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USING ELECTRIC IMPULSES FOR DEHYDRATION MATERIALS

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ABSTRACT

Airflow and anybody by friction with the surface drying biological object have the ability to accumulate electric charges. Water is a weak electrolyte, the more it in the product-materials, the higher its conductivity. In the process of drying, the surface layer of the materials is transformed into thermal insulation layer, which prevents transfer of heat into the depth of the materials, that is, evaporation of liquid from the deeper layers.

When the surface layer of the material dryes, it becomes the dielectric and in during the friction with the air stream is charging. These charges are accumulated and there may come a time when the electric current will be significantly high for the emergence the process of the micro-electro osmosis. Then the liquid under the influence of an electric field to rise through the capillaries to the outer surface of the particles of a biological object, and these particles have overcome significant obstacles [2].

Thus, using this effect or phenomenon, you can intensify the process of drying of biological objects.

KEYWORDS: Materials, Drying, Electricity, Impulses, Impulse Generator, Micro-Electro Osmosis, Capillary, Impulse Frequency, Duty Cycle, Hertz

INTRODUCTION

Method of Drying Process of Materials in a Thin Layer

The authors developed a method of drying of materials using effect of weak electric impulses, apparatus design and control system [1, 4]. The main object of the study was selected the dairy product - low-fat milk.

Experimental laboratory equipment, whose scheme is presented in Figure 1, consists from gas pipeline (2), which is made in the form of a grounded metal pipe. In this tube, electrode-emitter(5) coaxially mounted on insulators, which connected to the high voltage impulse generator (3). The turbine (1) is connected to the gas pipeline(2). On the right side of experimental laboratory equipment shows, electronic weighing device (8) with a dielectric platform (9). The transformer is designed to increase the voltage (4) (ratio of transformation – 0,06) and has a connection with high voltage impulse generator (3). Overall, serial control (monitoring) of all parameters is an electronic oscilloscope (6).

In addition, experimental laboratory equipment additionally equipped with electronic instrumentation: voltmeter, timer, liquid-pressure thermometer and anemometer (Figure 2).

The amount of low-fat milk in every experience dosed using the drip dispenser (the drip dispenser dosing- US PROFI 117 – 129, USA). In Figure 2 does not show. This is to ensure that the amount of biological product (low-fat milk) each experience has not changed. The dielectric platform (9) installed on the electronic weighing device (8), within, which fixed a circle. Precisely on the perimeter of the circle occurs of dosing product (low-fat milk) (10). That is low-fat milk by the drip dispenser (mass = 500 mg) shall be sent to the dielectric platform (9) and bottled within the circle (d = 20 mm) drawn by the platform.

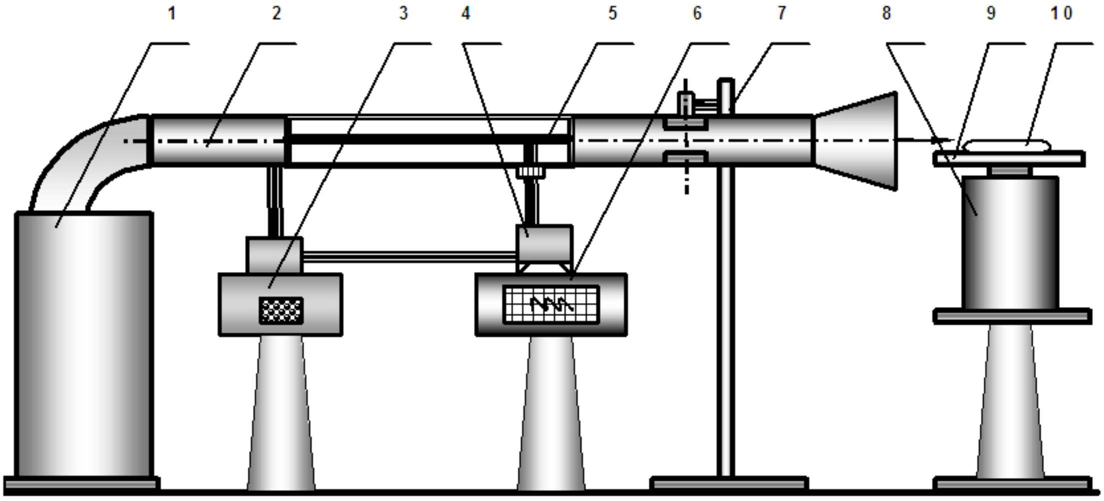

Figure 1: Experimental Laboratory Equipment for Drying of Low-Fat Milk in a Fixed Position on the Platform (Thin Layer): 1-Turbine; 2-Gas Pipeline; 3-High Voltage Impulse Generator; 4-Transformer for Increase The Voltage; 5- Electrode-Emitter; 6 -Electronic Oscilloscope; 7 - Tripod; 8-Electronic Weighing Device; 9 - Dielectric Platform; 10-Sample of Low-Fat Milk

