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A PROSPECTIVE METHOD FOR HOMOGENIZATION OF MILK

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Homogenization is one of the main processes in the production of most dairy products. In connection with the development of technologies that use homogenized components, increased requirements are imposed on the dispersion of the final product. The main technical problem of obtaining finely dispersed emulsions is the limited capabilities of homogenizers. Therefore, the creation of devices and methods for obtaining finely dispersed emulsions with the possibility of varying dispersion and high productivity is of increased relevance [1].

For homogenization of milk and other dairy products, valve homogenizing devices are mainly used, described in works [1,2]. The main working elements of the homogenizing head are the seat and the valve, the design of which, to a certain extent, depends on the degree of dispersion of particles during homogenization.

Analysis of valve homogenizers showed that these devices are characterized by significant dimensions, metal consumption and high energy consumption. It should be noted that foreign analogues do not differ significantly in these indicators. During homogenization in valve devices, particles are crushed to sizes of at least 1 μm. Even improved valve homogenizers cannot crush particles to sizes less than 0.5 μm [1,2,3,4]. A similar principle of particle crushing is used in spinneret-type devices. In them, the product is forced through parallel holes with a constant or adjustable cross-section. The disadvantage of these devices is also the impossibility of obtaining particles with a size of less than 1 μm.

Our study of the mechanisms of homogenization, together with estimates of the limitations of the dispersion of the final product inherent in various methods of homogenization, indicate that for homogenization of particles to sizes less than 0.7...0.3 μm, it is necessary to create conditions under which the mechanism of particle crushing will be implemented by disrupting the surface layers, i.e., to process the product with high-intensity disturbances. For this, a pulse homogenizer can be used [1,2].

The pulse homogenizer and technological tanks are included in a closed circulation circuit. The change and regulation of hydrodynamic operating conditions is carried out by taps. When connected to the power grid, milk is pumped to the pulse homogenizer, where, under the influence of pressure disturbances created by the pulsed movement of the piston-hammer, the milk fat globules are crushed.

Thus, homogenization is carried out due to the double action of cavitation and the pulsed movement of the piston - striker. In the technological tank 5 there is an opening regulated by a tap for supplying the homogenized liquid to the lower technological tank 4 for subsequent processing. The installation used a pulse homogenizer [3].

As shown in Fig. 1, the pulse homogenizer consists of a cylinder 1 with pistons-hammers 2, a rod 3, a pulse drive 4, inlet pipes 5 and outlet 6 of the homogenizing liquid, a collector 7 for the input of the homogenized liquid with holes 8 for its introduction into the cylinder 1, a valve 9 for the release and regulation of the flow rate of the homogenized liquid. The pistons-hammers 2 have axial through holes 10 in the form of diffusers, which alternate in diameter with the inlet 11 and outlet 12 holes around the circumference.

The pulse homogenizer works as follows. When the pulse drive 4 is turned on, the piston-hammer 2 makes reciprocating movements along the vertical axis using pulse movements of the rod 3. The homogenizing liquid is fed through the supply pipe 5 into the inlet manifold 7 and through the holes 8 enters the upper cavity of the cylinder 1. Then the liquid passes through the gap between the piston-hammer and the cylinder, as well as through the holes of the diffusers 10 into the lower cavity of the cylinder 1 and exits through the valve 9 as a finished product [4].

Throughout the entire time the liquid is in the upper and lower cavities of cylinder 1, it is affected by pressure disturbances created by the pulsed motion of the piston-hammer. Therefore, the grinding of liquid particles is carried out due to the dual action of cavitation and the pulsed motion of the piston-hammer.

The dispersion of the finished product is adjusted by changing the amplitude of the pulse movement of the piston - striker 2, changing the opening angle of the diffusers (changing the piston with other diffusers), the flow rate and temperature of the liquid.

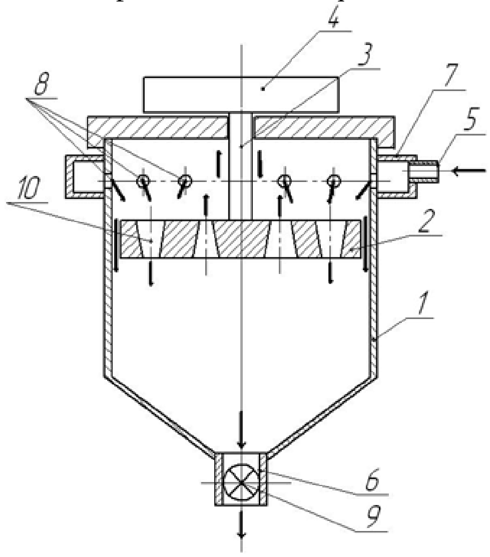

Figure 1 – Scheme of a pulse homogenizer: 1 - lower cylinder cavity; 2 - piston - striker; 3 - rod; 4 - pulse drive; 5 - supply pipe; 6 - discharge pipe; 7 - inlet manifold; 8 - holes; 9 - valve; 10 - lower cylinder cavity

Such a combination of essential features as the execution in the piston-striker of axial through holes in the form of diffusers, which alternate with the diameters of the inlet and outlet holes along the circumference, and its pulsed movement allows to increase the efficiency of homogenization of the liquid due to the combined use of the effects of the shock wave action of cavitation bubbles when they are slammed at the exit from the piston and additional crushing of particles with the disruption of their surface layers when they move through the gaps between the piston and the cylinder and through the diffusers. Moreover, the execution of diffusers, which alternate with the diameters of the inlet and outlet holes along the circumference, together with the pulsed movement of the piston, increases the efficiency of homogenization.

The use of a pulse homogenizer allows you to obtain products with particle sizes of the dispersed phase less than 1 μm at a maximum pulse pressure of 1.5…2 MPa and with a specific energy consumption of 1.9 kW (valve homogenizer – 4.0 kW).

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