

Motivation

Develop models for self-healing cementitious and polymer materials, in order to:

- describe the phenomenology of the experiments
- complement the material characterization and understand experimental set-up
- parameterize the self-healing behavior

Validate models with experimental data, based on crucial collaboration with the different research groups in SECEMIN and SEPOCOM

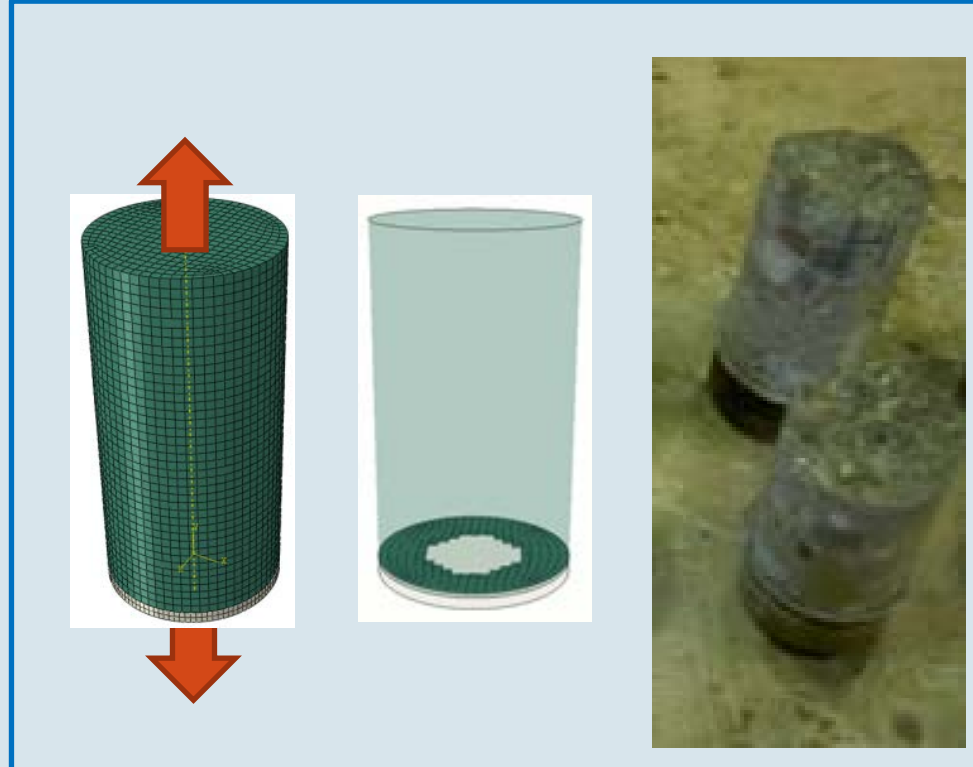
Valorization

- Strong collaboration between the different research groups.
- New acquired knowledge in fracture mechanics, solid-fluid problems, and design of new experimental set-ups.
- Numerical models expandable to other research scopes.
- Spill-over: M3Strength and Nanoforce projects.

Mechanical characterization of:

