m \cdot S_n \quad (2)$$

in which:

F_m – represent the grinding force, N;

S_n – the surface new created m^2 .

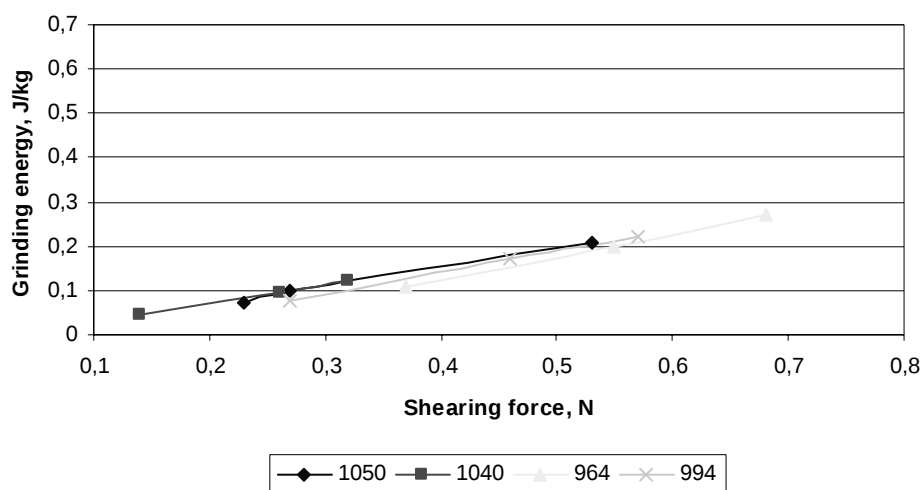
$$S_n = S_f - S_i \quad (3)$$

where:

S_f – final surface, m^2 ;

S_i – initial surface, m^2 .

In figure 3 it's presented the variation of grinding energy calculated with Rittinger relation, function of shearing force for sort processed in tables 1÷2.



Variation of grinding energy in function of shearing force from sorts studied at different values of density. Fig. 3.

3. CONCLUSION

Broken test follow determination the shearing force in function at section specimen. By analyze of results obtained are observed in that at grinding time have happen variable deformations in product, distinguished so elastic behavior of particle submissive of deformation. Can be observed that:

- the shearing force variation inverse proportional with products humidity, big values at shearing force, being canned for products with small humidity;
- shearing force its influenced at particles density having a different behavior function at product texture. The most bigger interval of variation are observed at celery, thing how are explained through fact that this have the most bigger difference of structure, descrescent by exterior to interior;
- grinding energy determined with the help of shearing force, after Rittinger law show small consumption, thing which are explain through fact that broken it produced from material fissuring, respectively the broken of material bundle cohesion.

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