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Multiphase flow modelling in fractured reservoirs using a novel computational fluid dynamics approach.

HAWEZ, H., SANAEE, R. and FAISAL, N.H.

2021

Multiphase Flow Modelling in Fractured Reservoirs using a Novel Computational Fluid Dynamics Approach

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Ph.D. Candidate: Haval Kukha Hawez, *School of Engineering, Robert Gordon University*

Principal Supervisor: Dr. Reza Sanaee, *School of Engineering, Robert Gordon University*

Co-Supervisor: Dr. Nadimul Faisal, *School of Engineering, Robert Gordon University*

Outline:

- Aims and Objectives
- Introduction
- Problem Statement
- Methodology
- Results and Discussion
- Conclusions

Objectives

- To demonstrate the accuracy of two different mathematical methods developed for the discrete fracture matrix (DFM) model.

Introduction

- Modelling of naturally fractured reservoirs (NFRs).
- Multiphase fluid flow take place while production in the subsurface.
- The physical properties of the multiphase flow is governed by conservation of mass, momentum and energy.

Introduction

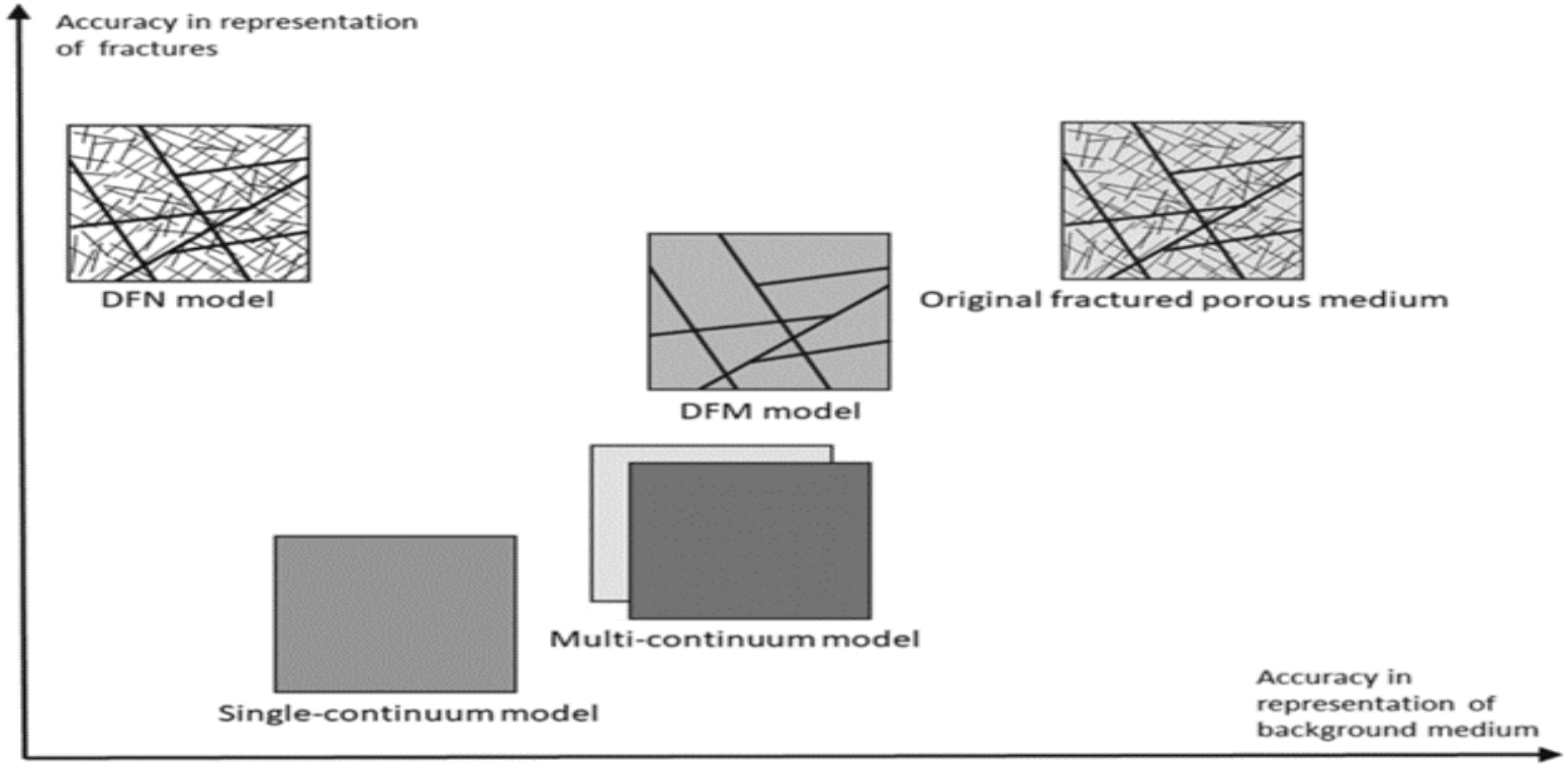


Figure: Illustrating the fractured porous media model concepts .

Problem Statement

The lack of understanding the fracture-matrix hydro-mechanical interaction that causes a rapid decline in the initial production rate and unfavorable recovery factor.

