Finite Swelling and Fracture of Biological Tissues, Hydrogels and Shale: A Micro and Macro Analysis

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ABSTRACT

Swelling is a common phenomenon in both biological media, geomaterials and synthetic materials. It is often associated with ionized molecules that attract counterions that in turn attract water through osmosis. The ionised molecules are clay platelets in shale and proteoglycans in biological tissues. Since antiquity, diagnosis of disease has been done partly through observation of swelling of tissues. Swelling is often linked to fracture. This lecture will highlight the present understanding of the phenomenon and numerical simulations performed on finite swelling of ionised porous media as well as the interface conditions along fluid boundaries. The inclusion of fracture propagation is done though a new XFEM-technique particularly suitable of hydraulic fracturing problems. Results from experiments and computational mechanics will be presented and compared.

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