



HAL
open science

Melting of a phase change material in a moving capsule: A parametric study

Clément Rigal, Romain Noël, Agathe Chouippe, Denis Funfschilling, Yannick
Hoarau

► **To cite this version:**

Clément Rigal, Romain Noël, Agathe Chouippe, Denis Funfschilling, Yannick Hoarau. Melting of a phase change material in a moving capsule: A parametric study. EuroMech 2023 - Colloquium 622 on Suspension flows and rheology: inertia, shape and roughness matter, Jun 2023, Nice, France. hal-04447356

HAL Id: hal-04447356

<https://hal.science/hal-04447356>

Submitted on 9 Feb 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Copyright

Melting of a phase change material in a moving capsule: A parametric study.

Clément Rigal^{1,2}, Romain Noël², Agathe Chouippe¹, Denis Fünfschilling¹, and Yannick Hoarau¹

¹Laboratoire ICUBE, équipe mécanique des fluides, Strasbourg.

²Univ. Gustave Eiffel, Inria, COSYS-SII, équipe I4S, F-44344 Bouguenais, France.

June 2023

Abstract

In recent years, there has been growing interest in the development of reversible thermal storage systems for urban development. The present work deals with one of these systems, which consists of a fluid flow carrying microcapsules containing a phase-change material (mPCM, cf. [1]) circulating in a porous layer integrated into the urban structure. It focuses on the the melting process occurring in the fluid-driven encapsulated phase change material.

The fluid equations inside and outside the capsule are solved using the lattice-Boltzmann method on a two-dimensional simulation. A collision operator based on the partial saturated method ensures the boundary conditions at the interfaces between fluid and solid phases. A second set of distribution functions on the lattice is used to solve heat transfer, while an enthalpy-based model provides a realistic solution for the phase change, by means of an enhanced multi-relaxation-time collision operator.

The results are detailed and investigated in order to understand the impact of several parameters (Reynolds number of the fluid, Stefan number of the phase-change material) on the phase change kinetics. The effect of the angular velocity of the shell with respect to its content is evaluated in particular.

References

- [1] G.V.N. Trivedi and R. Parameshwaran. “Microencapsulated phase change material suspensions for cool thermal energy storage”. In: *Materials Chemistry and Physics* 242 (Feb. 2020), p. 122519. ISSN: 02540584. DOI: 10.1016/j.matchemphys.2019.122519.