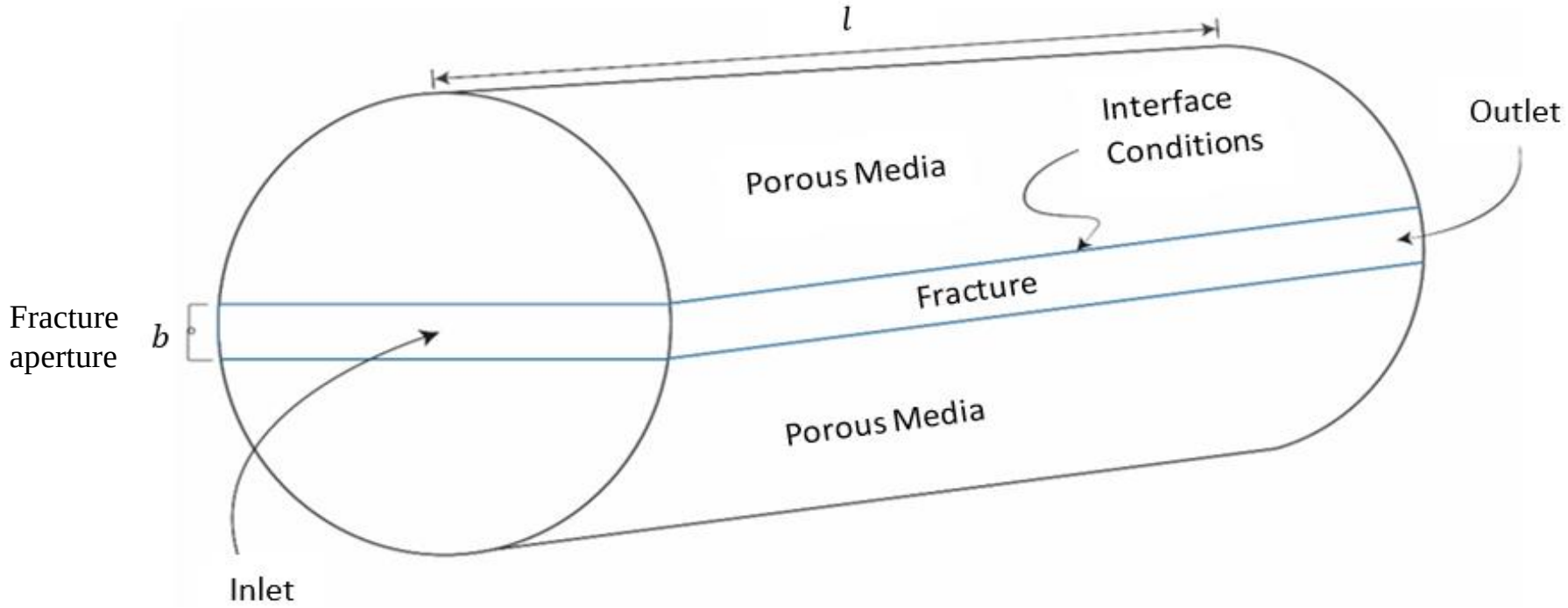


Figure: Shows a 3D fractured core model

Methodology

1. Mathematical Formulation
