Computational modeling of complex swelling process of foams

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ABSTRACT

A variety of foam products are used in building industry and serve e.g. as thermal barriers, for filling gaps and even for fixing parts like doors and windows instead of more complicated fixing systems. In order to improve, in the sense of handling and efficiency, those products, especially for sensitive applications, a reliable predictive simulation approach is needed. The existing models for intumescent material expanison [1] are almost exclusively limited to the study of 1D problems [2, 3]. This is not surprising as mutli-dimensional models require the inclusion of rheological properties of the expanding material [4] (which is not easy to measure) and the handling of a large number of self-contacts. A robust model for multidimensional expansion would be highly desirable since typical applications of intumescent material involve complex 3D geometries.

The aim of this project is to develop a computational model that is able to simulate filling and expansion processes mostly by heating. Hereby, the topological expansion including the question of fill grad and cavities as well as the pressure rise due to curing is of interest. Since the foam can swell up to 1000% and may interfuse with itself, the numerical description is very challenging. For a robust numerical treatment of potential foam interfusion and self-contacting scenarios, powerful mortar schemes for computational contact and interface mechanics [5, 6] will be employed and further extended. Moreover, the problem will be described in a Lagrangian manner, motivating the development of computationally efficient and robust remeshing technologies.

Keywords: *Finite deformation, mortar finite element method, self-contact, remeshing, large expansion, intumescent material*

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