Validation of XFEM Hydraulic Fracturing Model with Experimental Results from PMMA Mixed Mode Fracturing - MS Code 82

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ABSTRACT

In this paper, the fracturing of polymethyl methacrylate (PMMA) will be simulated using a model developed for crack propagation in hydraulic fracturing. Figure 1 shows the initial and final configurations of a 4-crack hydraulic fracturing simulation around a wellbore. A bilinear cohesive traction was used to model opening at the crack tip, and the crack path is shown to reorient itself in the direction of the maximum in-situ stress as it propagates. Figure 1 demonstrates that the model is capable of handling the propagation of multiple cracks in plane strain conditions. The model was developed using the eXtended Finite Element Method. As a form of validation of this XFEM model, the code will be repurposed in order to simulate the fracturing of PMMA under a compressive load, as tested in [1]. Figure 2 shows the experimental stress in the vertical direction from the DIC analysis at the final loadstep [1], assuming a typical value for the elastic modulus of PMMA. These results will be compared against the XFEM simulation.

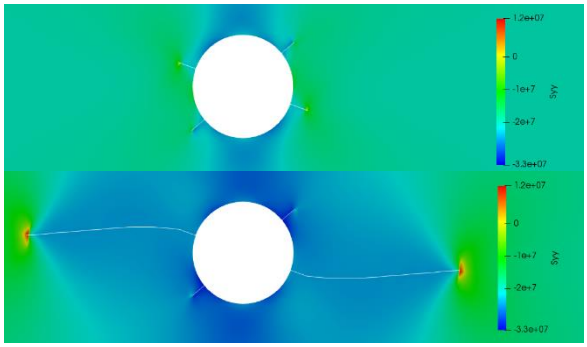

Figure 1: Initial and Final Configuration of a Hydraulic Fracturing Crack Simulation

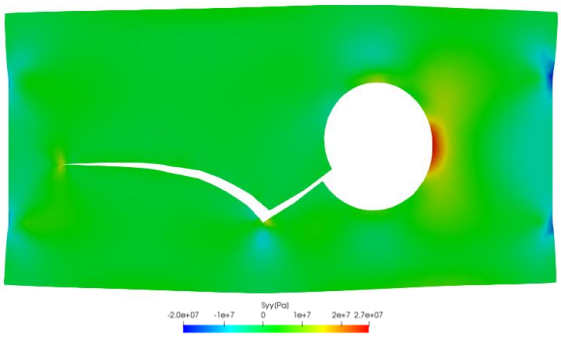

Figure 2: Experimental Stress in the Vertical Direction of Fractured PMMA at Final Loadstep (E = 3.1 *GPa*, Displacement ×5)

REFERENCES

[1]. Réthoré, J. (2018). PMMA Mixed mode fracture (Version 1.0) [Data set]. Zenodo. http://doi.org/10.5281/zenodo.1473126