

## MODELLING BY HOMOGENIZATION THE EFFECTIVE BEHAVIOR OF A FRAGILE MATRIX REINFORCED BY SWELLING INCLUSIONS

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This work is devoted to the modelling by homogenization methods of the mechanical behavior of a particulate composite (inclusions distributed in the matrix). Here, a swelling is prescribed to the inclusions within the composite and we want to model the internal stresses induced by this loading. A previous work [1] built up a model where the phases obey an elasto visco-plastic behavior (creep). This work focuses onto the damage behavior of the matrix and more precisely onto its brittle damage behavior. A piecewise linear damage model, proposed previously to describe the behavior of brittle materials, is adopted [2].

Then, this damage model is applied to the scale of the phases to represent the fragile behavior assuming that the evolution of damage of a phase is driven by its stress average. An inelastic strain standing for the contribution of damage is added to the elastic strain. Then, either this strain is assimilated to a free strain (Kroner approach [3]) or the strain rate is linearized (Hill approach [4]). The macroscopic behavior is established with the Mori-Tanaka homogenization scheme [5]. These two approaches are subsequently compared and it turns out that they are equivalent, for the considered particular loading (swelling prescribed to the inclusions) since they yield the same damage onset criterion and damage evolution law. Nevertheless, comparisons with full field computations highlight the tendency for the analytical model to overestimate the damage onset. That is why another analytical model is proposed assuming that the damage onset as well as the damage evolution are driven by the second moment of the stress over the matrix. As expected, comparisons with full-field computations show that the damage onset occurs sooner than for the previous model. However, both of the models above struggle with the modelling of the damage evolution. In order to overcome this issue, another model based upon an energy balance between the stored elastic energy and the dissipated one at the end of the failure is proposed. Forthcoming comparisons with full field computations are carried out to assess the relevance of the proposed approach.

### REFERENCES

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