Numerical modelling of convection driven melting using the General Enthalpy Approach

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Numerical modelling of solid-liquid phase change has drawn a lot of attention again in the past years due to its relevance in phase change materials (PCM), which are applied for reusing waste heat from industries and domestic applications. Detailed numerical modelling of solid-liquid phase change in PCM helps to understand the thermal response of a complete thermal storage. The Enthalpy-porosity approach [1] is a well-known and widely used method to model the solid-liquid phase change. Due to the large computational effort using this approach, the General Enthalpy Method [2] has been developed in later years. This approach despite its high efficiency did not draw a lot of attention due to its complexity in application. In this work, the General enthalpy method has been used to compute the solid-liquid phase change of the benchmark Gallium test [3] and other experiments. A solid viscosity instead of a Darcy term is used to implement the solid velocity suppression.

The complete numerical model using the General enthalpy approach is implemented in open source software, OpenFOAM. Different effective viscosity correlations for the mushy zone (solid-liquid interface) will be discussed in this work. In the General Enthalpy Method, an enthalpy and a temperature formulation for the convective term are compared and conclusions are drawn. Computational effort needed to compute the phase change and the resulting error using the Enthalpy-porosity method and the General enthalpy approach will also be compared.

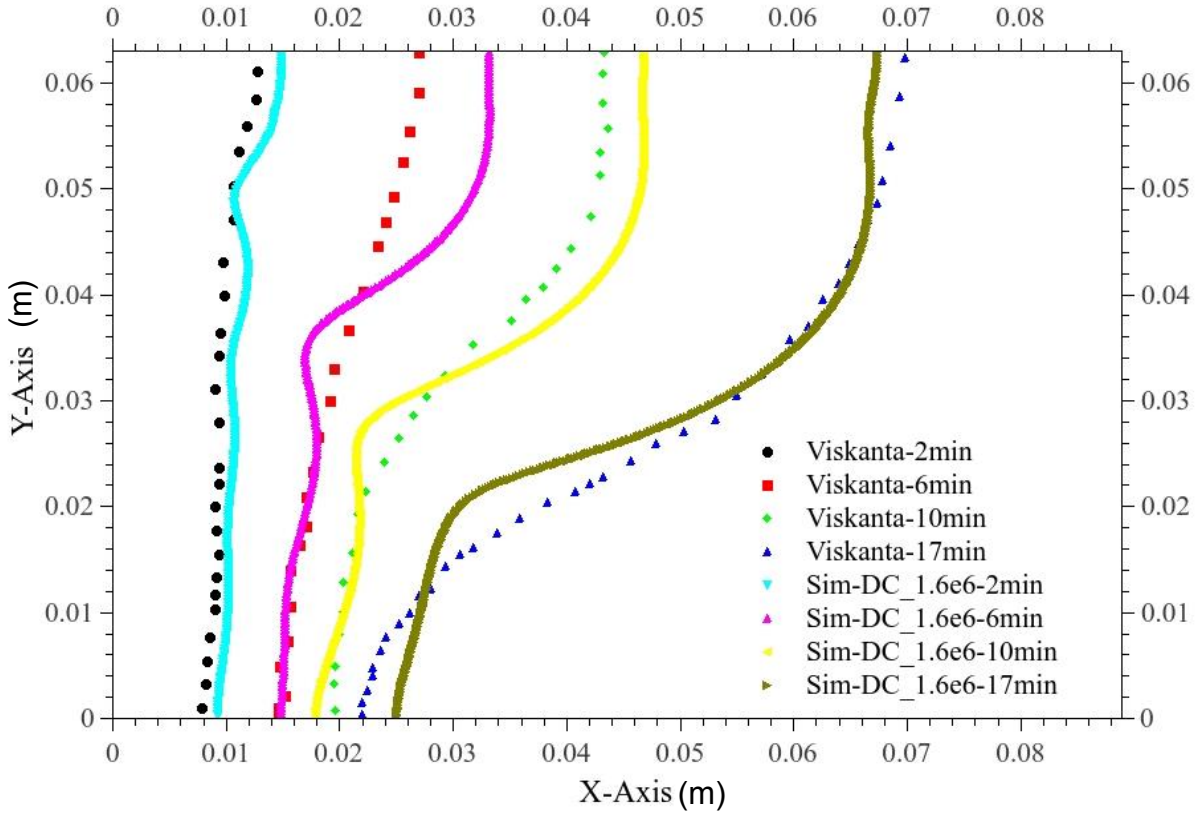

Fig 1: Validation of the general enthalpy approach implemented in OpenFOAM with the experiments performed by Gau and Viskanta for the melting of Gallium [3].

References:

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