Second International Workshop on the Finite Element Code LAGAMINE (LAGASHOP 2018)
31 January – 2 February 2018 | Delft University of Technology

Modelling with interface elements of the permeability alteration of coal due to sorption

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Abstract:

The porosity system of coal consists of two key parts, fractures (termed cleats) and much smaller pores in the matrix [1]. Any change of the cleat network likely modifies the permeability of the material. For instance, the aperture of the fractures may be affected by the evolution of the gas content adsorbed in the matrix [2]. Indeed, coal swells (or shrinks) due to the gas sorption (or desorption).

This work aims to present a numerical model at the scale of the matrix blocks and the fractures. These fractures are modelled with interface elements [3] specially adapted to manage sorption/desorption by taking into account the Langmuir's isotherm [4]. In the matrix blocks, the sorption strain is assumed proportional to the adsorbed gas content [5]. Depending on the boundary conditions, sorption strain affects the stress state and thus the fracture aperture.

This model was implemented in the Lagamine code in 3D for gas saturated conditions and in 2D for unsaturated conditions in the fractures. Contrary to a macroscale model previously presented [6], this model does not require the use of shape factors since the geometry is explicitly represented. This numerical model allows to model experimental tests such as swelling and permeability tests carried out in laboratory. Once the model at this scale is validated with the experimental campaign, it could be integrated in a multiscale approach for the modelling at the scale of a reservoir.

References:

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