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Researching the work of mini-grinder for rough fodder

Karimov Rustam Ruzimahmatovich, Abdullaev Ilkhom Eshkurbanovich, Ishmuratov Shavkat Saparovich, Ergashev Ryziboy Davlatmurodovich.

Candidate of Technical Sciences, Associate Professor, Termez State University, Termez, Uzbekistan.
Senior Lecturer, Tashkent State Agrarian University, Termez branch, Termez, Uzbekistan.
Assistant, Tashkent State Agrarian University, Termez branch, Termez, Uzbekistan.
Student, Termez State University, Termez, Uzbekistan.

ABSTRACT: The article has been given research on the development of the scheme and determines the angle of inclination of the blade of a knife cone-shaped working body of a mini chopper for roughage

KEY WORDS: roughage, stalk, grinder - cone-shaped working body, rotor, knife, blades, stalk, cutting, angle bent (tilt), cutting exertion, coefficient of stalk friction around the blade, speed, exertion, work and capacity of cutting.

I.INTRODUCTION

State program of developing agriculture of Uzbekistan is directed to the development of important field - animal husbandry and its supply with roughage, in the framework of creating small cattle-breeding, farming and peasantry, that demand a special attention at preparing high quality roughage at small material expenses. The practice showed that, unsatisfactory processing of rough fodder stalks by fodder preparation machinery bring to quality decline of got fodder and accordingly to the increase of its loss (to 30 %).
Essential decrease of exploitation expenses and the quality increase of fodder from rough stalks of fodder culture possibly at combining operations of grinding and cutting in fodder preparation machines, as the grinding and cutting of plants bring to the improvement of their fodder quality, decline of loss and economy of material remedies [1].

II.THE MATERIALS AND METHODS OF RESEARCH

The results of the research are handed to Joint-Stock Company «BMKB-Agromash» (in Tashkent city) and used in developing stationary mini grinder.
That's, why the investigations, directed to develop the scheme and defining bent angle of blade of the cone shaped working body of mini-grinder for rough fodder (Fig.1), and also studied the speed, exertion, work and capacity of cutting the stalks.
The grinder consists of a submitting tray 1, a casing 2, a rotor 3 with disks for fixing of knifes 4. The loads 5 are set to knives for providing rotor balancing. The grinder has a support 6. Diagrams of cutting process of a stalk are given below.
With the aim of providing qualified work of the grinder without vibration is necessary for defining some parameters of its working bodies.
At this stage, the calculations on defining parameters of cone shaped working organ of mini-grinder is given with using main conditions of theoretical analyses [2,3].

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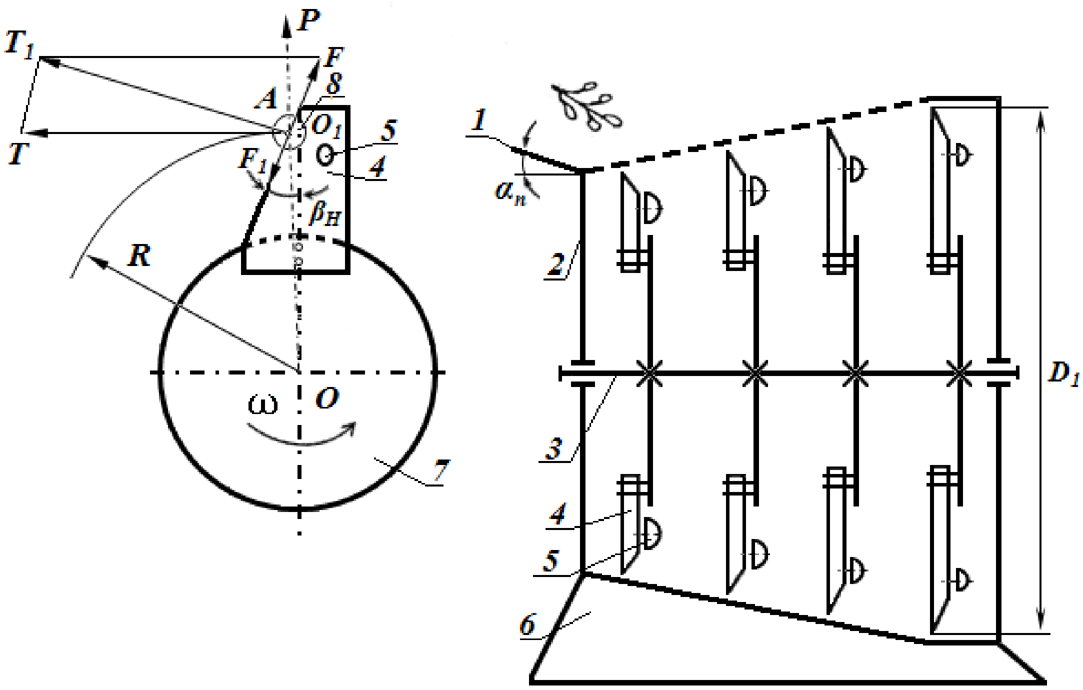

