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THE SELECTION OF THE CONTROL PARAMETER OF THE RAW COTTON ELECTRIC SORTER

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Abstract
This article describes the process of sorting volatile raw cotton of different qualities in the electric field of bipolar electrodes and establishes the need for simultaneous control of the process by changing the voltage of the electrodes and the operating speed of the drums.

Keywords: raw cotton, device, ginning process, electric sorting, property, quality, electrode, voltage

Introduction

One of the possible ways to obtain high-quality fibres and seeds is to sort the raw cotton flies before they are ginned. A device has been developed and manufactured for sorting raw cotton volatiles using an electric field, the schematic diagram of which is shown in Fig. 1.

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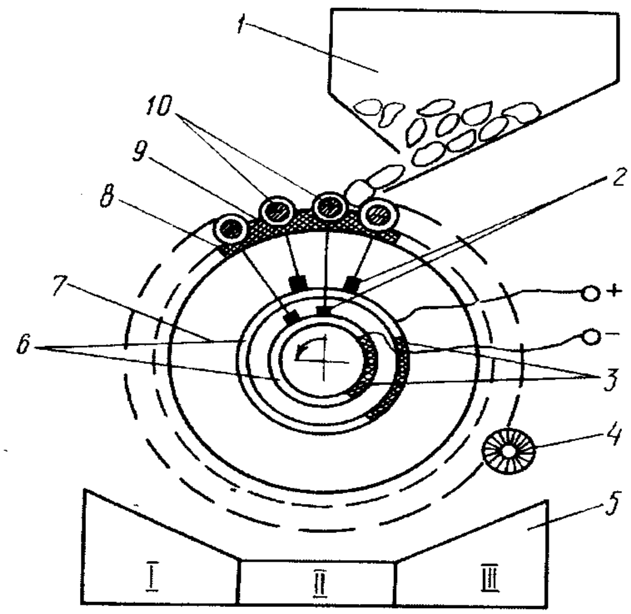

Fig. 1. Device for separating raw cotton volatiles: 1- bunker; 2- fixed contact; 3- dielectric insert; 4- brush; 5- receiver; 6- movable contact; 7- working body; 8- dielectric cylinder; 9- interelectrode space; 10- heteropolar electrodes.

The principle of electric sorting is based on the action of the electric field of bipolar electrodes10 on the voltages, depending on their quality indicators associated with the electrophysical properties. It is primarily assessed by the magnitude of the electrical force, which is located with the voltage of the oppositely polarized electrodes [1-5].

$$F_э = \frac{\varepsilon_0\left(\varepsilon_c - \varepsilon_u\right)\varepsilon_u^2 S_п U^2 \cos\theta}{2\left(\varepsilon_u R_c \sin\theta + \varepsilon_c t\right)^2} \qquad (1)$$

Where $\varepsilon_0 = 8{,}85 \cdot 10^{-12}$ f / m - electric constant; $\varepsilon_c - \varepsilon_u$ – relative dielectric constant of the vapour and the insulation layer; $S_п$ – polarized area of a particle with one electrode, m^2; U is the voltage of the electrodes; R_c - half the width of the fly; t is the thickness of the electrode insulation layer. In fig. 2 shows the dependences of the change in the electric force of attraction of the raw cotton volatiles, showing its quadratic growth on the voltage of the electrodes [4-9].

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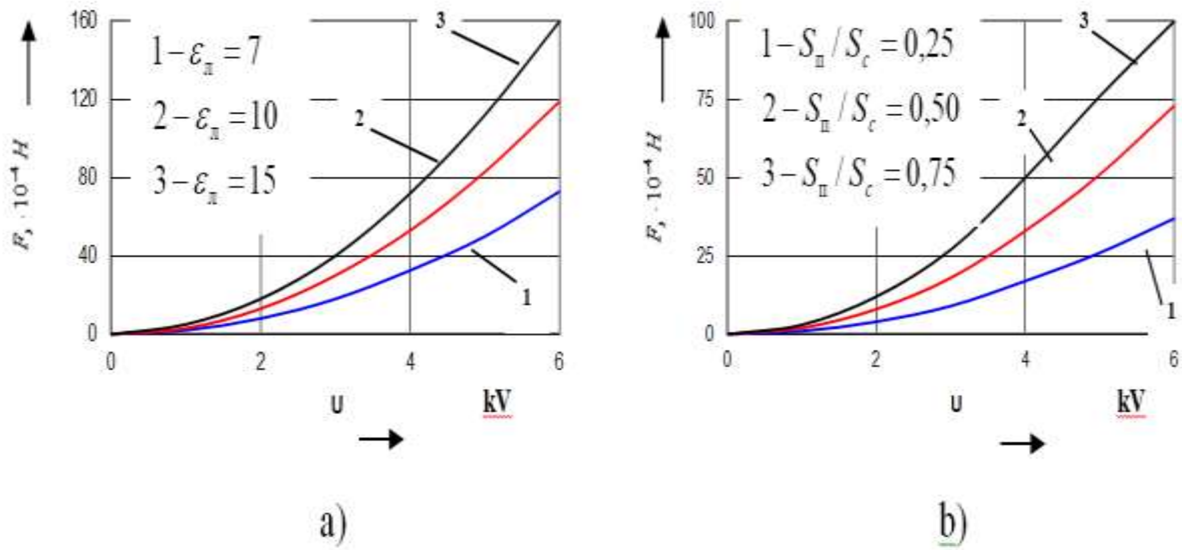

