3D modelling of the vane test in a power-law cement paste by means of the Proper Generalized Decomposition

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ABSTRACT

The effective modelling of the flow of fresh concrete materials in settings such as that of the vane test is a challenging process that is the object of ongoing research. Previous works modelled concrete and cement pastes as solids subjected to yielding or as Bingham or power-law fluids, both in two or three dimensions [1, 2]. Of the existing models, those implementing power-law fluids in three dimensions carry the best predictive ability considering the typically heterogeneous composition of concrete suspensions and the relatively complex three-dimensional features of their flows.

In this work, we model the vane test in a power-law cement paste using the Proper Generalized Decomposition (PGD). In this framework, the three-dimensional problem is solved as a sequence of 2D x 1D problems, thus alleviating the curse of dimensionality. This choice is supported by experience from previous works using the PGD to simulate Non-Newtonian behaviour using iterative resolutions [3, 4]. It is also particularly useful in addressing the inverse problem corresponding to the identification of the material properties of cement pastes from experimental data, as this requires many direct resolutions of the forward problem. The use of the PGD is also appealing because the model parameters can be introduced as extra coordinates of the problem [5].

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