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Study on the Energy Efficiency Issues in Extracting Fat and Oils from Cotton Seeds

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Abstract. The article deals with the issues of increasing energy efficiency in obtaining oil from cotton seeds. The relationship between the amount of oil obtained and the degree of damage to cotton seed pulp is shown. Electropulse treatment of cotton seeds is expected to increase the amount of oil produced and to reduce energy costs in the technological process. While the amount of oil extracted from cotton seeds under the existing technology was 14.6% relative to the seed and 35.8% relative to the kernel, this figure will increase to 4.5-5% with the proposed electric pulse treatment.

INTRODUCTION

The average consumption level of vegetable oil in the consumer market of our country today is 0.65 liters per capita, meaning that 218 thousand tons of it should be prepared to use annually. As the average annual growth rate of the population in Uzbekistan is reached to 3%, it determines simultaneous growth of consumption of vegetable oil and demands expanding its trade geography.

The Strategy of The Five Main Priorities of Development of the Republic of Uzbekistan for 2017-2021 is to further strengthen the country's food security, to produce ecologically clean products. In particular, the issues of modernization and re-equipping of cotton and oil-industry enterprises, introduction of modern effective technologies and scientific developments, ensuring the quality of cotton, oil and fat-and-oil products.

The process of extracting oil from the cotton seed has been taking place since ancient times, on the basis of which the mechanical impact of cotton seeds lies. Cottonseed oil was previously extracted by using hand powered mechanical pressure to squeeze the oil from the seed. It took a lot of time and effort, and only about half of the oil in the seed could be removed [1]. Cottonseed oil is extracted in a variety of stages in contemporary factories. These phases are time-consuming and involve a number of difficult procedures. Seed preparation, priming pressing, and steam heating are some of the methods used to make the solvent extraction process easier. Furthermore, the extraction process takes a long time, taking nearly 8 hours as an extraction residence time and consuming a lot of energy. When our ancestors used oil from the seeds and other oil-bearing crops, our fur coals were used. Later on, technical advances in the Earth have led to the improvement of this process [2-4].

METHODS

Today, the extraction of cotton seeds from technical cotton seeds is carried out on technological lines (Figure 1), including the sequential execution of several technological processes (Table 1).

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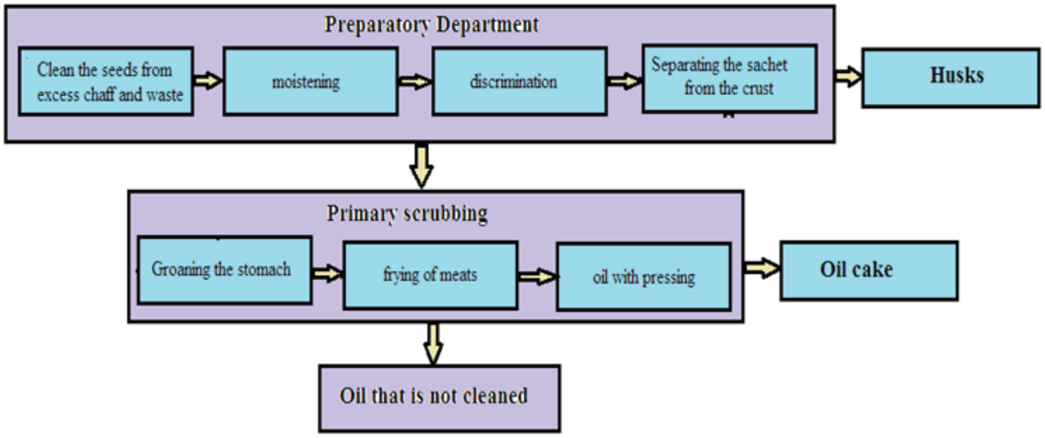

FIGURE 1. Cotton oil production technology

TABLE 1. Processed technological processes and energy expenditure on uncovered crude oil

Technological process	Equipment name	Performance Energy consumption	per 1 ton of cotton seeds; KWh	Heat energy for processing 1 tonnes of cotton seeds; Kcal
Fertilization and preparation plant			127.3	
Seed Treatment	USM	140t/day	23.98	
Moisture	VNIIJ	100t/day	21.22	7796
Output		120t/day	49.5	
Separation	P1-MSD	140t/day	32.6	
Seedling slices	BS – 5	100t/day	33.7	
Forpress factory			123.4	
Roasting products	G – 68	140t/day	30.3	27644
Squeezing	FP	100t/day	93.1	
Water supply			12.99	
Total			**297.39**	**35440**

The data given in Table 1 show that while at the oil-and-gas production facilities about 297.34kW of electricity is consumed to produce up to 1,000 tonnes of cotton seeds, 65 % of energy is spent to the initial scattering process.

$$\mu._{m} = \frac{W_{\text{cot.seed.oil}}}{W_{total}} = \frac{297,39}{451,1} = 0,65$$

Moreover, cotton oil production technologies are considered as energy-intensive, and for this at present, the existing oil-factories in our country use 1.2 kWh 106 kW to process 1 ton of cotton seeds [5, 6].

