Assessment of the Particle Finite Element Method. to solve primary atomization problems

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ABSTRACT

Primary atomization of a liquid charge injected at high speed into still gaseous chamber is investigated to get insight about the physical processes involved and the capabilities of numerical methods to track them. This work was originally published by Menard and collaborators [1] and subsequently the discussion continued with the work of Shinjo and Umemura [2] where in the latter authors question that the first job has represented the DNS of the first structures of the atomization.
As it was presented in [2] the authors show a numerical simulation using utmost 6 billion cells with sufficient grid resolution to capture the first ligaments and their consecutive droplet formation with results that are physically sound way. Also the authors show that ligament formation is triggered by the liquid jet tip roll-up, and later ligaments are also produced from the disturbed liquid core surface in the upstream promoted by Kelvin-Helmholtz (KH) and Rayleigh-Taylor (RT) mechanisms. Ligament production at the jet tip is affected by the surrounding gas vortices with further droplet collision. The greater the local gas Weber number the smaller the scale of the ligaments or droplets being formed.
In [2] some comparison with laboratory experiments is shown serving as the basis for the assessment of future numerical simulations around this physical phenomenon.
In the present work we focus on the capabilities of the Particle Finite Element Method (PFEM) in its second generation [3], to reproduce such a problem, following the physical phenomena established in previous works, matching the experimentally measured droplet distribution and comparing against another Eulerian type solver working on similar meshes. An extra bonus of this work is the understanding of the interface dynamics and its impact on the interface capturing process inside PFEM.

REFERENCES

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