Hydraulics

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Abstract

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ON TWO-PHASE SUPERSONIC FLOWS

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As is known, the temperature of a wall washed by a supersonic gas flow, at $\mathrm{Pr} \approx 1$, differs little from the stagnation temperature of the flow. It may be assumed, however, that when a liquid with a freezing temperature significantly higher than the gas temperature is introduced into a supersonic gas flow, a two-phase flow is formed, consisting of gas and particles of frozen liquid. The temperature of a wall washed by such a flow may be substantially lower than the stagnation temperature of the gas.

To test this assumption, an experiment was carried out in the hydromechanics laboratory of the M. V. Lomonosov Moscow State University. Water was introduced into a supersonic air flow at the exit section of a Laval nozzle ($M = 1.2$ and $M = 3.0$). The stagnation temperature of the air and the temperature of the water were both 15°. The mass flow rates of air and water were, respectively, 0.12 and 0.02 kg/sec. Within 8–12 sec after the start of the outflow, a steel rod placed in the flow became covered with an ice crust firmly bonded to the rod. The rate of formation of the ice crust, its thickness, and the strength of its adhesion to the surface of the rod were greater the higher the flow velocity.

The phenomenon described can evidently be used in engineering to obtain cold in high-pressure gas wells and main gas pipelines, as well as for cooling surfaces washed by a gas flow.

A quantitative theory of the phenomenon will be given in another paper.

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Note: Figure translations are in progress. See original paper for figures.