When extracting cotton oil from technical cotton seeds, it is the last and important step to clean, spin, crush and process hydrothermal treatment.

Seeds wetting process, unlike the extraction process of other varieties of oil, in regard to this type, cotton seeds are soaked in oil processing plants, but the moisture content of cotton plants and the seeds stored in its critical humidity is low in most cases, the moisture content of the seeds by 6-8% around. As a result, after the removal of moisture, technologically processed seeds delivered to the appropriate state. Humidity of soaked seeds depend on the moisture content in their core moisture. Thus, the humidity will be as follows:

For 1-3 varieties - 8.5 ... 9.5%

For 4 varieties - 9.5 ... 10.5%

In this case, optimum moisture is required to squeeze the humidifier seeds, remove the crust from scratch, and tear off the separated core [7, 8].
For wetting of seeds special VNIIJ humidifier or humidifiers are used. For the sowing of the seeds is used pure water and technological steam mixture.
With the help of VNIIJ humidifier soaking is carried out for 50-60 minutes, moistened with more vapor, but when the total moisture content of the seeds meets the requirements of the technological process at the specified time, the water actually does not reach the inner core layers. Therefore, this type of humidifiers cannot be relied on in production.
In the humidifier cells, the shelf life is at least 6-8 hours. In some cases, the duration is from 12 up to 16 hours. During this time, the water given to the surface of the seeds is distributed equally in all dimensions. Of course, to implement the process of soaking, every humidifier warehouse must have at least 3 moisture chambers. In this case, the sowing of seeds from one cell is carried out to the industry, the seeds will be kept in two cells over the time specified above. The third camera is packed with the product [9, 10].
If the seeds are not at the level of optimum moisture above the fertilization, the seeds will cause large amounts of damage during the bleeding, and will lead to early exposure of the buttock.
The body's permeability coefficient equals the development of patent permeability to the body's volume moisture capacity.

$$\lambda_m = a_m \cdot C_m \cdot \rho_m \tag{1}$$

Here; a_m - publicity diffusion coefficient; C_m - volume of moisture content of the material; ρ_m - material absolute dryness density.
Squeezing the syllable sieve. When squeezing the seed, it is not the same for breach of different tissues. In the crushing of the sunflower, the epidermis, the vicinity of it, and the rotavirus are less corrupted than other parts of the seed. When picking cotton seeds, the moth is most resistant. Resistance of the cortex is higher than that of cough [11].
For the first time, when the lubricating oil magazine passes between the valves in the five-valve machine, the cell's structure is partially broken; the second is the cell structure, and the partial disruption of the alebral rhinoceros and lipid granules; After a third decay, the cell walls are completely damaged, but the unbroken lipid granules remain in the shell.
At the present time, the BC - 5 five-valve combustion units are being used in the oil and fat production facilities. Production efficiency of raw material for cotton seeds is 4.16 t / h. To measure the power consumption of the five-meter drill, the gear unit was loaded with 0, 25, 50, 75, 100 % of the product and simultaneously detected the quality characteristics of the product (moisture, drainage, and aggravation).
Chebishhev's method is used to obtain energy characteristics of a crushing device. Using this method you can define correlation equation and computational error [12].
The correlation equation using the Chebyshev method is expressed as follows:

$$r^{(h_1)}_{(j_1)/1} = \Sigma \frac{D^{(q)}_{q_1} D^{(q)^*}_{q_1}}{D^{(q_1-1)} D^{(q_1)}}; \tag{2}$$

The error of the equation is ± 0.016 kW.
The calculation of the calculation error.

$$\sigma^{(2)} = \sigma_y \sqrt{1 - r^2_{1/1} - \frac{b_1}{a_1}}; \tag{3}$$

The estimated deviation from the real value is ± 0.13%.
Based on calculations, the specific energy consumption and power equation required for the crushing of the moon.

$$P_B = 7.5 + 10.93 A_M - 2,781 A_M^2 + 0,286 A_M^3 \tag{4}$$

$$d_B = 10.93 - 2,781A_M + 0,286A_M^2 + \frac{7.5}{A_M} \qquad (5)$$

Here is the productivity of the $A_м$ - Squeezing device
The description of the five-valve tool constructed in accordance with (3) and (4) is given in Figure 1.