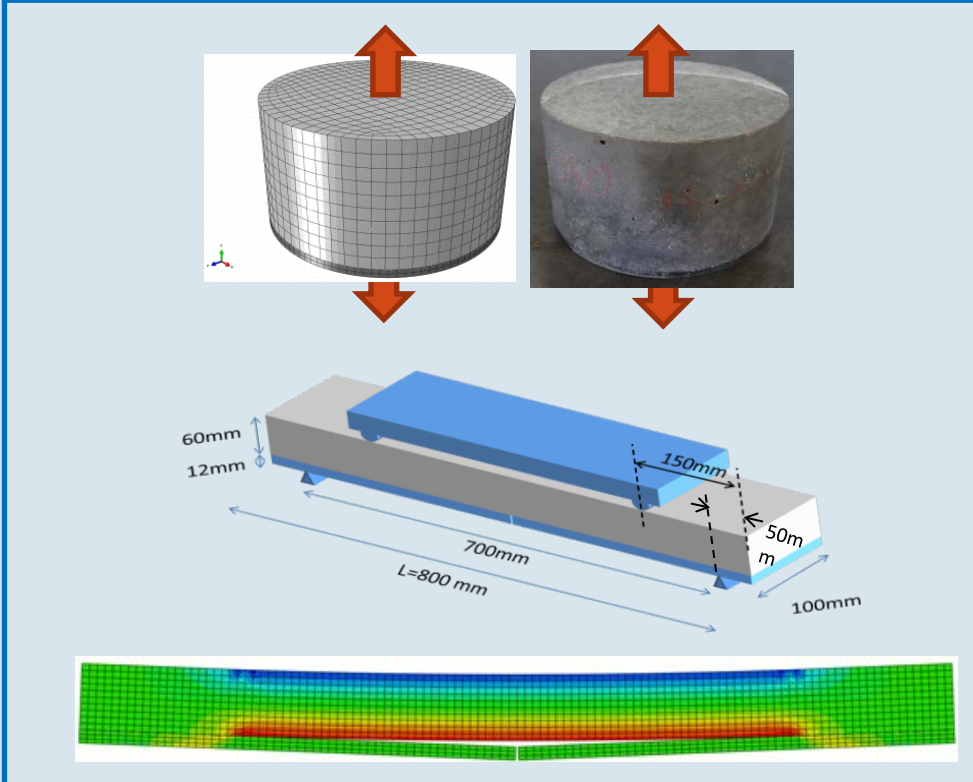
Elasticity and strength of concrete

- FE models of the experimental set-ups.
- Mechanical properties fitted with experiments.



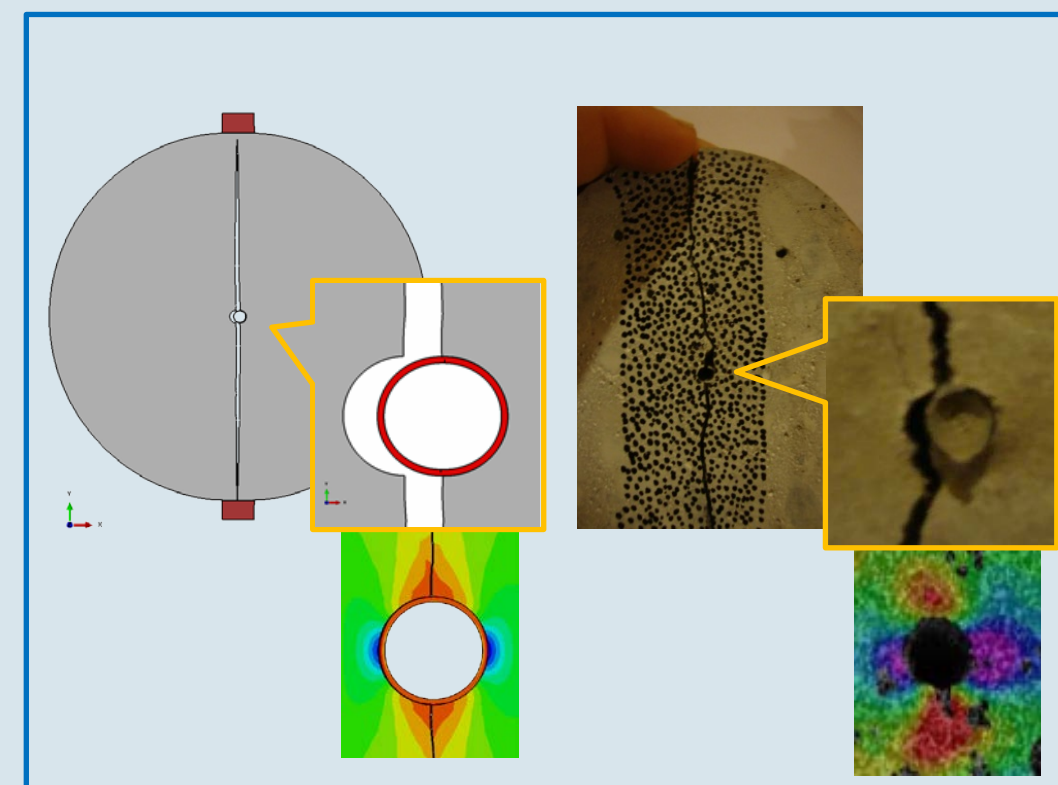
Glass-concrete interface

- New set-up based on 4 points bending test to improve the interface measurements.