2. Numerical Modelling
3. Numerical Experiment

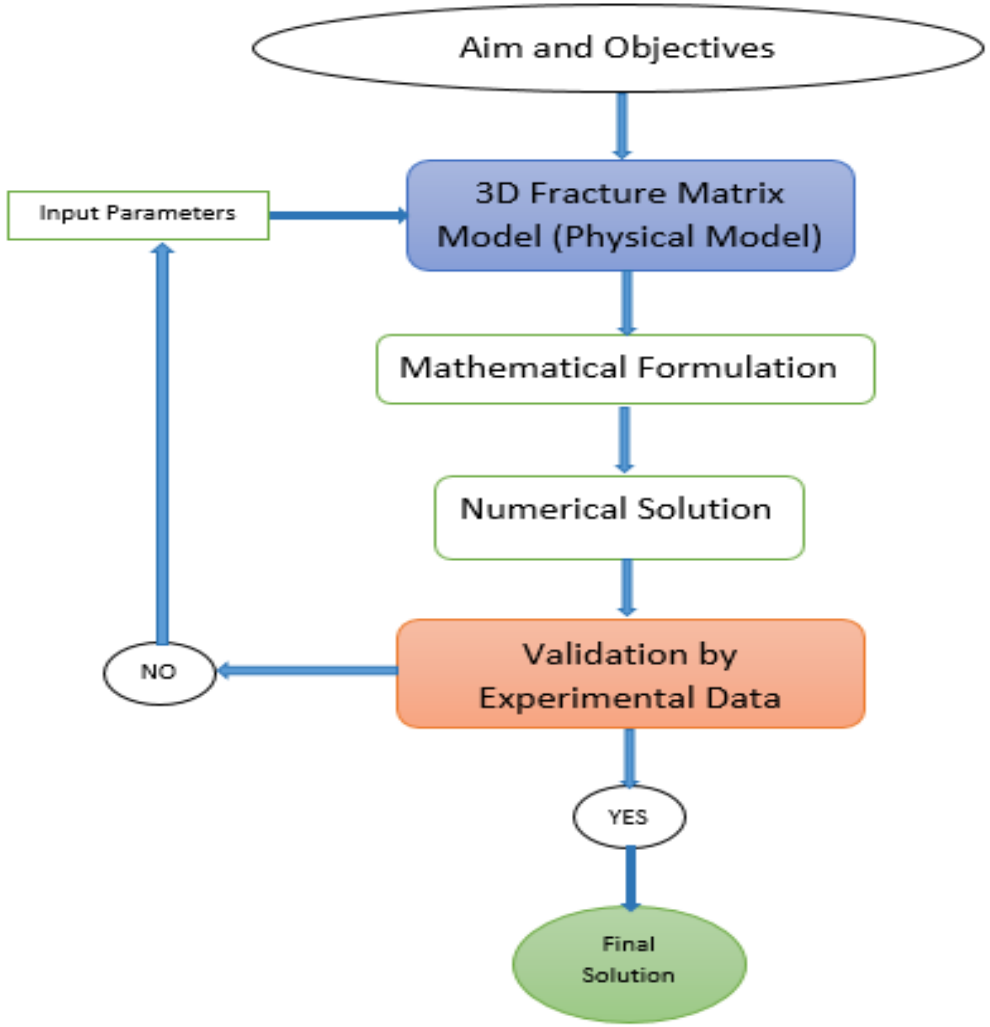


Figure: Shows the simulation workflow diagram.