Fig. 2. Change in the electrical force of gravity of raw cotton volatiles

The opposite trend has the effect of the maturity of the fibres on the multiplicity of the electric force $K_э$, defined as

$$K_э = F_э / G = F_э / mg \qquad (2)$$

where G is the force of gravity, N.

With an increase in the field strength up to 5 kV / cm, the difference Ke of volutes of different maturity also increases even more noticeably (line 2 in Fig. 3). Thus, the multiplicity of the electrical force is inversely related to the degree of maturity of the fibres of the volatiles, which makes it possible to carry out a clear separation of them. The smaller the mass of the fly, the more it deforms due to the low elasticity of the fibres, and, accordingly, the larger the polarization area. Therefore, with an increase in the mass of volatiles from 100 to 220 mg, the multiplicity of the electric force decreases from 10 to 4 [7-11]. This indicates that large volatiles containing mature fibres and seeds are exposed to an electric force of lower magnitude than small volatiles with less mature fibres and seeds. Thus, the electric field of oppositely polarized electrodes presses the cotton bats depending on their physiological maturity. Moreover, small and large particles are affected by electrical forces to varying degrees, which creates real prerequisites for their separation according to quality indicators.

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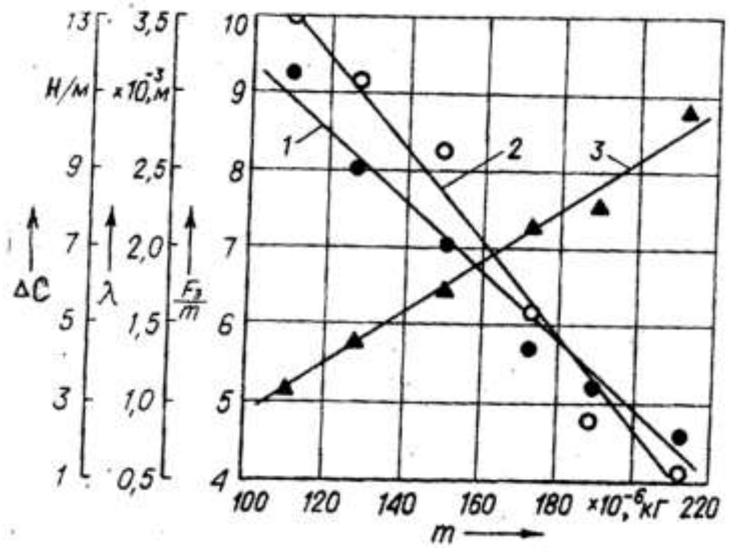

Fig. 3. Change in deformation (1), electrical multiplicity
force Fe / mg (2) and elasticity C (3) from the mass of volatiles

The latter is explained by the fact that the detachment angle of the flies is determined by the following formula [2].

$$\alpha = \arccos\left[\frac{v^2}{R_б g} - \frac{3\varepsilon_0\left(\varepsilon_c - \varepsilon_u\right) S_n \varepsilon_u^2 U^2 \cos\theta}{\pi a b^2 \gamma_m \left(\varepsilon_u \cdot R_c \sin\theta + \varepsilon_c t\right)^2}\right] \quad (3)$$

From (3) it follows that the angle of separation of the fumes from the rotating drum, and therefore the quality of the separation of the fumes, can be regulated by changing the frequency of the working body, which can be done by installing an adjustable electric drive on the electric sorter, which is powered by a voltage regulator. The lack of automatic regulation does not allow a more complete implementation of the principle of electric sorting. Based on the foregoing, it can be concluded that to further improve the sorting process, it is necessary to develop a system for automatic control of the rotational speed of the working drums and the voltage of the bipolar electrodes, which allows the separation of volatiles depending on their quality indicators.

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