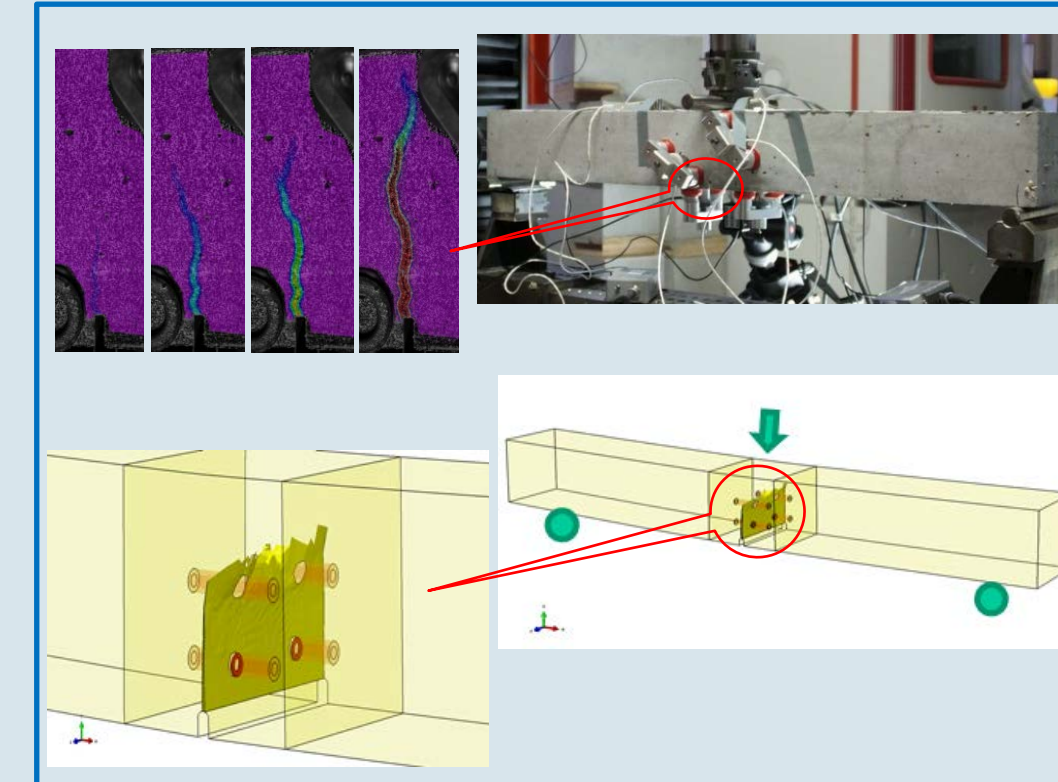
Interaction crack-capsules

Split test

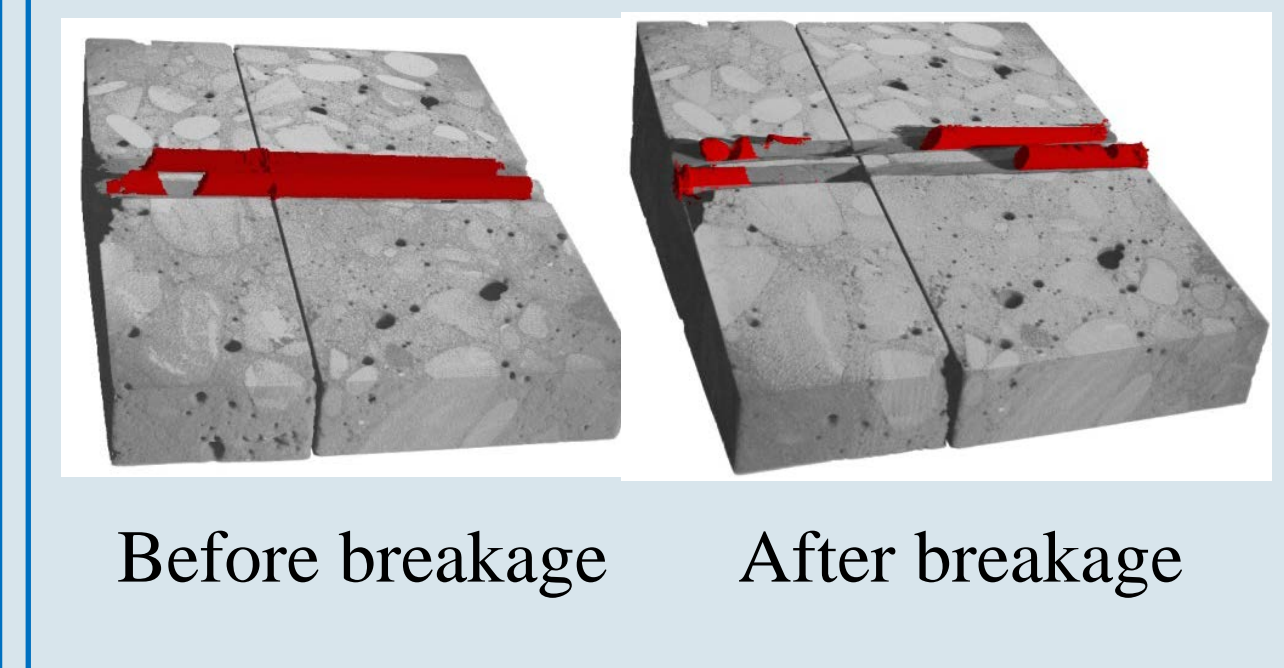
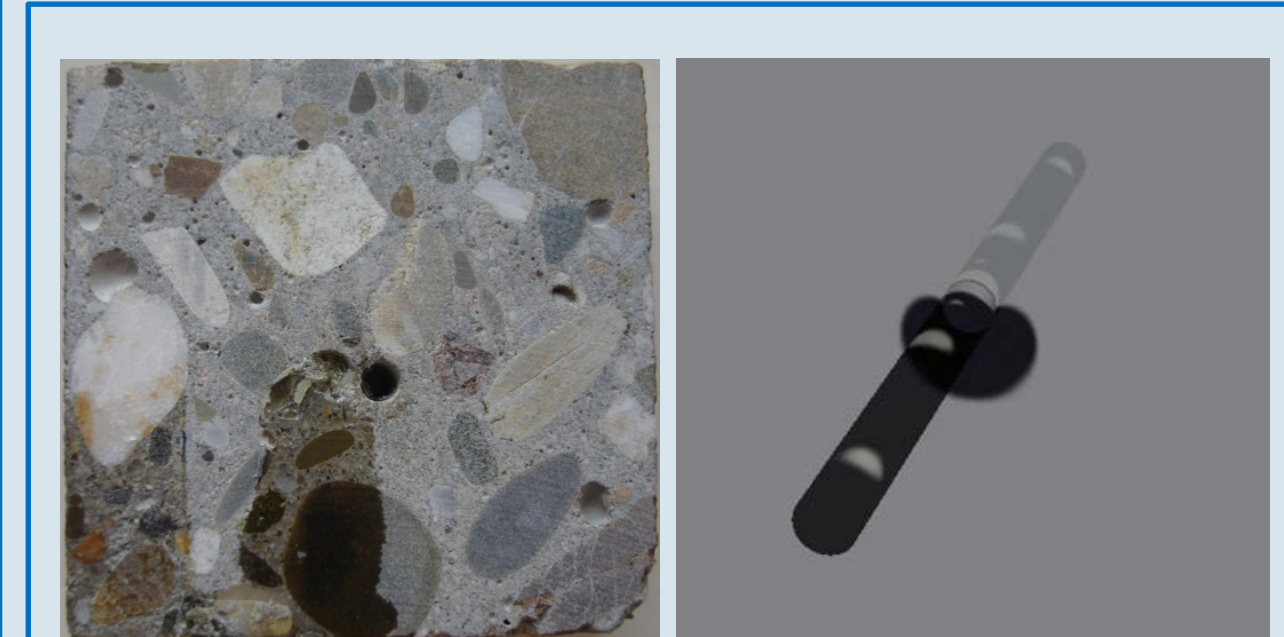


Bending test

- Crack propagation simulations.
- Model with XFEM and cohesive surfaces.
- Validate models with the experiments.