Methodology

Model 1

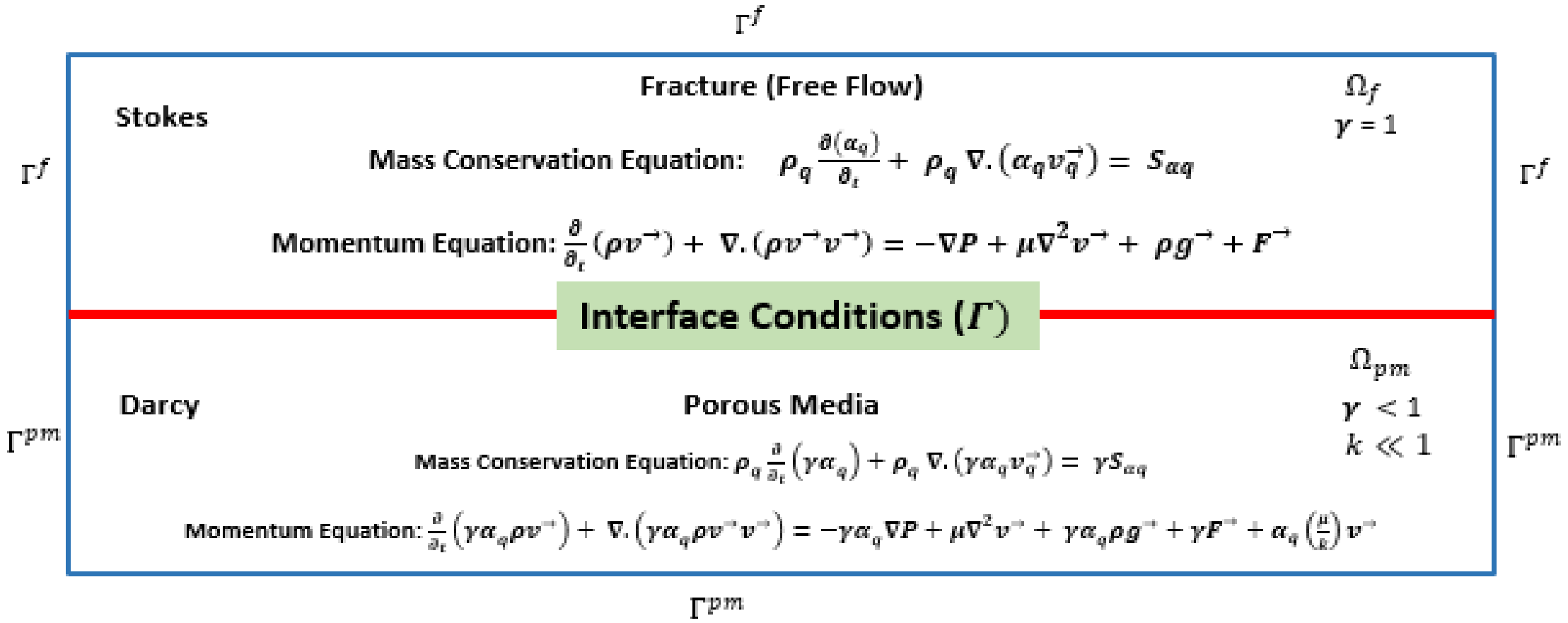


Figure: Shows the concept of two domain coupling (Fracture and Matrix).

