15th World Congress on Computational Mechanics (WCCM-XV)
8th Asian Pacific Congress on Computational Mechanics (APCOM-VIII)
31 July–5 August 2022, Yokohama, Japan

Numerical study on the hydrate rich sediment behaviour during depressurization

Sahil Wani [1*], Rahul Samala[2], Ramesh Kannan Kandasami[1] and Abhijit Chaudhuri[2]

[1] Department of Civil Engineering, Indian Institute of Technology Madras, Chennai, India,
*ce20d750@smail.iitm.ac.in

[2] Department of Applied Mechanics, Indian Institute of Technology Madras, Chennai, India

Key Words: Gas pressure, depressurization, multi-phase flow, saturation, THMC

Natural gas hydrates have been investigated for past several years as a potential resource for commercially producing gas. The stable condition for the formation of gas hydrates sediments i.e., high pressure and low temperature generally occurs in deep-sea and permafrost regions. The methane gas extraction from the hydrate-bearing sediments was carried out by drilling and using various dissociation methods. The dissociation methods include thermal injection, depressurization, and chemical injection, which will cause a significant loss of solids in the pore space of geomaterials after extraction. The loss of solids will eventually reduce the reservoir strength, leading to borewell wall collapse, causing subsurface landslides (Collett et al., 2002).

The behavior of gas hydrate sediments is governed by coupled Thermo-Hydro-Chemo-Mechanical (THMC) response during the gas extraction process. In this study, in order to understand the coupled behavioral response of hydrate rich sediments, a 2D hydrate reservoir is simulated (using a multi-phase numerical schema) and analysed under axis symmetric conditions. The initial results suggests that the rate of change of gas pressure near the well bore decreases with the increase in the duration of the extraction. Further, the maximum settlement occurs near the seabed level while the rate of settlement decreases with time. The maximum shear stress generally occurs near the well bore which results in associated maximum volumetric strains. Thus, the continuous gas extraction results in highly porous medium which is stabilized primarily due to the geomechanical changes.

REFERENCES

[1] Collett, T. S., 2002. Energy resource potential of natural gas hydrates. AAPG bulletin 86 (11), 1971–1992.