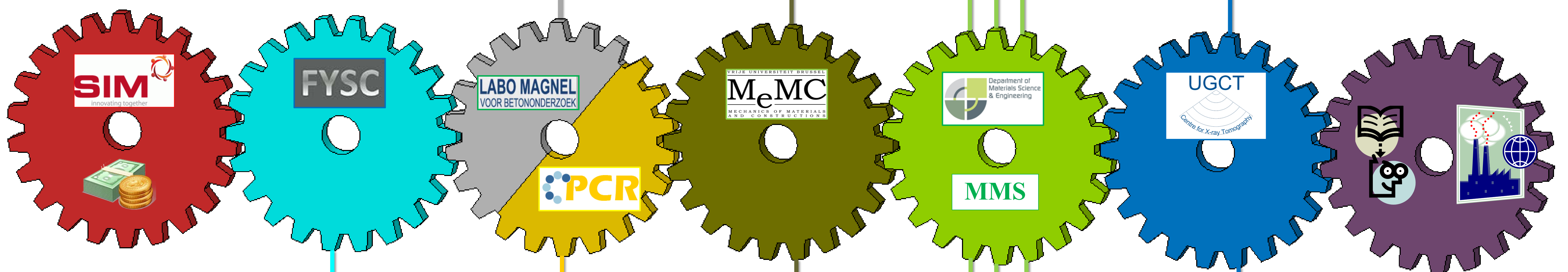


Leakage of healing agent from capsules in concrete



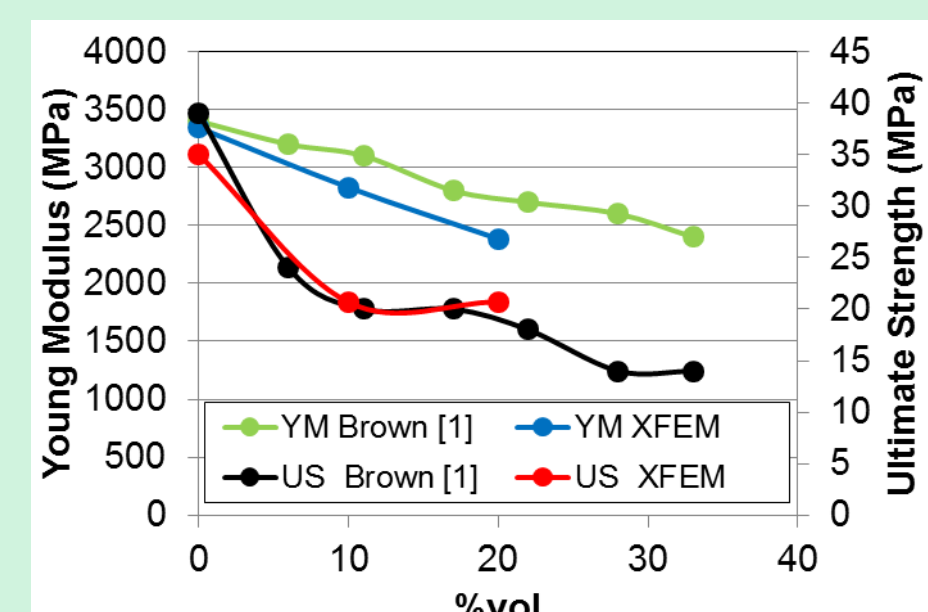
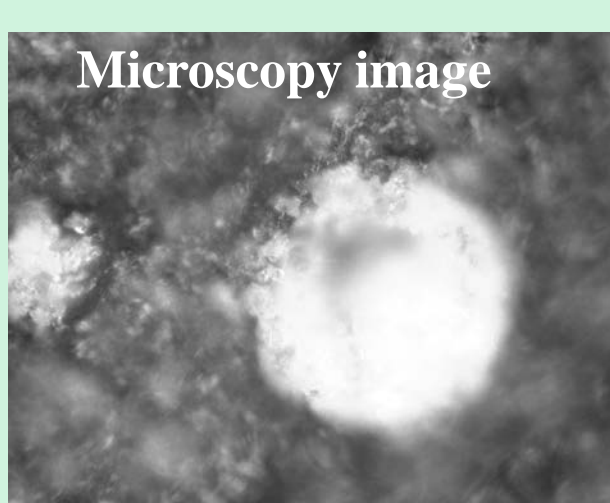
- 3D fluid dynamic model.
- New specific set-up to observe the leakage with micro-CT scan.
- Experiments and simulations are in good agreement.