Numerical Modelling of Multiphase Flow in Fractured Reservoirs

Model 2

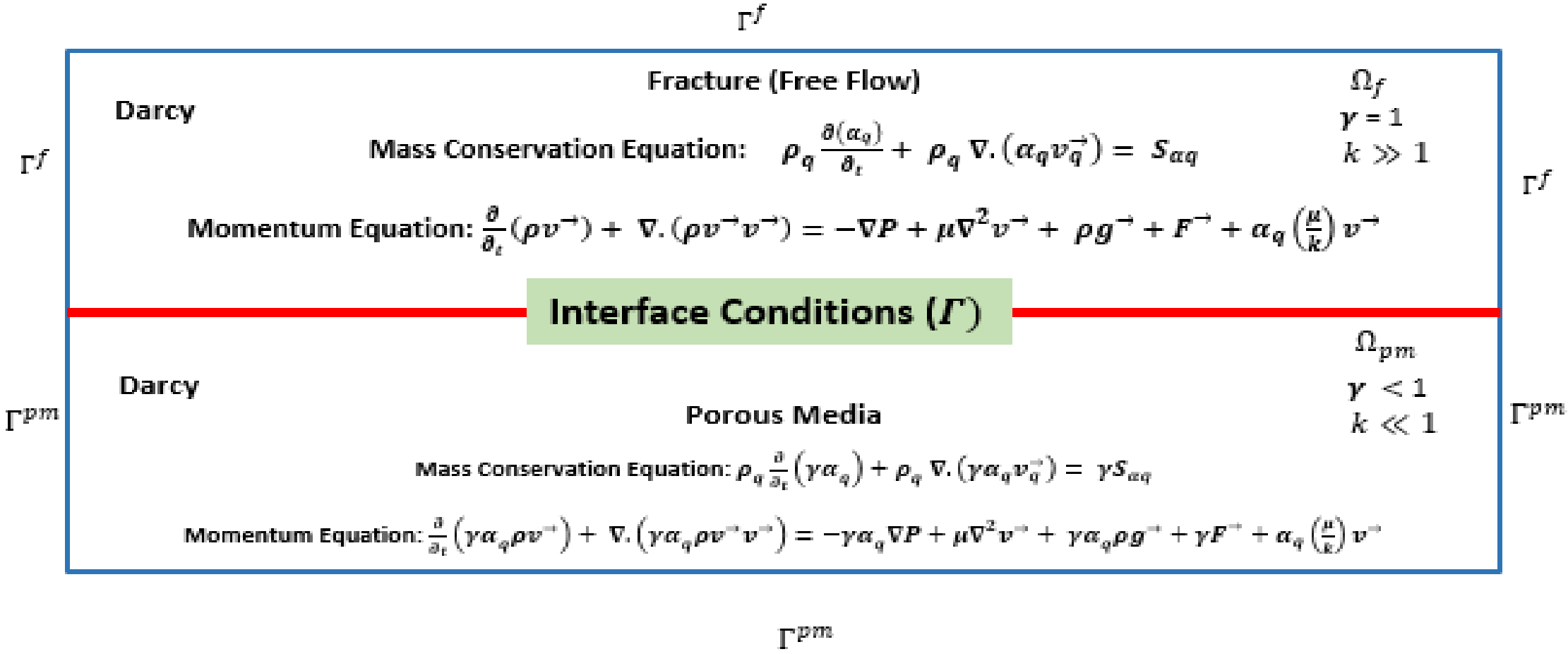


Figure: Illustrates the concept of two domain coupling.

