EUROPEAN INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND MANAGEMENT STUDIES

VOLUME03 ISSUE11
DOI: https://doi.org/10.55640/eijmrms-03-11-21 Pages: 112-116

ENGINEERING CALCULATION OF A SOY SEED SPRAYING DEVICE

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ABOUT ARTICLE

Key words: Soybean, blade, strength, steel, thickness, drum, shaft, electric motor.

Received: 08.11.2023
Accepted: 13.11.2023
Published: 18.11.2023

Abstract: This article details the mechanical calculations of the soybean seeding device. As a result of mechanical calculations, the length, diameter, thickness and electric motor power of the soybean seed cutting device shaft were calculated. In addition, one of the main elements of the stabbing device is the length, thickness and acceleration length of the blade.

INTRODUCTION

In 2022, 80,400 hectares of soybeans were planted in cultivated areas in the Republic of Uzbekistan, and 6,700 tons of seeds were spent on planting these areas. It is planned to collect 165,000 tons of soybean seeds from these fields. 15,000 tons of these seeds will be stored for seed, and 150,000 tons of soybean seeds will be processed. As a result, 30,000 tons of soybean oil and 113,000 tons of soybean meal are produced. Research is underway to develop dehulling devices for the production of a wide range of soybean oil, meal and meal for the food industry and domestic consumers worldwide. Advanced technologies are used that affect the productivity and quality of the oil needed for the food industry.

Materials and methods. Based on the literature, it was studied that the thickness of the husk of soybean seeds grown in the conditions of Uzbekistan is between 0.39-0.52 mm. In our researches, the bark and impact cutting methods are selected from the stinging methods, and the seeds are hit on the blade of the knife rather than on the shell of the device. In this case, it is advisable to bite the seed coat once by

the working organ of the machine. The problem of stinging with a single exposure method is technical difficulties due to the fact that there are seeds of different sizes. One way to solve this is to first calibrate (fractionate) the seeds before biting them.

Results. The working capacity of the grinding unit was calculated for a working capacity of 1250 kg/h of raw material. The reason for choosing this work productivity is that the maximum work productivity of the applied production enterprise is 1250 kg/h of soy raw materials. The performance for oilseed milling machines is determined as follows:

$$Q = (94{,}2 \ldots . 132) \cdot D \cdot L \cdot b \cdot n \cdot \rho \qquad (1.1)$$

in this D – the diameter of the shaft, the diameter of the shaft for the device was taken as 0.4 m;

L- length of the rotating shaft, m;

b – the distance between the rotating shaft and the cutting blade, in the device this distance is 0.003 m;

n – the rotation frequency of the drum, min-1, the rotation frequency of the device was chosen to be 1250 rev/min;

ρ- bulk density of the product, kg/m^3. Soybean seed density is 510...550 kg/m^3.

Taking into account that the performance of the shaft grinding device is related to the characteristics of the product being fired, formula (5.1) can be written as follows:

$$Q = \mathrm{A} \cdot D \cdot L \cdot n \qquad (1.2)$$

In this A- The correction factor for the structure of the shaft harrow and the product, for soybean seeds in this shaft device, this indicator is 0.119.

The length of the shaft was calculated as follows:

$$L = \frac{Q}{\mathrm{A} \cdot D \cdot n} = \frac{0{,}52}{0{,}119 \cdot 0{,}4 \cdot 20{,}8} = 0{,}525\ m$$

The length of the drum of the device is 600 mm, we calculate the length of the cylindrical shell part of the device as follows:

$$L_{\text{ц}} = L + (2 \cdot H) = 0{,}6 + (2 \cdot 0{,}1) = 0{,}8\ m$$

In this H – the distance between the blade and the bearings. It was taken as 100 mm.

The selection of the power and electrification required for burning oily raw materials in a shaft burning device is found by the following formula:

$N_d = 0{,}8 \cdot L \cdot D \cdot n \cdot \eta \cdot (50 \cdot t + 0{,}42 \cdot D^2) = 0{,}8 \cdot 0{,}6 \cdot 0{,}4 \cdot 20{,}8 \cdot (50 \cdot 0{,}006 + 0{,}42 \cdot 0{,}4^2) =$ 1,5 kW

In this t- soybean seed size, 0.006 m.

DISCUSSIONS

Taking into account the reserve factor of extension and electrification, the total power of electrification is determined as follows:

$$N_y = \frac{1{,}5 \cdot N_d}{\eta} = 1{,}5 \cdot \frac{1{,}5}{0{,}7} = 3{,}2\ kW$$

In this η- belt drive F.I.K. It was taken as 0.7.

In accordance with the standard, a 4.0 kW electric motor was selected.

Calculation of blade thickness in the device. We calculate the thickness of the blade, taking into account the forces acting on it (figure 1).

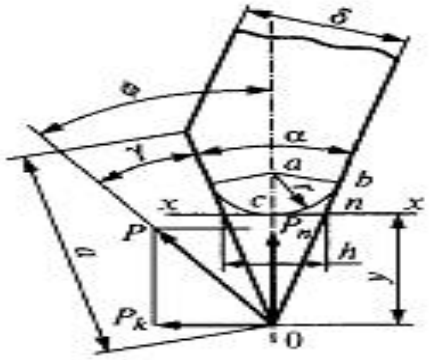

Figure 1. Blade calculation scheme.

Component of the thrust force P: The normal force P_H directed along the angle bisector is found as follows:

$$P_H = P \cdot cos\left(\gamma + \frac{\alpha}{2}\right) = 42100 \cdot \sin\left(45 + \frac{45}{2}\right) = 38895{,}3\ N \qquad (1.3)$$

In this γ – the angle between the blade and the product discharge hopper;

α – the angle at which the blade is mounted on the device;

P- the force that goes into biting soybean seeds in one revolution of the shaft.

The bending stresses in this section are found as follows:

$$\sigma_и = \frac{6 \cdot P_H \cdot y}{b \cdot h^2} \qquad (1.4)$$

In this b – blade length 0.6 m;

h – blade thickness, m;

y- blade tip (accelerated part).

So, y - the distance that determines the location of the bite at the tip of the blade is found as follows.

$$y = \frac{3}{2}\frac{P_H}{\sigma_и \cdot tg^2/2} = \frac{3}{2} \cdot \frac{38895{,}3}{210000000 \cdot 0{,}15} = 0{,}002\ m \qquad (1.5)$$

(5.4) the thickness of the blade is found from the formula.

$$h = \sqrt{\frac{6 \cdot P_H \cdot y}{\sigma_и \cdot b}} = \sqrt{\frac{6 \cdot 38895{,}3 \cdot 0{,}002}{210000000 \cdot 0{,}6}} \approx 0{,}0019\ m$$

As a result of the above calculations, a blade with a thickness of 3 mm was selected.

CONCLUSIONS

As a result of the calculations, the dimensions of the parts of the device were equal to the following: The length of the drum of the device is 600 mm, the length of the cylindrical shell part is 800 mm, the power of the electric drive in the device is 4.0 kW, the length of the blade is 600 mm, the thickness of the blade is 3 mm, the length of the accelerating part of the blade is equal to 2 mm.

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