SECEMIN

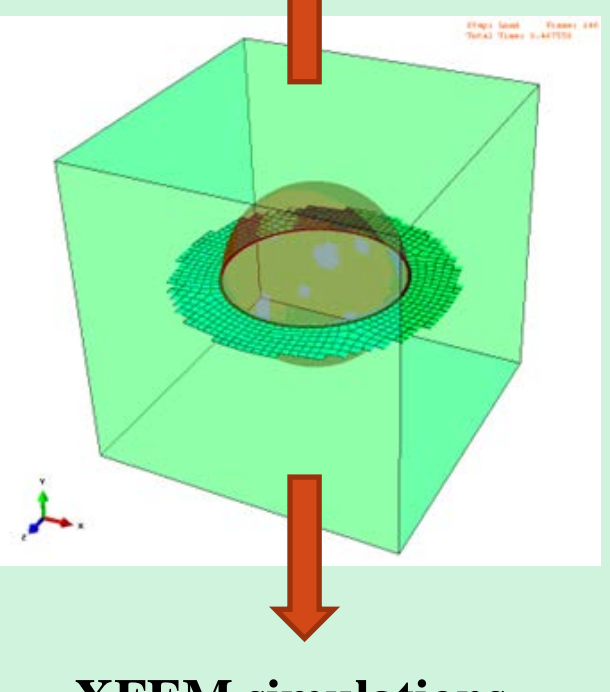


SEPOCOM

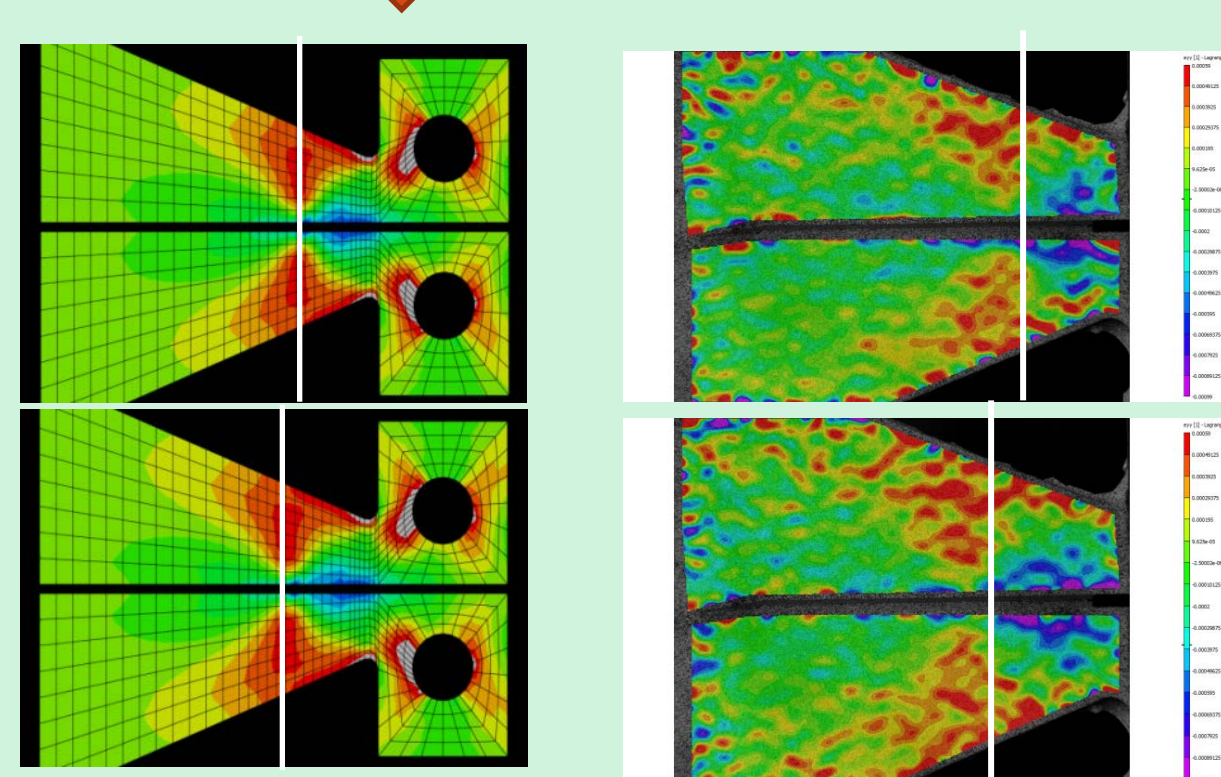
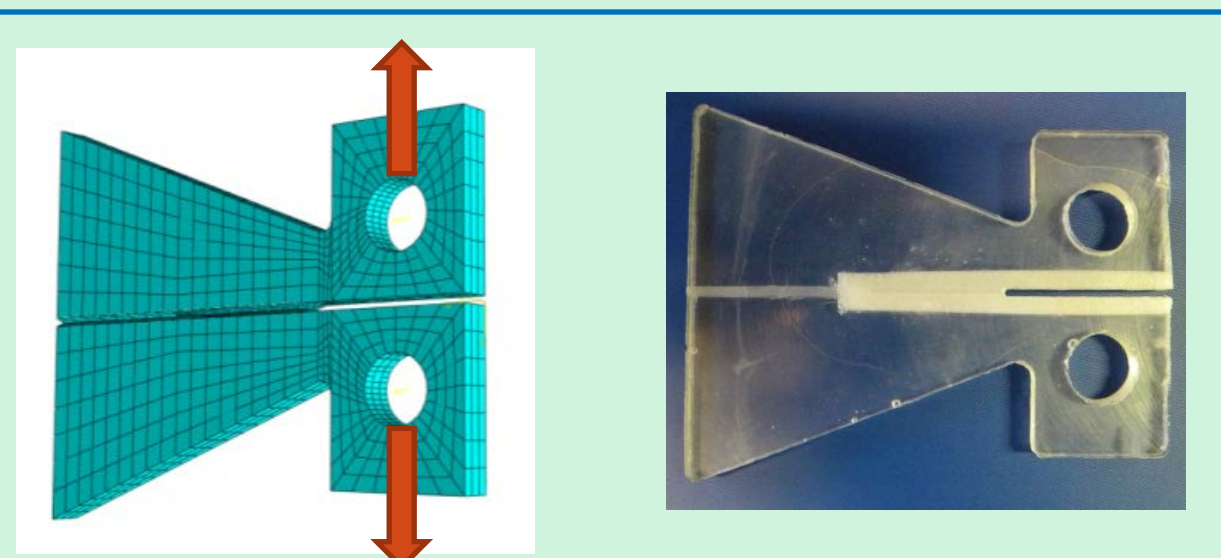
Mechanical characterization of polymer with microcapsules



