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# MODELING OF SELF-HEALING PHENOMENA IN A POLYMER MATRIX BASED ON A MICROCAPSULE SYSTEM

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Traditionally, engineers design materials and structures in such a way that they have increased strength and stiffness in order to prevent damage and failures. But natural materials, like skin or tree bark, can deal with failures in a more efficient way: they heal by themselves. Inspired by these naturally self healing mechanisms, the field of research with respect to manufactured self healing materials growth steadily in the last years. For example, White *et al.* [1] developed a self healing system with microencapsulated healing agents and catalysts embedded in a polymer matrix. If a crack breaks through such a capsule, the healing agents flow into the crack and polymerize due to reaction with the embedded catalysts, which leads to the closure of the crack and, hence, regaining of a certain amount of strength and stiffness.

In this contribution we focus on the numerical simulation of both, the microcapsule as well as the vascular system based polymer structures using the Theory of Porous Media (TPM). The model consists of four different phases: solid matrix material with embedded catalysts, liquid healing agents, solid healed material and air. The amount of catalysts inside the matrix is described by the concentration. For the description of damage behavior, a discontinuous damage model is used. Furthermore, in view of the change from liquid healing agents to solid healed material, a mass exchange between these two constituents is introduced, dependent on the concentration of catalysts. Finally, the applicability of the developed macroscopic four phase model is presented by means of numerical examples, e.g. the tapered double cantilever beam (TDCB), cp. Brown *et al.* [2], where we are able to simulate the macroscopic behavior in a qualitatively good sense, see Fig. 1.

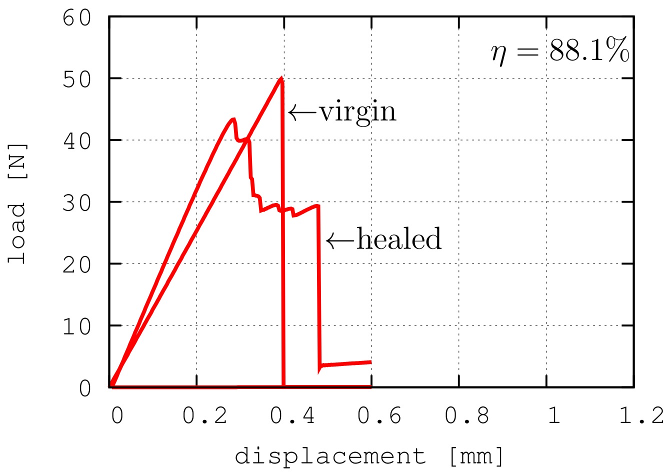


Figure 1: Load-displacement curve of a self-healing TDCB with enclosed microcapsules and a healing efficiency $\eta$ of 88.1%.

## REFERENCES

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