Figure 1. Diagram of a mini-grinder for roughage:

1-tray; 2-casing; 3-shaft with a disk rotor; 4-knife; 5-lead; 6-support; 7-rotor; 8-stalk.

As the working body of a grinder is cone-shaped, its diameter will be defined proceeding from following correlation.

$$D_1 < D_2 < D_3 < \ldots < D_i \,, \tag{1}$$

where $D_1 < D_2 < D_3 < \ldots < D_i$ - diameters of working body measured by a final part of the knife rotating with balanced loads, mm.

For prevention of an imbalance of working body should observe a condition

$$m_1 > m_2 > m_3 > \ldots > m_i, \tag{2}$$

where $m_1 > m_2 > m_3 > \ldots > m_i$ - masses of the load of balancing knife, kg.

As it is known, the speed of knife rotation, and consequently its capacity, can reduce considerably, having provided sliding cutting in the chopping instan of stalks for rough fodder [4].

As the stalk sliding on an edge at the moment of re-cutting is substantially caused by a corner (d_n) a stalk inclination concerning a knife blade, which is provided with the help of submitting tray of a grinder when handling the stalks to a knife.

Centrifugal power influences a stalk

$$P = mV^2/R \,, \tag{3}$$

where m - mass of a cut-off part of the stalk, given to the plane of a cut, g.;

V- encircled speed of a stalk in the plane of a cut, m/s;

R - distance from a stalk axis to an axis of rotation of working body, m.

Using the theorem of cosines, and we find

$$R = \sqrt{R_r^2 + \frac{d_{epigenons}^2}{4}\cos^2\alpha_n - R_r d_{epigenons}\cos\alpha_n\cos\beta_n} \,, \tag{4}$$

where R_r - radius of a rotor, mm; $d_{epigenons}$ - diameter of a stalk, mm; β_n- corner of a stalk submission, *degree*.

So we find radius of the rotor

$$R_r = 0{,}5D_i - l_{H_i} \,, \tag{5}$$

where l_{H_i}- of that length of the knife, mm.

After substitution (4) to a formula (3) we will receive

$$R = mV^2/\sqrt{R_r^2 + \frac{d_{epigenons}^2}{4}\cos^2\alpha_n - R_r d_{epigenons}\cos\alpha_n\cos\beta_n} \,, \tag{6}$$

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so, force of inertia

$$T = ma \quad , \qquad (7)$$

where, *a*- circle component of stalk acceleration in the plane of a cut, m/s^2.
On the accepted assumption

$$a = V/\Delta t \, , \qquad (8)$$

where, *Δt*-time, for which the stalk gets speed *of V* during a cut, c.
At this stalk sliding on a knife blade interfering force of a friction

$$F = fN \, , \qquad (9)$$

where *f* - factor of a friction of a stalk on an edge; N-normal force of a stalk upon an edge, *N*.
As at big encircled speeds of a knife bending of a stalk is insignificant, its elastic resistance is also insignificant, and we will not consider it.
Then, according to above given assumption, we will determine a condition of stalk sliding along a knife blade. In this case, the sum of projections of all powers, effecting the stalks cutting, should be more than the power of a friction.
For an edge with an inclination to the back, this condition is described by an inequality

$$\frac{mV}{\Delta t}\sin\beta_n + mV^2/\sqrt{4R_r^2 + d_{epigenons}^2\cos^2\alpha_n - 4R_r d_{epigenons}\cos\alpha_n\cos\beta_n}$$

$$f\left(\frac{mV}{\Delta t}\cos\beta_n - \frac{mV^2}{\sqrt{4R_r^2 + d_{epigenons}^2\cos^2\alpha_n - 4R_r d_{epigenons}\cos\alpha_n\cos\beta_n}}\right), \qquad (10)$$

