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Hydraulic Fracturing Simulations using a Homogenized Continuum Approach

Recent development in shale gas extraction has made it increasingly important in a worldwide scenario. Shale gas production is currently over 20% of overall gas production in the U.S, and over the next few decades this number will perhaps double. In Argentina, the Vaca Muerta oil field is estimated to be the third largest shale gas reserve in the world, with an alleged 802 trillion cubic feet of recoverable gas. All in all, this data paints a future in which a lot of research and development will be made to minimize production costs and maximize the revenue obtained by said extraction. Due to the low matrix permeability of shale rock, a very important factor in unconventional gas production is hydraulic fracturing. Parameters defining how the fracture occurs are intimately related to how much the reservoir will produce, and taking in consideration the costs of on-site experimentation, numerical solutions for this problem are much striven for. This paper shows a new approach, developed by Dynardo GmbH, on how to model hydraulic fracturing efficiently through FEM. Traditional methods usually rely on discrete fracture modeling, making it overly expensive to model an actual three-dimensional reservoir. The proposed method relies on a homogenized continuum approach in which fractures are calculated at a material level, and therefore provide a means of obtaining a solution in a reasonable amount of time. Due to the confidentiality of reservoir data, two fictional test cases were simulated as basis for this paper. These cases are used to show how the method works and what type of results and conclusions can be obtained by using this approach.