ISSN 0018-151X, High Temperature, 2018, Vol. 56, No. 1, pp. 146–148. © Pleiades Publishing, Ltd., 2018.
Original Russian Text © D.A. Gubaidullin, R.G. Zaripov, L.A. Tkachenko, L.R. Shaidullin, 2018, published in Teplofizika Vysokikh Temperatur, 2018, Vol. 56, No. 1, pp. 145–147.

SHORT COMMUNICATIONS

The Dynamics of an Aerosol in an Open Tube under Oscillations of Various Intensities near Resonance

D. A. Gubaidullin[a, b, *], R. G. Zaripov[a, **], L. A. Tkachenko[a, b, *], and L. R. Shaidullin[a, b, ****]**

[a] *Institute of Mechanics and Engineering, Kazan Scientific Center, Russian Academy of Sciences, Kazan, 420111 Russia*

[b] *Kazan, Volga Region, Federal University, Kazan, 420000 Russia*

**e-mail: gubaidullin@imm.knc.ru*

***e-mail: zaripov@imm.knc.ru*

****e-mail: luda_tkachenko@inbox.ru*

*****e-mail: liqn@mail.ru*

Received April 21, 2017

Abstract—The dynamics of an aerosol in an open tube under the action of acoustic waves of various intensities near the first eigenfrequency in the transient mode, when shock waves are not formed, was experimentally studied. The time–pressure profiles of the aerosol were obtained, whose shape becomes somewhat different from the harmonic one only at resonance. The time of aerosol clearing for different frequencies and the piston-displacement amplitudes is determined. It is demonstrated that the dependence of the aerosol clearing time on frequency with a minimum at the first eigenfrequency is nonmonotonic in character. In the transition mode, the aerosol clearing occurs 1.5 times faster than in the shock-free wave mode with the same piston-displacement amplitudes.

DOI: 10.1134/S0018151X1801008X

INTRODUCTION

Nonlinear effects that arise under acoustic oscillations in homogeneous [1] and inhomogeneous media attract great attention due to the possibility of their practical use [2, 3]. Acoustic coagulation [4] is of particular interest, which can be used, for example, in the sedimentation of aerosols in industrial emissions (gas with particles that arise from the combustion of fuels in power plants or in cement kilns; vapor of water and other liquids in heat-engineering structures, for example, in cooling towers) or for purifying liquids in the food and chemical industries. The features of studying two-phase flows with solid particles, droplets, and bubbles and the mechanisms for the formation of regions with an increased concentration of the dispersed phase in such flows have been considered [5–7]. Coagulation and sedimentation of aerosols in acoustic fields in tubeunder various oscillation modes near resonances have been considered in experimental studies [8–15]. In [8–10], coagulation and sedimentation of droplets of machine oil and tobacco smoke (1–10 μm), droplets of oleic acid (1–10 μm) and smoke particles obtained from the combustion of an incense stick (0.3 μm) under the oscillations in the shock-wave formation mode were studied. Coagulation and sedimentation of droplets obtained from di-ethyl-hexyl-sebacate liquid (0.863 μm) were investigated in shock-free wave and shock-wave modes and in the mode of transition to shock waves [11–15]. It has been shown that when shock waves are applied to an aerosol, coagulation ends after a few seconds, but even a low-intensity wave field causes accelerated coagulation. In a continuation of [15], the dynamics of an aerosol in an open tube was studied under the effect of acoustic fields of various intensities in the transient mode, when shock waves do not arise.

MATERIALS AND METHODS

The experiments were carried out on an apparatus that was previously used to study nonlinear aerosol oscillations in a closed tube upon transition to the shock-wave mode near the first eigenfrequency at small excitation amplitudes [15]. A quartz tube 0.918 m in length and 0.1 m in diameter was placed vertically. Oscillations were created by a piston of the same diameter using a TIRAvib S 5220/LS vibrostand (Denmark) with a BAA 1000-ET power amplifier and a cooling fan. The vibrostand was controlled and monitored using a computer with a Vibration Research 9500 controller (United States) and a Brüel & Kjær 4513 piezoelectric IEPE accelerometer (Denmark). A Brüel & Kjær 8530C-15 pressure sensor (Denmark) was placed near the piston, the data from which were recorded by the computer through an ENDEVCO-136 three-channel bridge voltage amplifier (Brüel & Kjær, Denmark) and a DSO 3062A digital oscilloscope (Agilent Technologies). Aerosol with a droplet diameter of smaller than 1 μm [11] was used as an operating medium, which was created using an ATM 225 TOPAS aerosol generator (Germany) from