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FRACKING PROCESSES IN POROUS MEDIA EXTENDED

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Hydraulic fracturing in porous media, such as soil and rock, came into play in the late 1940s and found its application in the oil and gas industry, the exploitation of deep groundwater sources and deep geothermal energy plants. Fracking in non-saturated and saturated porous media is an important area of research, since these methods are widely used in practice.

In contrast to the application of fracking techniques, the theoretical and computational description of this method, especially in saturated soil and rock, is still in its infancy. To overcome this situation, the present contribution aims at describing the basic fracking process in saturated porous materials. The derivation is based on the well-founded Theory of Porous Media (TPM) [1] and includes a permeable rock-like material saturated with water. Evolving cracks as a result of fracking [2, 3] are included in the description by enhancing the TPM by the phase-field approach to fracture [4], where the phase field itself is used for the detection and evolution of single cracks and crack fields, which are mainly driven by the pressure of the fracking fluid. This method is enhanced by the crack-opening indicator in order to distinguish between opening and closing cracks as well as to include pre-fractured domains in the phase-field approach.

By use of the solver PANDAS, which has been created for the solution of strongly coupled problems in extended continuum mechanics, numerical examples with 2-dimensional and 3-dimensional geometries exhibit the possibilities of the overall procedure.

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