Mesh Sensitivity Analysis

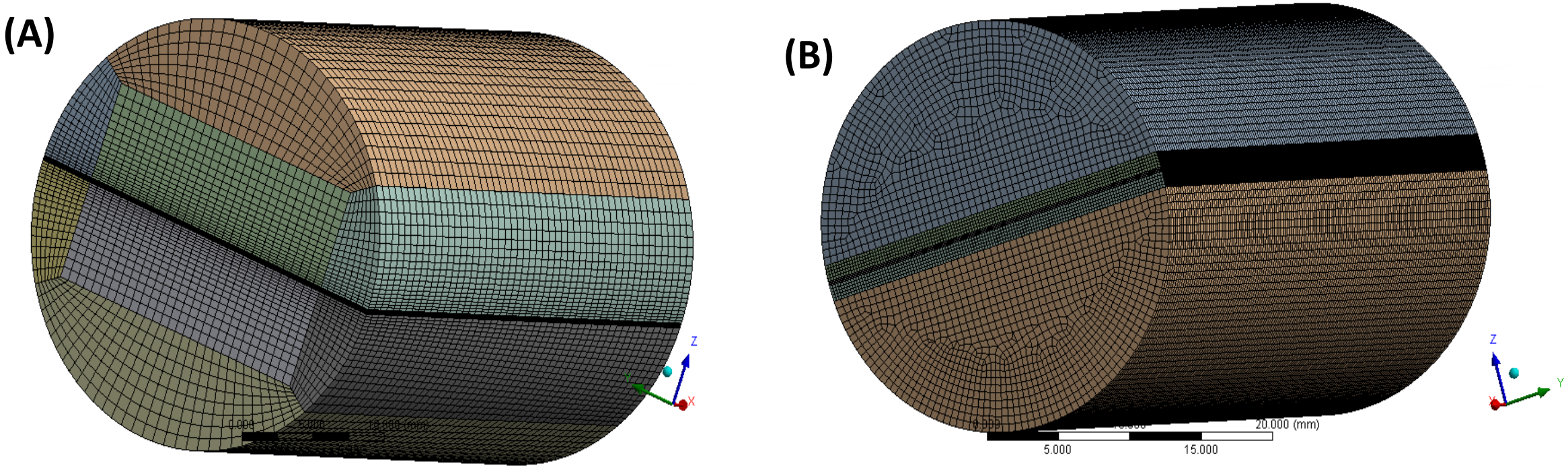
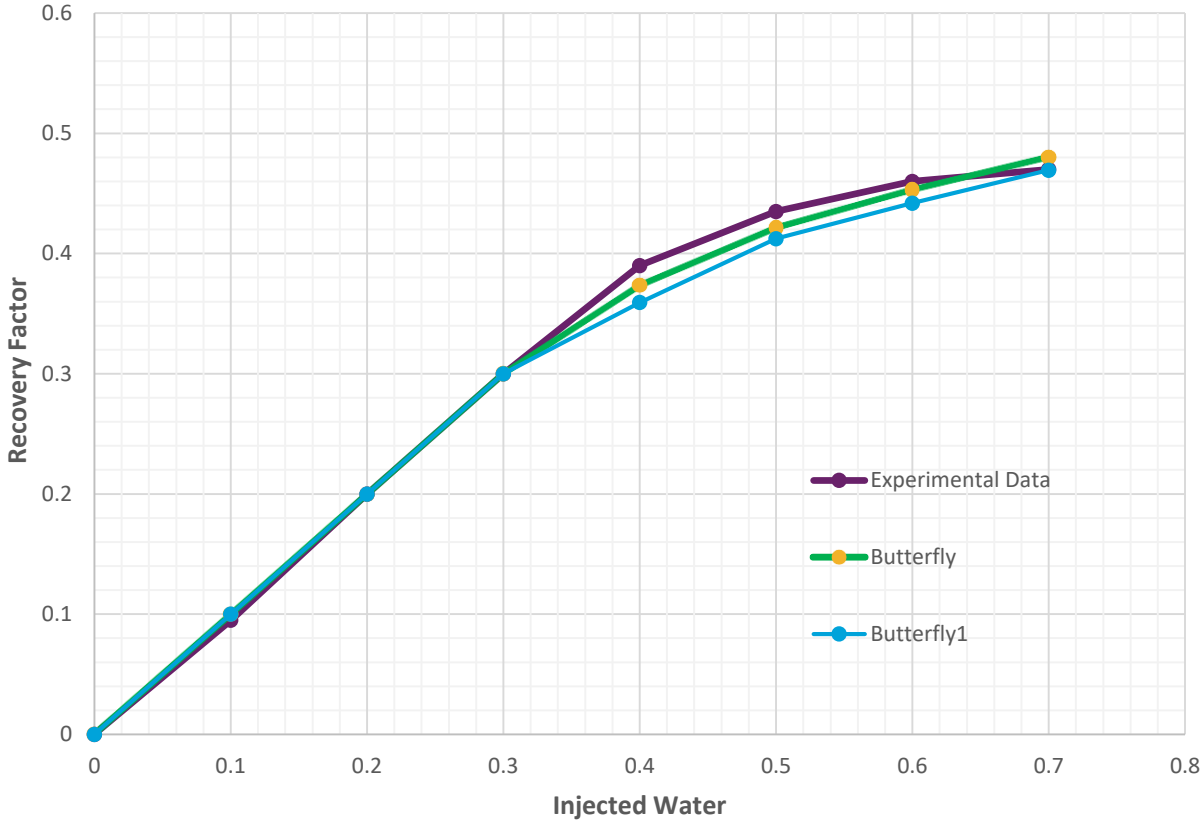


