RESEARCH ARTICLE OPEN ACCESS

Research, Design and Manufacture the Sachi Seed Separator Machine

Nguyễn Minh Huy
Ho Chi Minh City University of Food Industry

ABSTRACT
In the sachi fruit production, the removing of the sachi skins and get seed is a very important stage due to this fruit that contains high levels of oil. However, in Vietnam, this stage currently has been conducted manually. The productivity therefore is often very low. With this method, the quality of sachi fruit depends greatly on the individual's skills. This paper presents the research results on the development of sachi seed seperator machine used for industrial sachi oil production.
Keywords: sachi oil, sachi fruit, removing the skins, seed separator machine

I. INTRODUCTION

Sachi grows in Daklak of Viet Nam decades later in small farm, which is notable for the hight oil and protein content of its seeds. Both this oil and protein are of great benefit to human health, particularly for young and elderly persons [2]. are a source of abundant supply oil production industry (54 % Omega 3, 33.6 % Omega 6, 7.2% Omega 9, 5.4% Otros) [3] . In addition to omega, Sachi also contains antioxidants like Vitamin A and Vitamin E, some essential amino acids and proteins.

Figure 1: Nutritional ingredients

Thanks to these nutrients, it has usurp the "crown" of olive oil, which is considered to be the most advanced vegetable oil ever made by mankind.

Nutrition industry uses Sachi to make products from seeds, nutritious powder. The pharmaceutical industry uses Sachi oil as a capsule, using leaves to make herbal tea. Food industry uses Sachi oil to mix high-quality salads, tops that can be used as vegetables. Cosmetic industry for skin care, hair, beauty protection ...

This research introduce overview of sachi seeds and sachi separator machine used in food production line or oil pressing

Figure 2: Ripe fruits (four, five and six seeds) and seeds with a peeled kernel (white)

The commercial producst is the dry seed. It features a hard shell that is difficult to remove. If done manually, the cost of shelling can be as much as half the market value, but it can also be done using machinery. The shell constitues about half the weight of the seed. However, it is not recommend to shell the seeds before the final transformation since kernels exposed to oxygen in the air quickly turn rancid

II. OPERATION OF THE EQUITMENT

It is a difficult to remove sachi seeds and kernels for many reasons:

- Sachi are different in sizes.
- Beads and martial sachi must be separated by great force
- Sachi flesh and peels are stuck to each other.

In order to separate sachi peels and seeds, Paredes, Moore [2, 3] has proposed the following procedures:

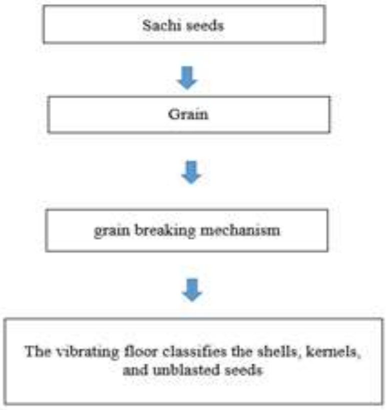

Figure 3: Principle of sachi flesh separation

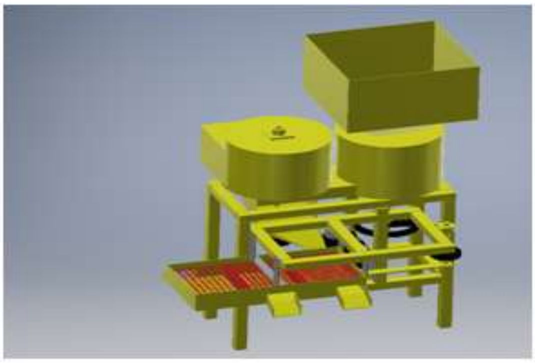

Figure 4: Design model

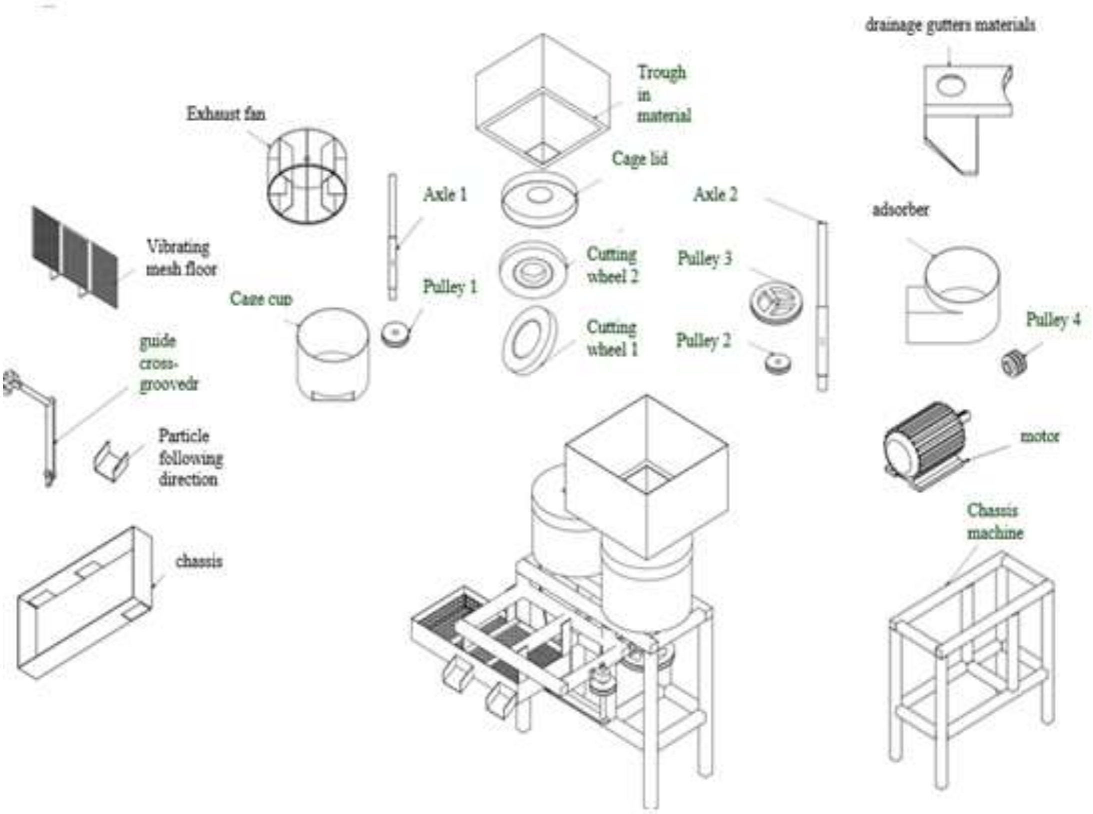

Figure 5: Assembly drawing model

III. THE MAIN COMPONENTS OF THE MACHINE

3.1 Graint material direction:

For continuous operation of Sachi separator machine, make sure to provide enough materials for the machine. Therefore, the feeding hopper must have a volume so that about 5 minutes we feed once with a capacity of 200kg/h

So the largest volume of feed hopper is:

$M = \frac{200 * 5}{60} = 16,6$ (kg)

The volume of the feeding hopper is calculated:

$V_{tt} = \frac{M}{\rho} = \frac{16,6}{650} = 0,024$ (m^3)

ρ - Specific gravity of Sachi seeds: 650 (kg/m3)

With the materual storage coefficient of the funnel is $\varphi = 0,4$, the required volume of funnel is:

$V_{ct} = \frac{V_{tt}}{\varphi} = 0,0128$ (m^3)

The inclination of the funnel wall with the horizontal plane forming the angle β. In order for the material to flow on its own, the large angle must be greater than the friction angle between the Sachi particles and the funnel wall, i.e.:

tg β > 1 => β > 45^0

Based on the structure of the hopper, the machine has the following shape and size:

a = 290 mm, b = 120 mm ; h = 100 mm

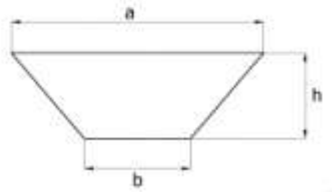

Figure 6.1. Diagram for calculating feed hopper

Actual volume of funnel:

$$V = \frac{1}{2} \times h(a+b) = \frac{1}{2} \times 0,1(0,29+0,12) = 0,0205\ (m^3)$$

Thus the actual volume of the feed hopper meets the calculated volume we have, that is $V > V_{ct}$. (Funnels are made from steel plates)

3.2 Calculation of vibrating sieve

The part that shocks is the cam and transmission rod. The force exerted from the engine is transmitted through the cam, rod and vibration. Results of vibration screening are shown in the figure.

