IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Optimal wellbore configuration for gas hydrate reservoir systems**	
Project Number	**IMURA0816**	
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Research Clusters:

Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? *(Please nominate JUST **one.** For more information, see www.iitbmonash.org)*		**Highlight which of the Academy's Theme(s) this project will address?** *(Feel free to nominate more than one. For more information, see www.iitbmonash.org)*	
1	*Earth Sciences and Civil Engineering (Geo, Water, Climate)*	***1***	*Advanced computational engineering, simulation and manufacture*
		2	*Clean Energy*

The research problem

Natural gas hydrate is a potentially vast energy resource for the future. However, the fundamental behavior of hydrate dissociation during energy recovery is not fully understood due to the complex interplay of phase change and multiphase flow within porous media. In particular, this study aims to understand these processes in the context of sediments from a select Indian basin. In India alone, methane hydrate reserves such as those found in the Krishna-Godavari and Andaman basins, are present in such a quantity that production from even 10% of these reserves is sufficient to meet the

country's demand for a century. As of yet, no commercial production of gas from methane hydrates worldwide has been possible as research is still ongoing to find an efficient and economically feasible way of extraction.

Conventional approaches deploy a single wellbore scheme to implement dissociation through thermal stimulation or depressurization. A single wellbore scheme has to overcome forced convection and cooling caused by the fluid flowing back to the wellbore. The endothermic dissociation of hydrates also reduces the temperature, which may result in the reformation of hydrates at a constant pressure. In addition, as the dissociation front increases radially from the wellbore, there may exist the possibility of a decrease in the temperature gradient and an increase in the pressure gradient, which may lead to the hydrate reaching a stable phase and preventing the occurrence of further dissociation. On the other hand, forced convection as in the case of horizontal wellbore and dual wellbore production, improves the heat transfer within the dissociating region; leading to significant increases in gas production levels. This research plan aims to design an optimal wellbore configuration with the dual wellbore and horizontal wellbore configurations as the basis and expects to achieve still higher levels of gas production, energy efficiency ratio, while controlling water production levels.

Project aims

The project aims are as follows:

1. In-depth understanding of coupling between fluid flow and mechanical deformations in gas hydrate bearing sediments
2. 3D reservoir scale simulations with varying hydrate saturations as per data pertaining to the Krishna Godavari Basin.
3. Numerical modelling of hydrate reservoirs with different wellbore orientations, well placements and combination of production techniques in order to yield optimal wellbore configuration.

Expected outcomes

The present study would help in understanding the physical processes responsible for gas hydrate dissociation as well as mechanism of heat transfer and fluid flow set up in the reservoir during production processes. By conducting a sensitivity analysis based on production scale parameters such as wellbore orientation, level of depressurization and thermal stimulation, well spacing etc., the study aims at bridging the gap between current cost efficiency of production from methane hydrate reservoirs and bring it to economically feasible levels.

How will the project address the Goals of the above Themes?

This project addresses the themes like clean energy, and advanced computational engineering, simulation and manufacture.

Capabilities and Degrees Required

A BTech/M.Sc./M.Tech degree in Geology, Geophysics, Mechanical, Petroleum Engineering. Background in numerical modelling will be preferred.

Select up to **(4)** keywords from the Academy's approved keyword list **(available at http://www.iitbmonash.org/becoming-a-research-supervisor/)** relating to this project to make it easier for the students to apply.

Geo Science, geotechnical, geomechanics (7)
Modelling and Simulation (37)