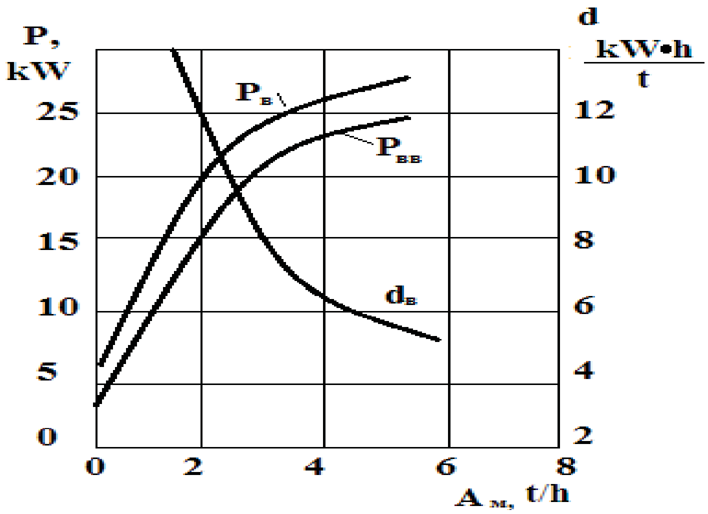

FIGURE 2. The energy characteristic of a five-meter magician burner

Analysis of the description indicates that when the productivity is increased from 0 to 3.5-4.0 t/h, the power consumption increases rapidly, more exactly obtaining 2 % of each productivity increase. The maximum loading mode for the crushing device is energy-optimistic. However, product degradation should not exceed 85-90 % under defined conditions. The energetic characteristic of the drill bit shows that the specific power consumption is 35-40 % higher than the minimum [13].
Based on the data given above, the analysis of power consumption of oil seeds in the existing oil-production enterprises currently is W_{val}. = 35000-37500 kWt, depending on the efficiency of power consuming devices for the three drilling products.
Currently, almost all oil enterprises use cotton fiber roasting method. By this method, depending on the varieties of the seeds, the melting of the tomato is pre-cooled to 12.0-17.5 % and the temperature is increased to 65-700 ° C. Then, the moisture can be fired at a temperature of 100- 1050 C until 6-7 %. The main purpose of the cooking is to create favorable conditions for the release of raw material from the raw material. As a result of hydrothermal treatment, the properties of proteins, phosphatides, various nitrogen, specific pigment gassipol and its properties change. As a result of moisture and temperature, some toxic gossypol is harmful to the proteins and phosphatides. However, the fattening ability of the grass, which is obtained by the denaturation of proteins at high temperatures, decreases. In addition, other substances (amino acids, lysine, and methionine) are subject to varying degrees of heat and are subject to change. As we know, the specific heat capacity of the product to be heated regardless of how to heat the products (in case of heat treatment) should be considered. If the specific technical load is $C_A = 1,372 + 0,0069 \cdot t, kDj / \left(kg \cdot {}^0C\right)$ equal to the thermal capacity of the coil, then the average temperature of the trench after the roller is $t = 25^0 C$ equal to the specific heat capacity of the hammer $C_A = 1.5445 kDj / \left(kg \cdot {}^0C\right)$. We use the following formula for the heat energy required to heat a kilogram of wheat to a specific temperature.

$$Q = m \cdot c(t_2 - t_1) kDj / kg \qquad (6)$$

Here: *m* is the product mass, s is the specific thermal capacity, t_1 is the initial temperature of the product, t_2 is the heating temperature of the product [14].
If you are cooking from technical seeds at 100-1050 S, you can get 115.83 kW of energy per 1g of product, 115830 kDj for baking 1 ton of product, 35 tonnes per day for processing, and 1 per hour 4054050 kJj of energy consumed during lunch.

SOLVING STYLE

In order to accelerate the process of wetting the technical cotton seeds, we recommend that the product be processed electrochemicals. When processing electrochemicals, it allows the seeds to be separated from the oil and fat from the meat. Here, the properties of absorbing, extracting and dehumidifying electrodes are used in the processing of various products. It should be borne in mind that the absorption process is extremely effective when it is close to the globe. Removal of the absorption can be avoided and a controversial process may occur when removed from the tank.

The following factors have been identified for determining the treatment of electrochemicals during the technical pigging process: Radiation Voltage (U), Capacitor Capacity (S), Distance between Rugs, Processing Time.