- Representative model of capsule-matrix based on XFEM
- Mechanical properties decrease when the microcapsule volume fraction increases.
- Simulations compared with experimental data.



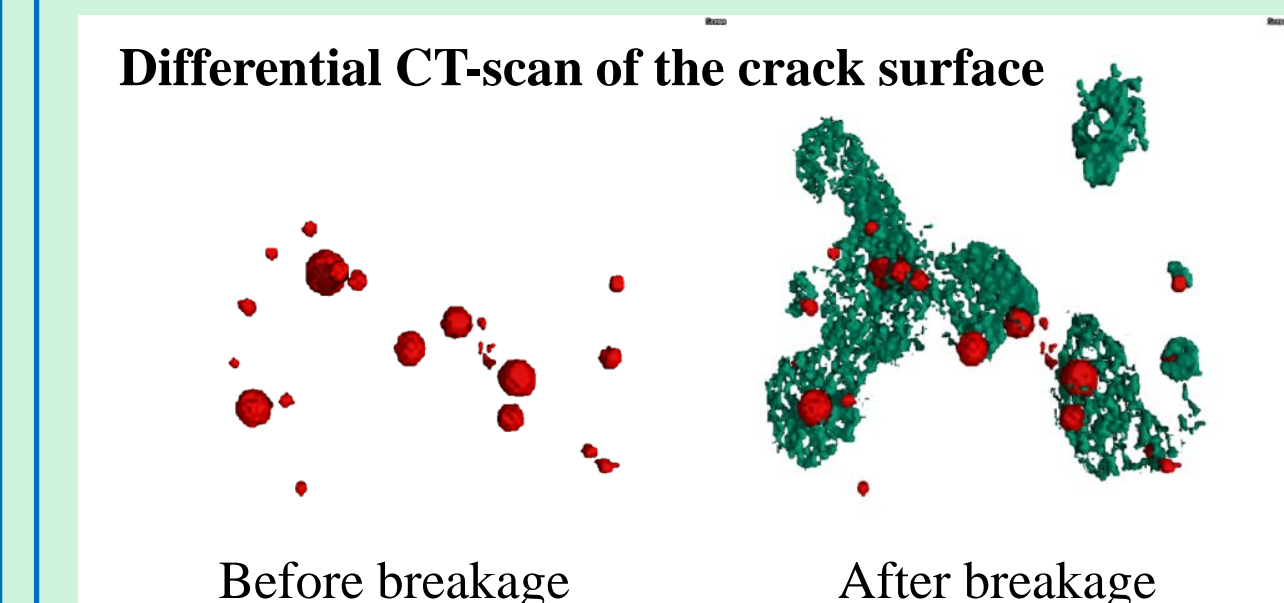
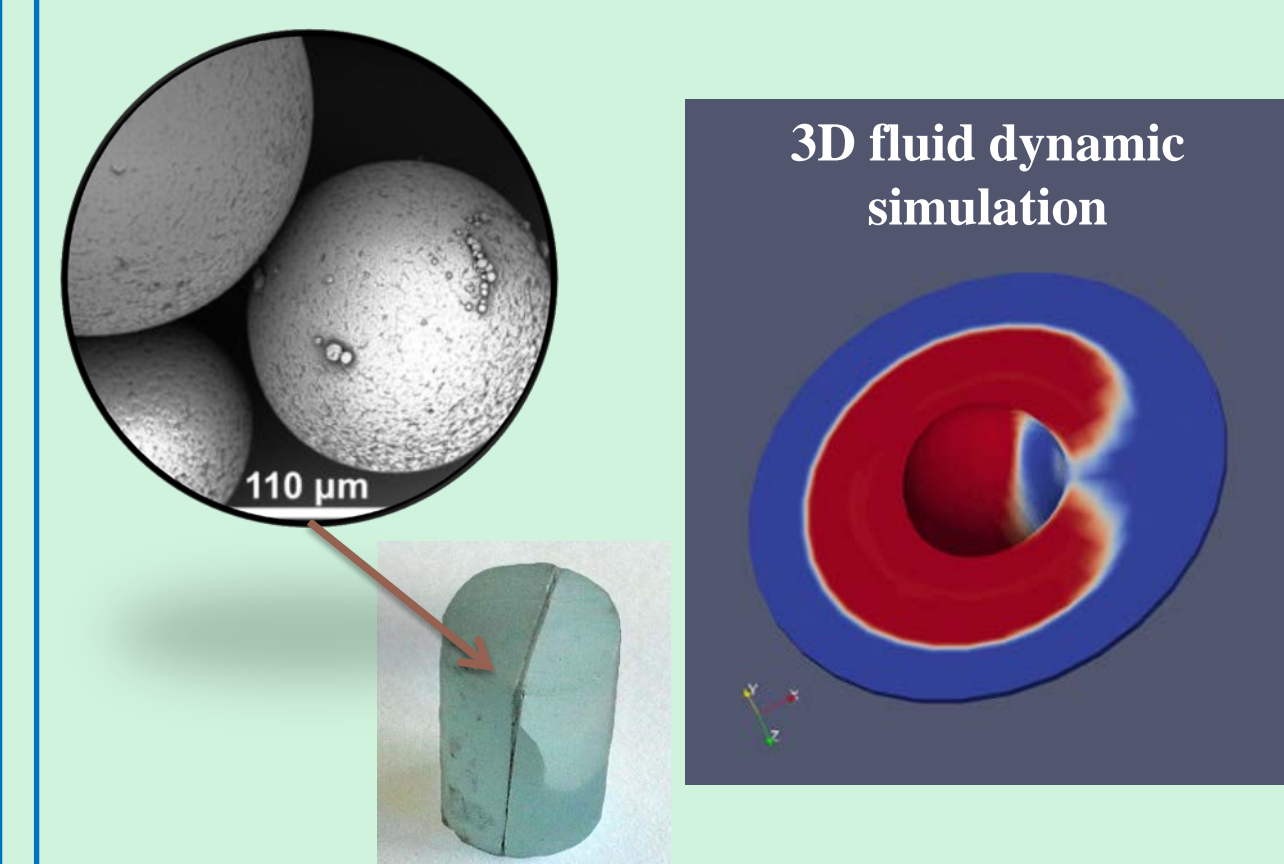
Crack propagation in TDCB for self-healing polymers



XFEM simulations Digital Image Correlation (DIC)

- Detail model of TDCB based on XFEM.
- Unstable crack propagation.
- Good agreement between simulations and DIC experiments.

Leakage of healing agent from micro-capsules in polymers



- 3D fluid dynamic model of one microcapsule.
- New set-up to observe the leakage with micro-CT scan.
- Experiments and simulations are in good agreement.

Reference

[1] E. N. Brown et al. *Journal of Materials Science* **39** (2004) 1703-1710.

Acknowledgements

Thank you to the researchers Eleni Tsangouri, Xanders K. D. Hillewaere, Kim Van Tittelboom, Elke Gruyaert, Jianyun Wang, Jeroen Van Stappen, Hannelore Derluyn, Jose A. Ramos; with your experimental data the models have landed into the real world.

Conclusions

- Research projects with strong collaboration between different research groups enhance the final results.
- Modelling is a gear that speeds up the research mechanism, improving the experiments and adding scientific knowledge.