After transformations, the equation becomes

$$\frac{1}{2}d_{epigenons}^2\cos^2\alpha_n - R_r d_{epigenons}\cos\beta_n\cos\alpha_n + R_r^2 - \Delta t^2V^2 ctg(\beta_n - \varphi) < 0 \, , \qquad (11)$$

Let - $x_1 = \Delta tV$ as stalk moving in the course of cutting.
Then, solving the inequality (11) -consequently β_n, we will achieve:

$$\beta_n < \varphi - arcctg\frac{\sqrt{d_{epigenons}^2\cos^2\alpha_n - 4R_r d_{epigenons}\cos\alpha_n\cos\beta_n + 4R_r^2}}{2x_1} \, , \qquad (12)$$

On the basis of above given experimental studies (Figure 2), that with the increase of cutting speed from 15 m/s to 19 m/s and diameter of stalks from 4 mm to 16 mm at regular submission speed of stalks [5], exertion of cutting decreases by hyperbolic types from 89.4 N to 85.5 N, as well as the cutting job increases to a straight line forms in the cutting speed from 4.79 N.m to 5.93 N.m on diameter of stalks from 5.14 N.m to 6.10 N.m.

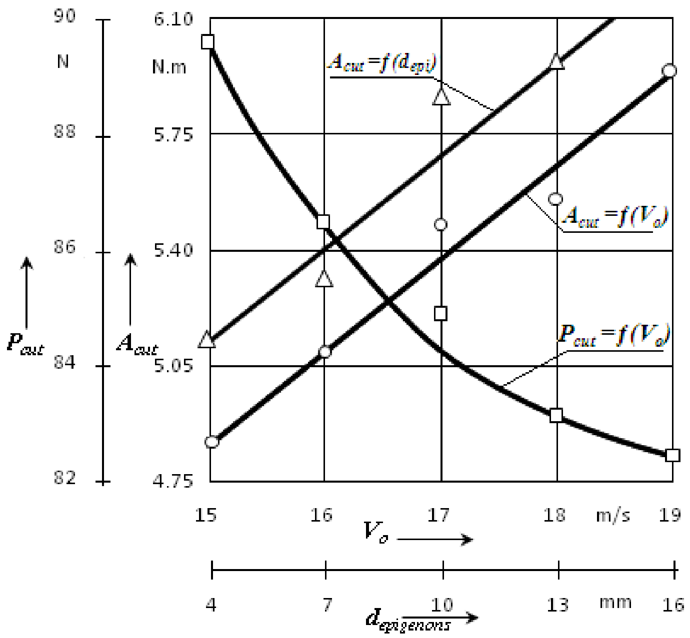

Figure 2. The change of exertion P_{cut} and the work A_{cut} cutting depending on the circle speed V_o cutting and diameter $d_{epigenons}$ stalks.

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This is explained with that, at crossing of the curves determine the optimal value of parameters of that cutting speed of 16.6 m/s , diameter of stalks 7…10 mm, cutting exertion 85.2 N.m, and the work 5.25 N.m.
As well as the cutting work of the knife depends on the geometry of cutting edge, which depends on the thickness, sharpening angle and sharpness of the blade. Research results are indentified by tenzonometric method (table)

Table 1. The dependence of the cutting work of the knife to its geometry

Parameters of the knife, mm	Of work cutting , n.m				
The thickness, mm	2,69/2*	3.03/3	3.27/4	3.52/5	4.27/6
The captivity angle of the knife, degree	5.54/11	6.02/13	6.31/15	6.61/17	6.84/19
The blade sharpness, mkm	6.75/25	7.11/75	8.50/125	8.11/175	8.97/225

*) Note: in numerator – the cutting work; In denominator – geometry of the knife.

It is seen from the table 2, that with the increase of the knife thickness from 2 mm to 6 mm, the sharpening angle of the knife from 11 degrees to 19 degrees and the sharpness of the knife from 25 mkm to 225 mkm the cutting work increases accordingly to 63 %, 81 % and 75.3%.
So, with the increase of value of the parameters of the knife the cutting work also increases in average 73.1%.

III.RESULTS OF THE RESEARCH

The results of studies on defining consuming the capacity of mini grinder to the cut of stalks depending from the length of the knife is cited in the Fig.3, that with the increase of the knife length from 80 mm to 120 mm decrease the consuming capacity to 11.3%, i.e., their curved depending has hyperbolic view.
Also, with the increase of angle bent of the knife edge from 22 degree to 54 degree the consuming capacity is increased to 3.9 % , i.e., their depending will have line character.

