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One-dimensional adiabatic flow of equilibrium gas-particle mixtures in long vertical ducts with friction. (English) Zbl 0673.76087

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Summary: The equations of the steady, adiabatic, one-dimensional flow of an equilibrium mixture of a perfect gas and incompressible particles, in constant-area ducts with friction, are derived taking into account the effects of gravity and of the finite volume of the particles. As is the case for a pure gas, the mixture is shown to be subject to the phenomenon of choking, and the possibility of an adiabatic heating of the mixture in a subsonic expansion is also theoretically predicted for certain flow inlet conditions. The model may be used to approximately describe the conditions existing in portions of volanic conduits during the Plinian phases of explosive eruptions. Some results of the numerical integration of the equations for a typical application of this type are briefly discussed, thus showing the potential of the model for carrying out rapid analyses of the influence of the main geometrical and flow parameters describing the problem. A non-volcanological application is also analysed to illustrate the possibility of the adiabatic heating of the mixture.

MSC:

76N15 Gas dynamics, general
80A20 Heat and mass transfer, heat flow (MSC2010)
76M99 Basic methods in fluid mechanics

Keywords:

steady, adiabatic, one-dimensional flow; equilibrium mixture of a perfect gas and incompressible particles; constant-area ducts; subsonic expansion; volanic conduits; Plinian phases of explosive eruptions; non-volcanological application; adiabatic heating of the mixture

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