The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

A DIFFUSE INTERFACE METHOD WITH NON-INSTANTANEOUS RELAXATION FOR TWO-PHASE FLOWS DESCRIBED BY GENERIC EQUATIONS OF STATE

Barbara Re[1*] and Rémi Abgrall[2]

[1] Politecnico di Milano, Department of Aerospace Science and Technology,
via La Masa 34 - 20156 Milano, Italy, *barbara.re@polimi.it
[2] Universität Zürich, Institute for Mathematics,
Winterthurerstrasse 190 - 8057 Zürich, Switzerland

Keywords: *Baer-Nunziato model, pressure-based formulation, generic equations of states, chemical potential relaxation*

In computational fluid dynamics, diffuse-interface methods (DIMs) are popular and efficient strategies for the simulation of unsteady compressible multiphase flows, able to cope with the material interfaces, which may deform, coalesce, and break up as time evolves. These methods assume a small, artificial mixing of the fluids at the otherwise resolved interface and they are based on augmented systems of governing equations, which include suitable transport terms to account for the interaction between phases.

In this work, a full non-equilibrium, Baer and Nunziato (BN)-type model is used to simulate weakly compressible two-phase flows. A pressure-based formulation is considered to ease the development of a robust discretization of the non-conservative terms involving the gradient of the volume fraction and the use of arbitrary equations of state [1]. Finite relaxation terms in pressure and velocity describe how the fluids are driven toward mechanical equilibrium at interfaces. This BN-type model is equipped with non-instantaneous mass transfer by including thermo-chemical relaxation. In this regards, the relaxation time scales are estimated by means of simple but physically-based constitutive relations recently proposed for the water vaporization [2], under the Stiffened Gas EOS.

The influence of finite relaxation times is investigated in one-dimensional numerical tests, involving vapor-liquid water flows and multi-component mixtures.

REFERENCES

[1] B. Re and R. Abgrall. A pressure-based method for weakly compressible two-phase flows under a Baer-Nunziato type model with generic equations of state and pressure and velocity disequilibrium. (2021), arXiv:2107.12408 [physics.comp-ph].

[2] H. Lochon, F. Daude, P. Galon and J.-M. Hérard. Computation of fast depressurization of water using a two-fluid model: Revisiting Bilicki modelling of mass transfer. *Computers & Fluids* (2017) **156**: 162–174.