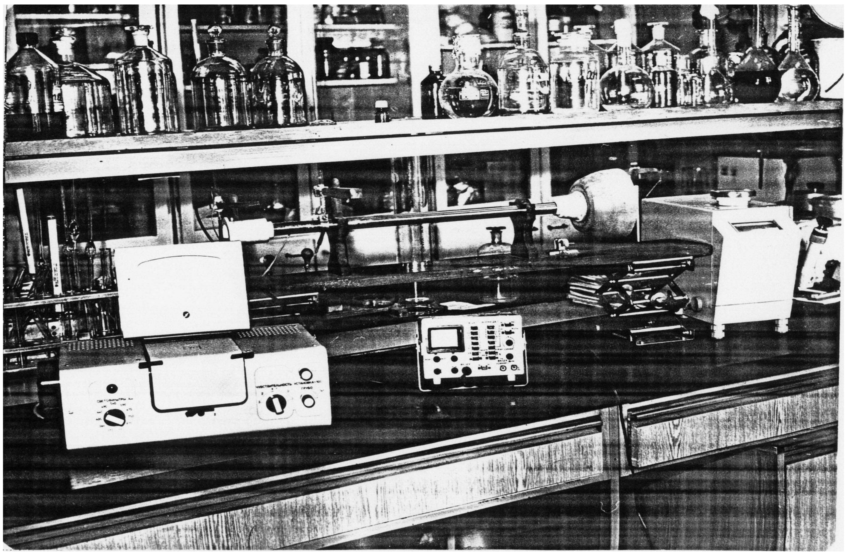

Figure 2: Photo of the Experimental Laboratory Equipment

At the generator high voltage impulses (3)for investigation are determined of characteristics: voltage (amplitude) of the (U, Volt), impulse frequency (f, Hertz) and (S) duty cycle (ratio of the impulse to their duration).Before starting the turbine (1) marked the initial reading of electronic weighing device (8) (500 VLKT) [3].

After switch on of the Experimental laboratory equipment, periodically after a certain period of time (60 sec.) recorded measurement results After all the necessary research, results were entered into the table (Excel), followed by the analysis of these experiments.

On the experimental results obtained graphs: “Drying kinetics of low-fat milk in a thin layer at different frequency impulses” (Figure 3), and “Change the speed of drying of low-fat milk in a thin layer of moisture content at different frequency impulses” (Figure 4).

The moisture content of the product W counted in relation to weight are absolutely dry substance, which in the process remains the same, and indicated by the formula: [5, 6].

W= Gm – Gc/Gc·100% **(1)**

Gm –of the total mass sample, changing in the drying process, kg;

Gc – the dry matter weight, kg.

THE RESULTS OF RESEARCH

Research of drying parameters of low-fat milk conducted without using effect of weak impulses and with using these impulses. Using effect of weak impulses was carried out using a high voltage impulse generator.

Constant parametres: Voltage **U** = 600 Volts, duty cycle **S** = 3.

On the scale of the high voltage impulse generator, sequentially in each experiment changed the impulse frequency **f** Hertz. According to the results of the experiments received dependency graphs W = F(t). (Figure 3)

