STABILITY OF A MONODISPERSED DROPLET FLOW IN A GASEOUS MEDIUM OF VARIABLE DENSITY

V. V. Blazhenkov and D. B. Chashchikhin

UDC 532.5

Experimental studies are performed of the effect of gaseous medium pressure on the stability of a flow of monodispersed droplets. The dependence of particle angular scattering upon gas density is obtained. It is shown that scattering increases with pressure of the gaseous medium.

Problems involving transport of monodispersed macroparticle flows are of practical import in creating devices used in electrodroplet-jet [1] and cryodispersion [2] technology. The design of such devices requires knowledge of particle scattering within the flow for various parameters of the flow itself (dimensions, mean velocity, and dispersion of particle velocity) as well as the gaseous medium within which the flow travels.

There exist a few studies which have examined the effect of flow characteristics on particle transport [3, 4]. At the same time there is a lack of publications on the effect of gaseous medium density on flow stability.

The present study will experimentally investigate the effect of the surrounding gaseous medium on stability of a flow of monodispersed particles. The angular scattering of monodispersed particles in a flow was measured as a function of gas density for this purpose.

An experimental apparatus the block diagram of which is shown in Fig. 1 was used. It included: vacuum chamber 1, including a drop generator (see Fig. 2) and collector with submersible pump; a chamber for preliminary degasification of the working liquid 3 with pump and filter, hydroaccumulator 4 with reservoir for creating and regulating working pressure; thermostat 2, providing system temperature output at the specified operating temperature.

The drop generator shown in Fig. 2 includes: filler 1, attached to the vacuum chamber body, piezovibrator 2, attached to brass substrate 3, which is clamped to the generator shell 4 by ring clamps. A heater for more precise temperature stabilization is wound on the shell. A grid filter was attached above the generator. Two Nichrome-constantin thermocouples measured the temperatures of the heater and the flow at the chamber input.

The experiments on angular scattering of droplets were performed using VM-1 vacuum oil as the working substance. The diameter of the pump orifice was 403 μm. Flow temperature at the chamber input was maintained constant at 50°C. Air pressure in the vacuum chamber was measured by an accumulator. The absolute deviation of the droplets from the vertical axis was recorded. Hence only the projection of the droplet scattering cone in the vertical plane was studied. Measurements were performed by photography over a baseline of 1850 mm. In a single wide angle photograph 35-45 drops were counted depending on generation frequency and pressure in the chamber. The head between the working liquid pressure in the generator and the pressure in the vacuum chamber was maintained constant at 2 atm over the course of the

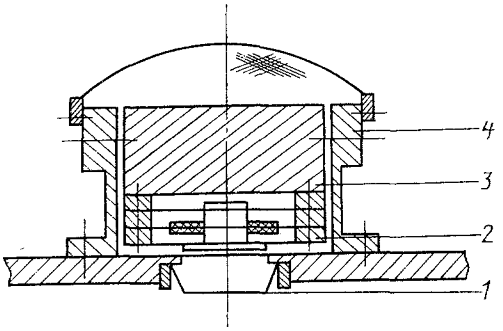

Fig. 1. Diagram of experimental equipment.

Moscow Energy Institute. Translated from Inzhenerno-fizicheskii Zhurnal, Vol. 60, No. 4, pp. 668-670, April, 1991. Original article submitted October 10, 1990.

 0022-0841/91/6004-0512$12.50

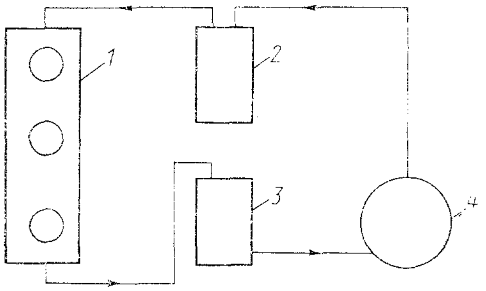

Fig. 2

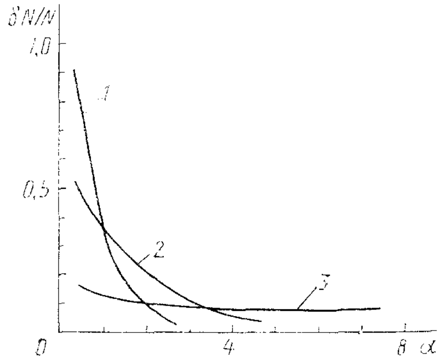

Fig. 3

Fig. 2. Monodispersed droplet generator.

Fig. 3. Relative quantity of droplets δN/N vs angle of deviation α, sr·10^4; chamber pressure: 1) 419 torr; 2) 711; 3) 740.

experiment. Figure 3 shows the dependence of the relative quantity of droplets δN/N vs deviation angle α. For lower pressures in the vacuum chamber these values are not shown, since in this case the deviation did not exceed the experimental error.

NOTATION

N, quantity of particles studied; δN, number of particles with identical deviation angle; α, angular deviation.

LITERATURE CITED

1. E. V. Ametistov and A. I. Motin, Tr. Mosk. Énerg. Inst., No. 119, 13-17 (1986).
2. V. F. Gunbin, Tr. Mosk. Energ. Inst., No. 119, 27-39 (1986).
3. V. V. Blazenkov and V. F. Gunbin, Tr. Mosk. Énerg. Inst., No. 85, 10-24 (1988).
4. E. P. Muntz and M. Dixon, J. Spacecr., 23, No. 4, 411-419 (1986).

STABILITY OF PERIODIC FLOW IN A MICROPOLAR FLUID

M. A. Brutyan and P. L. Krapivskii

UDC 532.51:536

The stability of unidirectional periodic flow in a micropolar fluid is treated. An analytic expression is found for the critical Reynolds number of stability loss.

Among the non-Newtonian fluids, for whose description one needs additional hydrodynamic variables, one of the best known is the so-called micropolar fluid. Along with the classical hydrodynamic variables (velocity, pressure, and so on), for macroscopic description of this medium one requires three additional variables, interpreted as the components of the angular velocity of microrotation Ω.

The equations of a micropolar fluid are substantially more complicated than the Navier–Stokes equations. This renders the construction of rigorous solutions, and particularly the stability analysis, more difficult. Most of the stability studies of a micropolar fluid were carried out numerically (see, for example, the stability studies of Couette [1], Taylor–Couette [2], and Benard–Rayleigh [3] flows). It is, therefore, of interest to investigate a problem for which one can expect to obtain analytic results in the study of linear and weakly linear stability.

As will be seen in what follows, such an example is unidirectional periodic flow of a micropolar fluid, induced by an external force F ~ siny, directed along the x-axis (the so-called

Translated from Inzhenerno-fizicheskii Zhurnal, Vol. 60, No. 4, pp. 670-679, April, 1991. Original article submitted March 23, 1990.