The new production of electrotechnology cottonseed oil and energy efficiency rating

A Turdiboyev\(^1\) and D Akbarov\(^1\)

\(^1\)Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, Tashkent, Uzbekistan
uzigabek1920@mail.ru

Abstract Oil and fat products in food mix clusters, especially from technical seeds; cotton oil which has a specific character is one of the most important products for our domestic needs. Demand for oil and fat products, the growing demand of the population, and corporate foodstuffs to meet the growing population of the country. 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. As a result of applying the proposed technology, the process of pressing and squeezing oil from cottonseed seeds, reducing the duration of the frying of seeds, in turn, makes it possible to reduce the extracted technical oil.

1 Introduction
At present, in practice, technologies for the production of vegetable oils using press units are used. They include basic, preparatory, auxiliary, and additional operations [1]. According to the existing technology of cottonseed oil production, cottonseed seeds are cleaned from heavy, mineral and organic substances; sorted, crushed, fried, pressed and sent for cleaning and additional factory processing [2, 3, 4].

The number of additional factory processing operations, their labor intensity, and energy intensity depend on the qualitative process of moistening, crushing, frying, and pressing.

The energy intensity of technological operations in the existing technology is, % of the total energy intensity: acceptance of technical seeds-2, cleaning seeds from heavy, mineral and organic substances-3, humidification-2, chewing-11, separation-9, crushing-10, frying-20, pressing-30, preparation of kunzhar for extraction-10 and extraction-2%. These data indicate that the most energy-intensive in the production of cottonseed oil are shaking, crushing, frying, and pressing (71% of the total energy intensity), in which much attention should be paid to reducing the energy costs of these processes, [5, 6].

To achieve this, we propose a new electrotechnology for the production of cottonseed oil with the use of complex electropulse treatment (Figure 1).
Figure 1. New electrotechnology of cottonseed oil production with the use of complex electropulse treatment technological scheme: 1 is plant for cleaning seeds; 2 is a pneumatic pipe; 3 is a chamber for the emission of garbage; 4 is humidification chamber, 5 is devices for primary electrohydraulic processing seeds when moistened; 6 is a chamber for drying seeds; 7 is refrigerator, 8 is belt conveyor, 9 is noria, 10 is separator isolation of the core seeds from the husks; 11 is roller crusher; 12 is devices for electric pulse processing of crushed seeds; 13 is frying pan; 14 is press the oil.

2. Methods
The new electrotechnology for the production of cottonseed oil with the use of complex electropulse treatment is carried out as follows (Figure 1, b). Seeds of cotton clean from heavy and mineral substances, pass through the pneumatic pipe and throw out the garbage. Then the purified seeds are fed to a humidifier where the seeds are first treated with electro-gyrus impulses and moistens with hot water at a temperature of 60-70°C for 4 hours. The moistened and treated seeds are dried with hot air at a temperature of 100-110 °C for 7-8 hours, then they enter the chewing plant, where the process of chewing occurs. The product is supplied using a belt conveyor and a nose to a separator to separate the core from the husks. Then they are crushed. The crushed mixture is treated with electric pulse discharges 12 and then they are roasted at a temperature of 105-110 °C for 80-100 min. The processed seeds are fed to a press for pressing oil and then fed into a storage container [7, 8, 9].

Further processing of the received products - extraction, oil purification from impurities, weighing, dosage, packing is carried out in special oil-and-fat workshops of the plant.

In the proposed technology of cottonseed oil production, it is suggested to combine the process of moistening seeds with electrohydraulic processing, and also after the crushing process, the mixture of seeds should be treated with electric pulse discharges, which reduces the time of moistening of seeds, saves energy costs and increases oil yield [10].

In Uzbekistan, the most advanced technology for the production of vegetable oil is the technological line of the Tashkent oil and fat combination, with a capacity of 45,000 tons/year of oil. The cost of the technological line about installation is 31425236 thousand UZS. Electricity and fuel consumption (general) are 4427086.6 kWh/t and 3575000 m³/t respectively [11].

An estimation of the energy efficiency of cottonseed oil production with preliminary electropulse treatment was carried out following the "Methodology for determining the economic efficiency of the use in the economy of new technology, inventions, rationalization proposals" [12].

3. Results and Discussion
The cost of certain types of equipment of the electrotechnical line for the production of cottonseed oil is shown in Table 1.
Table 1. The cost of certain types of equipment for the technological line for the production of cottonseed oil

| Equipment                                      | Capital investments in the existing technology, sum | Capital investments in the proposed technology, sum |
|------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|
| Humidification chamber seeds                   | 25350000                                            | 3525000                                            |
| Plant for electrohydraulic processing of cotton seeds |                                                  | 31455000                                            |
| The device for electropulse treatment for a crushed mixture |                                                  | 1334000                                             |
| Generator of impulse voltages                  |                                                    |                                                     |
| Total                                          | 25350000                                            | 36314000                                            |

The proposed technology also uses the basic capital investment funds that are available following the existing technology.