Figure: Shows (A) the Butterfly structured meshing (B) the Semi O-ring meshing.

Mesh Sensitivity Analysis

(A)



(B)

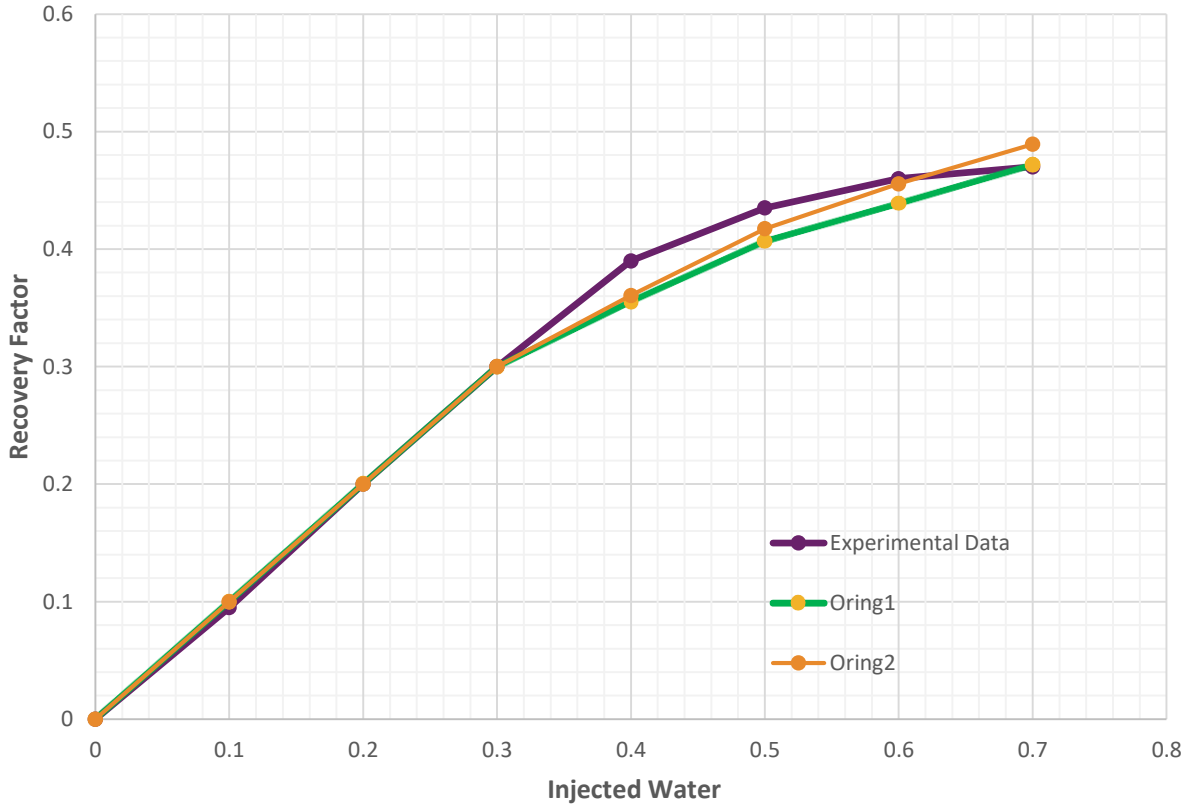


Figure: Shows the result of experimental data with **(A)** the Butterfly structured meshing **(B)** the Semi O-ring meshing.

