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EXTRACTION OF WATER FROM A CAPILLARY SPECIMEN IN AN ACOUSTIC FIELD

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The authors present results of experiments on drying of a model capillary specimen in a subheated air flow in an acoustic field. It is established that the acoustic field causes considerable intensification of the drying process. The influence of the specimen position relative to the front of an acoustic wave and the flow velocity is established that the acoustic field causes considerable intensification of the drying process. The influence of the specimen position relative to the front of the acoustic wave and the flow velocity is investigated.

The phenomenon of drying of materials (water extraction) in an acoustic field has a rather long history [1]. In [2] the authors report on acoustic drying of wood (pinewood specimens), which has a complicated capillary-porous structure. The complexity of the internal structure of wood substantially hinders a theoretical analysis of the process of acoustic drying. Therefore it is of interest to carry out experiments on model specimens with a known, rather simple structure. As such a specimen, we took lead glass of cylindrical shape with 2790 independent longitudinal cylindrical capillary channels with a diameter of 70 μm. The characteristic transverse and longitudinal dimensions of the specimen were 5.2 and 24 mm, respectively.

The experiments were conducted in the channel of a model drier. As the source of sound under acoustic drying conditions, use was made of a Hartmann jet generator with the following characteristics of the acoustic field: the frequency was 400 Hz, the intensity of the sound was 176 dB relative to $p_0 = 2 \cdot 10^{-5}$ N/m^2. The velocity of waste air averaged over the channel cross section and the velocity of blowing of the specimen were 26 m/sec, which is attributed to the parameters of the source of sound and to the drier construction. The air temperature was 20°. To measure the frequency and intensity of the sound, we used piezoelectric transducers of the LKh-610 type, an S5-3 spectrum analyzer, and an oscillograph.

The specimen was filled with distilled water, and weighing of the specimen was performed on an analytical balance, model VLA-200-M. The specimen was fastened on a holder in two positions: with its axis directed perpendicular to the flow velocity, in this case the front of the acoustic wave fell on the lateral surface; with its axis directed parallel to the flow velocity, here the wave front fell on an endface of the specimen.

Results of the experiment are in Fig. 1, which shows dependences of the amount of extracted water on the time of drying in the case of convective drying in the presence and absence of an acoustic field. As is seen, the acoustic field substantially intensities the process of specimen drying. The gain in the amount of moisture extracted by the sound increases with the drying time. This result indicates deeper penetration of the sound into the capillaries as compared to the action of the gas flow. When a certain small amount of water is attained in the specimen, stabilization of the difference in the extracted moisture occurs, i.e., the process of drying in two variants (in the acoustic field and only by the flow) virtually ceases. It should be noted that in the convective drying the process terminates at a larger amount of moisture in the specimen. In the case of the longitudinal position of the specimen (see Fig. 1b), water extraction by the gas flow is accelerated, which leads to a relative decrease in the contribution of the acoustic field.

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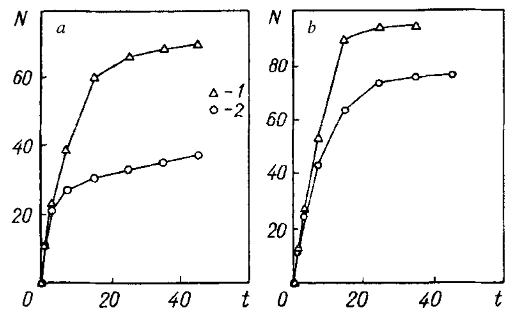

Fig. 1. Kinetics of specimen drying with a perpendicular (a) and longitudinal (b) position of the specimen axis relative to the air flow velocity: 1) in an acoustic field; 2) convective drying. N, %; t, min.

Since the flow temperature was low and the kinetic curves show rather high drying rates, for further studies the question of the aggregate state of the extracted moisture arises.

The results obtained give the possibility of analyzing theoretically the process of drying of a simple capillary specimen in an acoustic field with a gas flow.

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NOTATION

p_0, threshold sound pressure; N, amount of extracted moisture expressed in percent relative to the initial weight of the water amassed by the specimen; t, drying time.

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