Some Properties of the Low Mach Number Diphasic System

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This work deals with the derivation of a diphasic low Mach number model which is well adapted to the Direct Numerical Simulation (DNS) of two immiscible fluids. This model is obtained through a Mach number asymptotic expansion applied to the compressible diphasic Navier-Stokes system, expansion which filters out the acoustic waves [3, 4]. This approach is inspired from the work of Andrew Majda [1] which gives the equations of low Mach number combustion for thin flame and for perfect gases. When the equations of state verify some thermodynamic hypothesis, we show that the low Mach number diphasic system predicts in a good way the dilatation or the compression of a bubble. Moreover, when the two fluids are perfect gases, we prove that this system preserves the positivity of the temperature and of the thermodynamic pressure and that there is convergence toward an unique equilibrium when the geometry is monodimensionnal. At last, we propose an entropic and convergent lagrangian scheme in monodimensionnal geometry.

Key-words : diphasic flow, immiscible fluids, low Mach number system, entropy.

References

[1] Majda A. et Sethian J.A. – *The derivation and numerical solution of the equations for zero Mach number combustion* – Combust. Sci. and Tech., **42**, p. 185-205, 1985. See also : Majda A. – *Equations for low mach number combustion* – Center of Pure and Applied Mathematics, University of California at Berkeley, report no. 112, 1982.

[2] Paolucci S. – *On the filtering of sound from the Navier-Stokes equations* – Sandia National Laboratories report (Livermore), SAND82-8253, 1982.

[3] Dellacherie S. – *Dérivation du système diphasique bas Mach. Simulation numérique en géométrie monodimensionnelle* – CEA report, to appear.

[4] Dellacherie S. and Vincent A. – *Zero Mach Number Diphasic Equations for the Simulation of Water-Vapor High Pressure Flows* – Proceedings of the 11^{th} Conference of the CFD Society of Canada, Vancouver, 2003.