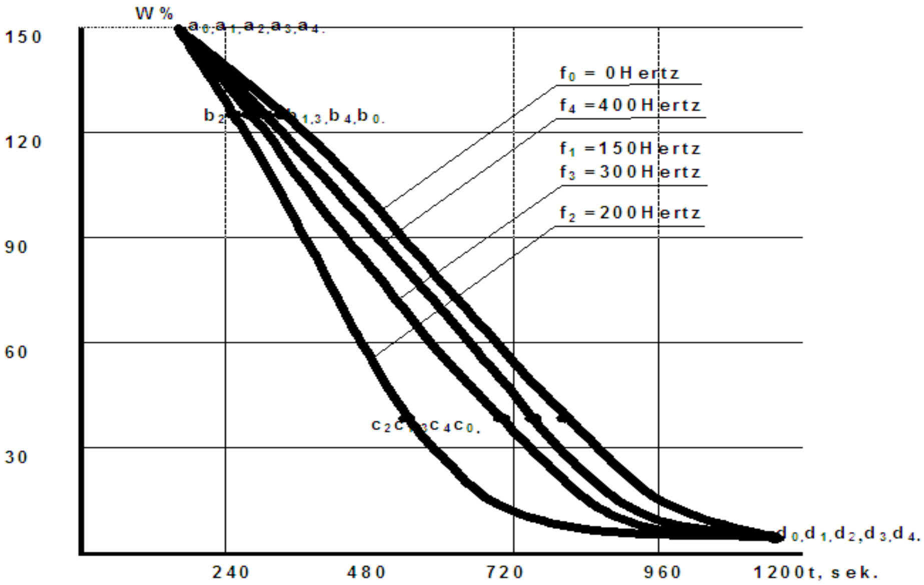

Figure 3: Drying Kinetics of Low-Fat Milk in a Thin Layer at Different Frequency Impulses: “A – B” – 1 Period of Drying, “B – C” – 2 Period of Drying, “C – D” – 3 Period of Drying

The correlation coefficient close to 1. Analysis of these graphs shows that the greatest intensity of the drying process of low-fat milk, we are observing byusingeffect of weak impulses with next parametres:

U= 600 Volts;

f_2= 200 Hertz;

S = 3 (duty cycle);

t= 660sec.

Control time without usingeffect of weak impulses is t = 1200 sec.

Drying speed – change of moisture content of low-fat milk (**dW**) for infinitesimal time interval (**dt**), and is indicated by the formula (2) [5, 6].

$$\mathbf{V = dW/dt} \quad (2)$$

Speed of drying of low-fat milk was determined by drying curve, by graphical derivation of **V = F(W)** as the slope of the tangent line drawn through the point of the curve. This corresponds to a specific of moisture content drying of the product.

Analyzing the charts according to **V = F (W)** presented in Figure 4, have determined that the maximum speed of the drying of low-fat milk in a thin layer of impulse frequency is f_2 = 200 Hertz and V_2 = 0.220 sec^{-1} (optimal drying period t = 660 sec.).S = 3 (duty cycle).

The General conclusion, that with the optimal speed V_0 = 0.220 sec^{-1}, drying speed increased to 1.82 times.

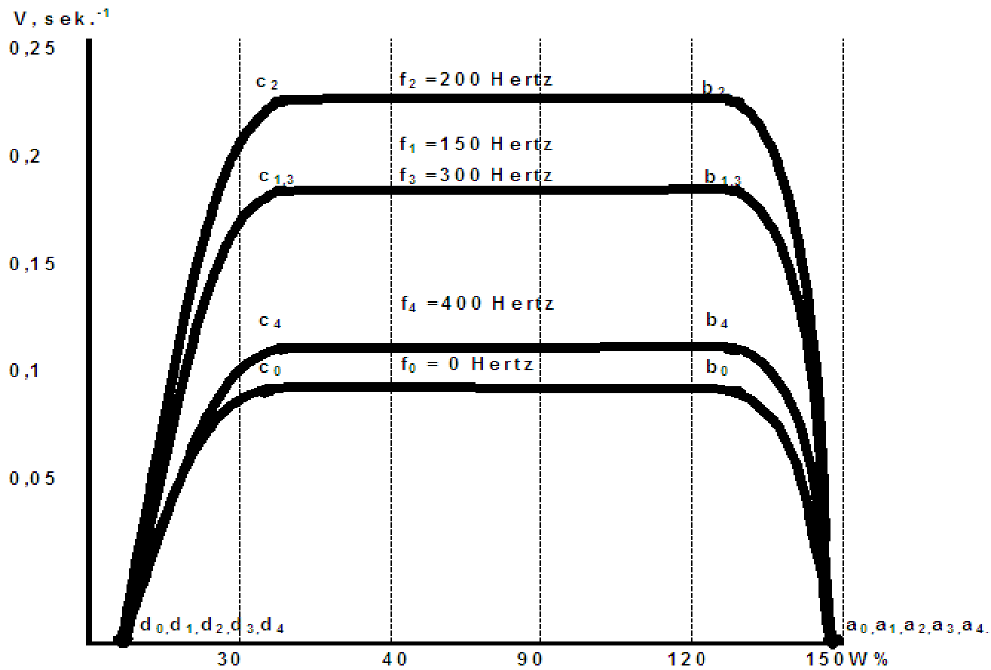

Figure 4: Change the Speed of Drying of Low-Fat Milk in a Thin Layer of Moisture Content at Different Frequency Impulses: “a – b” – 1 Period of Drying, “b – c” – 2 Period of Drying, “c – d” – 3 Period of Drying

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