The product is emulsified by means of the electrochemical bulkhead capacitors. The capacity is 0.1 mkf, the volume is 24 kV and the processing time is 5-6 minutes

The results obtained from the experiment are shown in Figure 3 in the graphical representation.

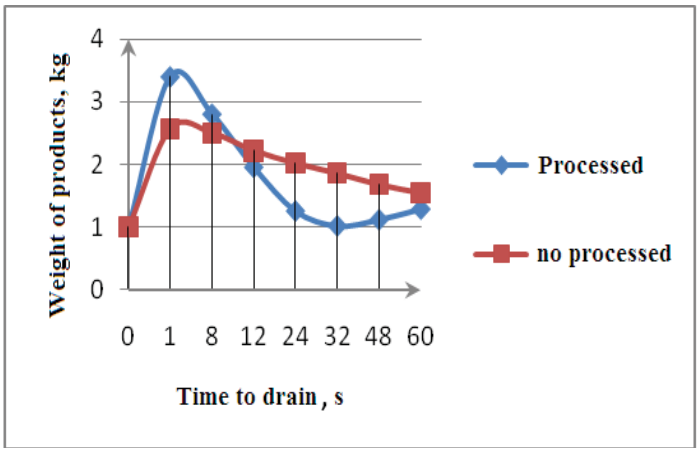

FIGURE 3. Effect of processed and untreated seeds on moisturization and natural conditions

The data show that when treated with seeds in water, electrogidrose pellets did not add more water to the controllable seeds, and its drying doubled. However, the moisture content of the processed cotton seeds changes over time, depending on the moisture content of the environment. In oil-plants humidifying prior to sampling, moisture can be treated with primary electrogidroppuls. Energy expenditures decreased 1.5 times

In condition of electride-porous processing of technical cotton seeds, the consumption of energy in the technological environment depends on the number of impulses.

According to the information, 2,520 kJ of energy is being spent to optimize waste water by treatment with cotton seeds.

One of the first electrophysical effects of electro-pulses is the treatment of technical oils in order to increase the amount of oil in the process of pressing the vegetable oil from vegetable crops. One of the most widely-used technologies today is the primary electropipulous treatment of drying plant products and juicing juices.

TABLE 2. Indications obtained from experiments

Number of impulses, n	Operating Voltage kV.	Processed product		Unprocessed control product	
		Difficulty, kg.	The amount of oil extracted in % of the burst	Severity, kg.	The amount of oil released is about% tensile
18	4	1.59	27.03	1.57	27.54
18	4.5	1.54	27.22	1.53	26.86
18	5	1.53	28.64	1.57	27.29
18	5.5	1.57	29.80	1.56	27.64
18	6	1.60	30.89	1.58	26.87
18	6.5	1.58	31.56	1.59	27.62

The difference between electro-pulsed processing and other electrophysical effects is that when electro-pulsed machining of technical seeds occurs suddenly, electrical and mechanical factors affect the product. In this complex, cells are attached to the cells and paraxim cells. As a result, the tissues of the seed cells are distorted uniformly.

The results of primary electro-pulsed processing of cotton seeds are shown in Table 2.

The existing technology of slimming cotton is 14.6 % higher than that of cotton seeds, which means that the rate of electric pulses will increase by 3.5-4%. As a result of the use of the proposed technology, pressurized oil will be able to squeeze larger amounts of oil in the process of oil production, reduce the duration of frying up to 2 times and reduce the energy consumption of 115.83 kJj to 69.50 kJ per 1 kg of product by lowering the temperature of 65-700 ° C 1 tonnes of cotton seeds while saving up to 46330 kJ of energy during the roasting process. Here, 65-700 C° temperature is given to reduce the viscosity of the product. In turn, it will be possible to reduce the amount of fat extracted from the extraction process.

CONCLUSIONS

During electro-hydrographic treatment of the technical cotton seeds, it is possible to optimize the seeds for a short period of time, destroy the cell walls of the seeds, which in turn increases the fat content. When the humidifying moisture in the current wetting cells is reached to 6 to 8 hours, the recommended electro technology will reduce the moisture content by 2-3 hours. This, in turn, saves the excessive consumption of enzymes.

The amount of fat taken from cotton seeds is 14.6%, compared to cotton seed fiber by 35.8%, while the rate of electric pulses increases by 4.5-5%.

By means of electric impulse treatment, the secondary product obtained by reducing the temperature and time of the roasting process in the present technology can preserve the fertility of the sshrot, preventing the loss of the protein in it.

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