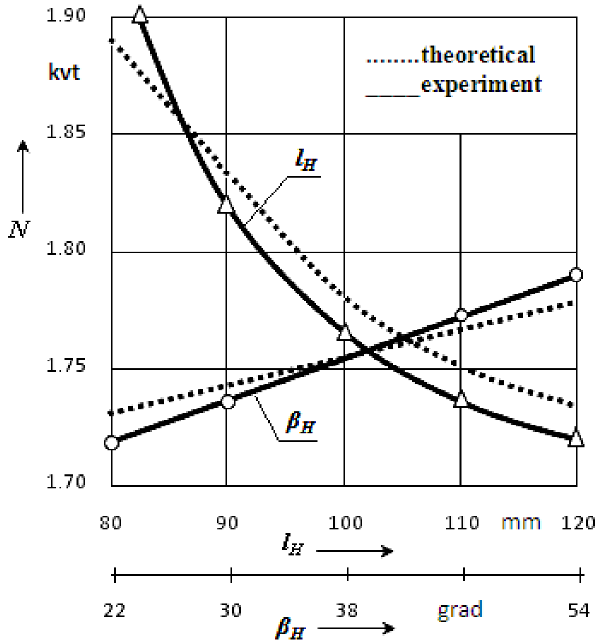

Figure 3. Depending the consuming N capacity of mini-grinder on l_H length and β_H angle bent of the blade.

So, on the basis of expression (5) and (12) theoretical data are compared with experimental, and difference between them does not exceed 5%.

IV.CONCLUSION

Based on conducted researches it is possible to make the following summaries:
- the defined dependence of angle bent of the knife blade (β_H) from different factors of stalk cutting process, i.e., at the following calculations: R_r=130…190 mm, x_1=0.5…2 mm, α_n=0…20^0, φ=24…30^0, $d_{epigenons}$=4…16 mm and β_H=0…48^0;

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- at angular speed till 18 *m/s* is observed the noticeable decrease of cutting exertion, but its further increase brings it to smooth over the difference of exertion;
- with the increase of angular speed of cutting at regular speed of handling stalks the activity of cutting edge of the knife, and smoothing action of cutting edge is increased, i.e. the general work, spent to the cut, is decreased in the account of increasing the cutting time about 1.7…4.7•10^{-3}s, but the optimal speed of knife cutting is equal to 17…19 m/s.

REFERENCES

[1] Karimov R.R., Imanov B.B., Karimov Y.Z., Choriev G.N. Development of scheme and defining the bent angle of blade of cone-shaped working organ of mini-grinder // Collection of materials of the International Scientific-Technical Conference on the theme: «Modern materials, technics and technologies in machine building», April 19-20, 2014.
[2] Karimiv R.R., Imanov B.B., Karimov Y.Z., Abulov M.R. To the research of cone-shaped working organ of mini-grinder of rough fodder. // Scientific Journal «Вестник ТашГТУ» (Bulletin of Tashkent State Technical University), №3, 2013.
[3] Karimov R.R., Kholmurodov M.Kh., Toshpulatov T.M., Avazov J.D. Research of bent angle of working organ blade for mini-grinder of rough fodder. //«Reports of the Academy of Sciences of the Republic of Uzbekistan» Scientific Journal, Tashkent, № 5, 2011.
[4] Karshiev F.U. Substantiation of working organ parameters of mini-grinder of rough fodder: Autoreferat of dissertation written…. on candidate of technical sciences. Tashkent, 2007.
[5] Karimov R.R., Turaev B.B., Tulaganov A.A., Avazov Д.J. Defining the exertion of cutting of stalk fodder. //«Problems of Mechanics» Scientific Journal, Tashkent, № 4, 2010.

AUTHOR'S BIOGRAPHY

№	FULL NAME PLACE OF WORK, POSITION, ACADEMIC DEGREE AND RANK	PHOTO
1	**Karimov Rustam Ruzimahmatovich,** Candidate of Technical Sciences, Associate Professor, Termez State University, Termez, Uzbekistan.	
2	**Abdullaev Ilkhom Eshkurbanovich,** Senior Lecturer, Tashkent State Agrarian University, Termez branch, Termez, Uzbekistan.	
3	**Ishmuratov Shavkat Saparovich,** Assistant, Tashkent State Agrarian University, Termez branch, Termez, Uzbekistan.	
4	**Ergashev Ryziboy Davlatmurodovich,** Student, Termez State University, Termez, Uzbekistan	