6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

EXPERIMENTAL VALIDATION OF NUMERICAL APPROACH FOR FREE SURFACE FLOWS MODELING BASED ON LATTICE BOLTZMANN METHOD

J. Vimmr[1], O. Bublík[2] and L. Lobovský[3]

[1] University of West Bohemia, Univerzitní 8, 301 00 Pilsen, jvimmr@kme.zcu.cz
[2] University of West Bohemia, Univerzitní 8, 301 00 Pilsen, obublik@ntis.zcu.cz
[3] University of West Bohemia, Univerzitní 8, 301 00 Pilsen, lobo@kme.zcu.cz

Keywords: *Lattice Boltzmann Method, Free Surface Flow, Gravity Casting, Experimental Measurement*

Free surface flow is an important physical phenomenon involved in many manufacturing processes, e.g. material transport, machining, casting etc. This work is focused on the numerical simulation of free surface flows using the lattice Boltzmann method and its validation with experimental data. The main advantage of the lattice Boltzmann method compared to classical methods is that the solution of the Poisson equation, required to meet the condition in the form of the continuity equation, is avoided [1]. Because of this, the lattice Boltzmann method is simpler and less computationally demanding than the finite element and finite volume methods. To capture the free surface of the incompressible fluid (glycerol, sugar solution) in this study, we adopt the algorithm based on the volume of fluid method (VOF) established by Thürey [2]. The advantage of this algorithm is that the mass flow between grid points is calculated directly using the distribution functions, avoiding so the need to introduce a new equation for the movement of the liquid-gas interface as is the case of the classical VOF. The surface tension effect was also incorporate to the algorithm [3]. The developed computational algorithm was used for the simulation of the gravity casting process in the several testing 3D computational domains. The experimental measurements of gravity casting process were captured using a high speed camera. The obtained results show that the developed numerical algorithm was in the very good agreement with the experimental data.

REFERENCES

[1] S. Succi, R. Benzi, F. Higuera, The lattice-Boltzmann equation a new tool for computational fluid dynamics, *Physica D* Vol. **47**, pp. 219–30, 1991.

[2] N. Thürey, *Physically based Animation of Free Surface Flows with the Lattice Boltzmann Method*, Doctoral thesis, Erlangen 2007.

[3] S. Donath, K. Mecke, S. Rabha, V. Buwa, and U. Rüde, Verification of surface tension in the parallel free surface lattice Boltzmann method in waLBerla, *Computers Fluids*, Vol. **45**, pp. 177–186, 2011.