As of 12.24.2016, at official rates, 1 US dollar is 3200 UZS.

Energy consumption Table 2 and the economic cost of electricity the new proposed technological processing.

Table 2. Initial data for the estimation of energy-effectiveness

| Index                                      | One. measure | According to the existing technology, UZS | According to the proposed technology, Sum |
|--------------------------------------------|--------------|------------------------------------------|------------------------------------------|
| Output for the year                        | t            | 45000                                    | 47000                                    |
| Productivity of the production line        | t/hour       | 580                                      | 606                                      |
| Capital investments                        | sum/t        | 31425236                                 | 31461550                                 |
| Electricity consumption (total)            | kWh/hour     | 4427086.6                                | 3320314.5                                |
| Fuel Consumption (General)                 | m³/t         | 3575000                                  | 2860000                                  |
| Cost of 1 kWh of electricity               | sum          | 182.40                                   | 182.40                                   |
| The cost of fuel (gas)                     | sum/m³       | 191                                      | 191                                      |

Energy consumption Table 3 and the economic cost of the electrical new proposed technological processing.

Table 3. Number and salary of maintenance staff

| Index                                      | One. measure | On the existing technology | On the proposed technology |
|--------------------------------------------|--------------|----------------------------|----------------------------|
| Number of people                           | people       | 670                        | 655                        |
| The average hourly rate of one worker      | thousand soums | 1400                      | 1400                      |
| Basic salary                               | thousand soums | 938000                    | 917000                    |
| Additional wages, 25% of the tariff fund   | thousand soums | 234500                    | 229250                    |
| Deductions from reserve fund               | thousand soums | 15500                     | 15500                     |
The maintenance and current repairs make up 6.0% of the book value of machines, 31574.8 sums according to the existing technology, and 22733.9 sums according to the proposed technology (Table 4).

Table 4. Expenses for 1 ton of finished products, sum

| Consumption                                      | On the existing technology | On the proposed technology |
|--------------------------------------------------|----------------------------|----------------------------|
| Electricity                                      | 17929.92                   | 13442.88                   |
| Fuel                                             | 15165.4                    | 12128.5                    |
| Salary basic and additional with deduction on social insurance and TB | 1188                       | 1161                       |
| The maintenance and operation of the equipment, including depreciation for maintenance and maintenance of equipment | 31574.8                    | 22733.9                    |
| **Total**                                        | **65858.12**               | **38566.28**               |

The annual economic benefit from the introduction of plants for electrohydraulic processing of cotton seeds and electro impulse treatment for a crushed mixture is:

\[
E_g = [(C_1 + E_N K_1) - (C_2 + E_N K_2)] / A = [(65858.12 + 0.15 \cdot 31425236) - (38566.28 + 0.15 \cdot 31461550)] / 8393 = 183342567 \text{ sum.}
\]

Where \( C_1 \) and \( C_2 \) are the changing costs for some items of costing, respectively, according to the existing and proposed technology, sum / t

\( K_1 \) and \( K_2 \) are specific capital investments per unit of the finished output in physical terms, respectively, according to the existing and proposed technology, sum / t;

\( E_N \) - industry regulatory coefficient of economic efficiency of capital investments, equal to 0.15;

\( A \) is annual production in natural terms, t.

The expected economic effect on the production of 1 ton of cottonseed oil:

\[
P_1 = VP_1 : T_1 = 45000 / 670 = 67.1 \text{ t / person. hour.}
\]

\[
P_2 = VP_2 : T_2 = 47000 / 655 = 71.8 \text{ t / person. hour.}
\]

where \( VP \) is the output per year; \( T \) is the labor input, person-hours. Growth in labor productivity:

4. Conclusions

The proposed electrotechnology for the production of cottonseed oil reduces operating costs per 1 ton of finished products from 31574.8 UZS to 22733.9 UZS and reduces electricity costs from 17929.92 to 13442.88 UZS, increase line productivity by 12.6% and oil yield by 5-6%. Along with economic indicators, electrohydraulic processing of seeds at their moisture acceleration of the process of drying the seeds by 2 times. Also, the use of electro impulse treatment of the crushed mixture, allow increasing the yield of oil while further pressing and reduce the cost of electricity. At the same time, useful substances remain in the husks more.

