National Institute of Technology Rourkela

Departmental Seminar

Seminar Title	: Conference Return Seminar : Influence of Rock Heterogeneity on Carbon Sequestration
Speaker	: Vislavath Rahul
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Venue	: CE Seminar Hall
Date and Time	: 08 Jan 2025 (11:20am)
Abstract	: This paper explores the crucial role of rock heterogeneity in carbon sequestration processes, employing computational modelling through COMSOL software which is a FEM-based Multiphysics-based software. The study investigates how variations in hydrological rock properties, such as porosity and permeability, along with its mechanical properties, such as elasticity and cohesion etc., impact the efficiency of carbon capture and storage (CCS) in the subsurface. Diverse geological scenarios will be analysed through numerical simulations to assess their suitability for long-term carbon storage. Rock heterogeneity, often overlooked in traditional CCS models, plays a fundamental role in the dynamics of CO2 sequestration within subterranean environments through both mineral and mechanical sequestration. Variations in hydromechanical properties can significantly affect the physical behaviour of carbon dioxide after injection, influencing how it migrates through porous media and interacts with rock formations. The study employs a multi-physics-based approach to model these interactions, integrating principles of fluid dynamics, heat transfer and rock mechanics to simulate the behaviour of CO2 sequestration in various subsurface conditions. Key physical analyses include the study of fluid flow within porous media, pressure distribution and changes, the mechanical stress response of rock formations to injection processes, and the thermal impacts associated with deep underground CO2 storage. Rock heterogeneity is expected to significantly influence the distribution and movement of injected CO2, affecting its retention and potential leakage pathways. Additionally, the study highlights the importance of considering geological complexities in site selection and CCS operational parameters such as injection rate, pressure, cap-rock integrity and temperature to optimize the carbon sequestration process and mitigate environmental risks such as the unintended release of CO2 back into the atmosphere and induced seismicity. Insights from this research contribute to advancing our understanding of subsurface carbon storage mechanisms and informing sustainable strategies for combating climate change.