1.sieve shake 2.spring 3. Rotating cam 4. transmission rod

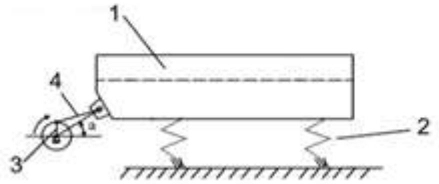

Figure 6.2: Vibrating sieve mechanism

According to the actual machine and the capacity of the machine we choose the sieve with the following parameters:

Screen type: Sieve round hole - size (mm) : 1000x400

- Large hole floor diameter (mm): Φ 18
- Oscillation frequency (shake): 300
- Amplitude fluctuations (mm):25

Calculate sieve mesh size

Select sieve with round holes for sieve and Sachi shell. Because Sachi seeds size from 13 - 16 m

The size of particles allowed to pass through the vibrating screen is:d = 16 mm.

So:

Hole area: $f0 = \pi r^2 = \pi 8^2 = 200,1$ mm^2

The yield of a sieve is calculated by the formula:

$Q = B.h.v_{tb}.\rho.\mu.3600$ (kg/h)

infer: $B = \frac{Q}{h.v_{tb}.\rho.\mu.3600}$

B – screen width (m).

ρ – Density of sieve material ρ = 550 (kg/m^3).

μ – the coefficient of grain drop on sieve.

h – Particle height on screen (m).

v_{tb} – Average velocity of particles on the sieve.

$V_{tb} = 2e.\ tg\alpha\ .\ \frac{n}{60} = \frac{n.e.tg\alpha}{30} = \frac{1450.0,01.tg30}{30}$

= 0,27 (m / s)

n – Number of revolutions of motor shaft.

$n = 30\ .\ \sqrt{\frac{k}{e}}$

inside:

k – efficiency factor, usually k = 1.5 - 2.5; choose k = 2

e – amplitude of sieve oscillation, choose e = 25 mm = 0.025 m

$n = 30\ .\ \sqrt{\frac{2}{e}} = 268$ (vg/minutes)

choose: n = 350 (vg / minutes)

replace the values (2 - 7) and get: B = 380 mm

According to our experience, the width of vibrating screen is 0.4m

3.3 Calculate weight and material on sieve

Top frame weight:

- U 100:19.5 m x 11 kg/m = 214,5 kg.
- V 50:16 m x 3.2 kg/m = 51,2 kg.
- Steel plate 3mm: 0.44 m^2 x 23.5 kg/m^2 = 10,34 kg.
- Weight of material on sieve: 21,8 kg.

When working, the vibrating frequency of the sieve must coincide with the frequency of the excitation force. Mean: $\tau = \tau_1$

or:

$$2\pi\sqrt{\frac{G_0}{g.k}} = \frac{60}{n}$$

So the hardness of the spring is:k = $\frac{G_s.n^2}{900.z}$, (N/m);

The value of the stimulating centrifugal force of the vibrating device on a spring is:

$$P_0 = \frac{P_Q}{z} = \frac{G_Q.R.n^2}{900.z} = \frac{246.0,02.1430}{900.4} = 2795 \text{ (N)}$$

The strain caused by centrifugal force on spring system is:e = P_0/k

or:

$$k = \frac{P_0}{e} = \frac{G_Q.R.n^2}{900.z.e} = \frac{2795}{0,001} = 2795000 \text{ (N/m)}$$

so:

$G_s.e = G_Q.R$

The above expression indicates the relationship between the quantities Gs, GQ, e, R. From this relationship we will determine the quantities when designing. For example, given e, R and knowing the weight of sieve Gs, we will calculate:$G_Q = G_s.\frac{e}{R}$, (N) ;

$$G_Q = 4915.\frac{0,001}{0,02} = 246 \text{ N} = 24.6 \text{ kg.}$$

The relationship in the above expression is only true when the spring is in elastic mode, ie separate from the resonant mode. The resonant oscillation frequency of the sieve system is:$\omega_{ch} = \sqrt{\frac{g}{e}}$, (1/s).

For vibrating screen, the working speed is usually higher than the resonant speed, normally choose ωlv = 2ωch.

IV. CONCLUSION

This research presents the design and manufacture of sachi separator machine which is tested to meet the technical requirements (Figure 9). In fact, it is possible for us to develop sachi oil chain with the contribution of automatic sachi separator machine to ensure food hygiene and safety, reduce labor costs and allows automated production lines.

Figure 7: Seeds before separation

Figure 8: Seeds after separation

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Nguyễn Minh Huy, “Research, Design and Manufacture the Sachi Seed Separator Machine” *International Journal of Engineering Research and Applications (IJERA*), vol.10 (03), 2020, pp 27-31.