References

[1] 1998 Methodology for determining the economic efficiency of the use in the national economy of new equipment, inventions, rationalization proposals Moscow State Committee on Inventions p 32

[2] Salimov Z 1981 Intensification of technological processes for the production of vegetable oils (Tashkent Uzbekistan) p 266

[3] Zakheim A Yu 1982 Introduction to the simulation of chemical-technological processes (Moscow Chemistry) p 288

[4] Beloborodov V V 1966 Basic processes for the production of vegetable oils Moscow Food Industry p 478
[5] Safarov A F 2009-2011 Development of the theoretical foundations of cellular destruction walls of oil-containing materials by electromagnetic fields Report on the research work of the program 3-F "Biology Chemistry Medicine" for Tashkent pp 123-147

[6] Lisitsyn A N Grigorieva V N 2001 Problems of deep processing of oil-containing raw materials and environmental safety of the resulting fatty products Maslozhirnovaya prom-st 4 Moscow pp 14-25

[7] Turdiboev A, Akbarov D 2017 New Electrotechnology for the Production of Cotton Oil International scientific-practical conference "Problems and prospects of development of innovative cooperation in the field of scientific research and personnel training" Bukhara pp 147-149

[8] Vakhidov A H, Holiknazarov O A and Shaymanov N A 2017 Energy efficiency of cotton production by electro-bulb processing Collection of materials of 1-scientific-practical conference of young scientists and professors-teachers on theme "Integration of science, education and production in the sustainable development of the agrarian sector" Tashkent pp 226-228

[9] Vakhidov A Kh, Salomov M N and Turdiboev A A 2015 The effect of electro-pulsed processing on the severity of the cellular structure Uzbekistan Agrarian Science Notification 1(59) Tashkent pp 94-96

[10] Vakhidov A Kh, Tadzhibekova I E and Turdiboev A A 2015 The advantage of using electrophysical methods in the production of vegetable oil X International Scientific and Practical Conference "Agrarian Science - Agriculture" (Barnaul) Collection of articles 3 pp 30-31

[11] Vakhidov A, Turdiboev A, Holiknazarov U 2016 Current problems of agricultural science, production and education” Materials of the II International Correspondence Scientific and Practical Conference of Young Scientists and Specialists in Foreign Languages Voronezh pp 75

[12] Radjabov A, Turdiboev A and Akbarov D 2017 The problems of energy efficiency in extracting fat and oils from cotton seeds and their sufficient solutions Journal "Irrigatsion and Melioratsion" 4(10)

[13] Artikov A A Safarov A F Mamatkulov A Kh 1987 Thermoradiation treatment of cottonseed mints In the book "Theses of reports of the All-Union Scientific Conference" Development and improvement of technological processes machines equipment for storage and transportation of food" Moscow

[14] Vakhidov A, Turdiboev A, Tadzhibekova I and Khaliknazarov U 2016 Analysis of the balance of energy used in moistening cotton seeds in the production of oil Materials of the International scientific-practical conference Modern trends in the development of the agrarian complex with Salt Catch FSBI PNIIAZ Russia pp 958-960

[15] Artikov A A, Safarov A F, Shomuradov T R, Gafurov K K and Bazarbaeva D Sh The method of extracting oil from the fruit seed 1739624 on the application number 4811766 from 09. 04. 90

[16] Safarov A F, Artikov A A, Usmanov A U and Mamatkulov A Kh 1990 Investigation of the effect of infrared frying of cotton-seed mints on the quality indicators of oil Tez report repub scientific and technical conf Scientific and practical aspects of the integrated use of cotton as a raw material for the food industry Tashkent p 123

[17] Khabibov F Yu, Dzhuraev Kh F, Abdurahmonov O R and Kobilov Kh H 2010 Intensification of the drying process of agricultural products by the combined method of energy supply Nauchno-Technical Journal "Chemistry and Chemical Technology" 3 pp 45-49

[18] Safarov A F, Artikov A A, Usmanov A U, Mamatkulov A X and Sarymsakhdzhaev A R 1990 Moisture-heat treatment of oil-containing materials Food industry M VO Agropromizdat 9 pp 25-26

[19] Usmanov A U, Mamatkulov A Kh, Dodaev K O and Dzhuraev Kh F 1988 Optimization of the process of infrared frying of the myatka seed of a cotton planter Tez report Rep scientific and
practical conf. young scientists and specialists  (Tashkent Tashkent State Technical Institute) p 3

[20] Artikov A A Safarov A F Mamatkulov A X and Saidmuratov U A and others The method of extraction of oil from cotton seeds According to the application number 4657716/13/009180 from 01/12/89