Validation

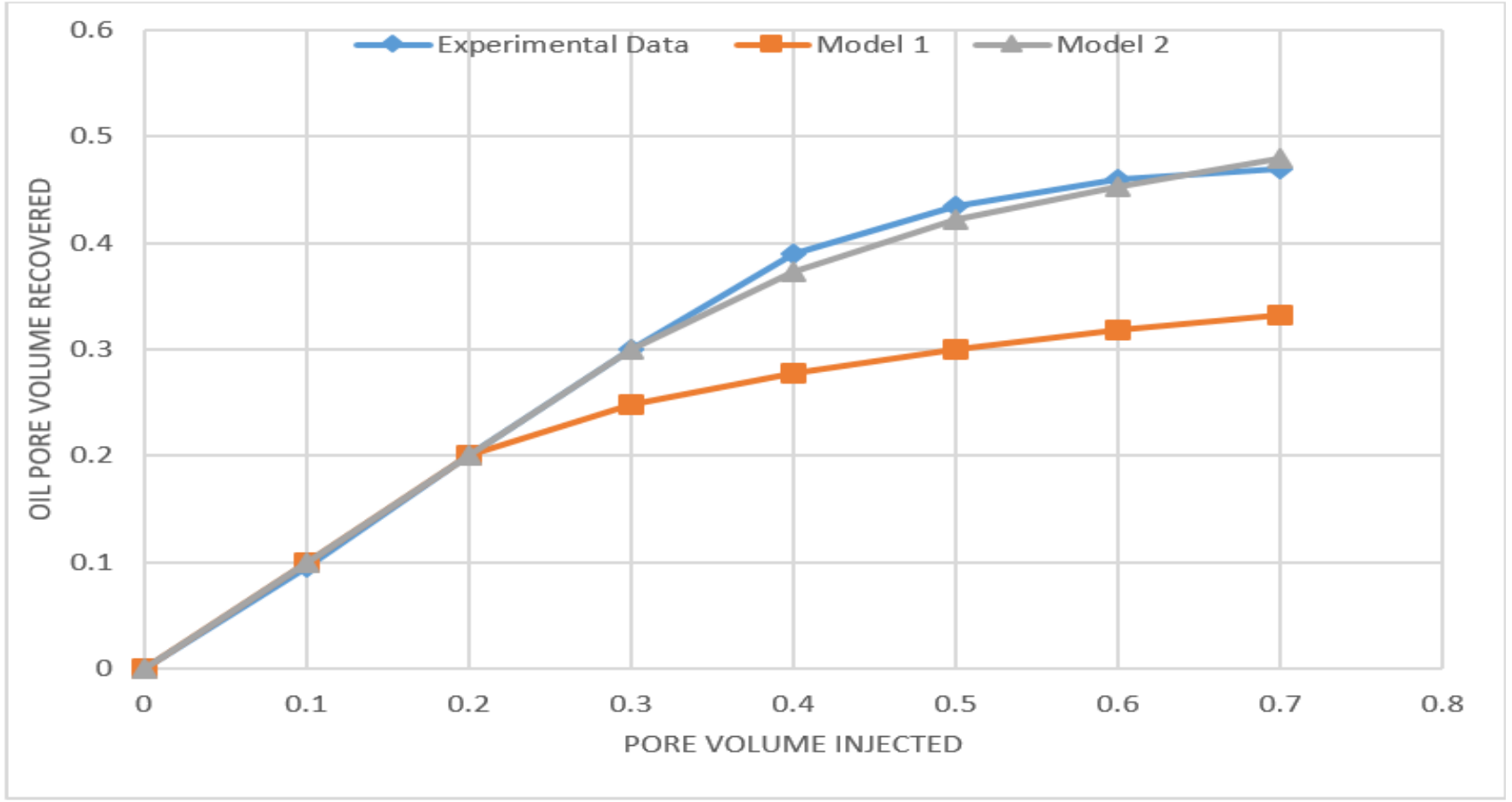
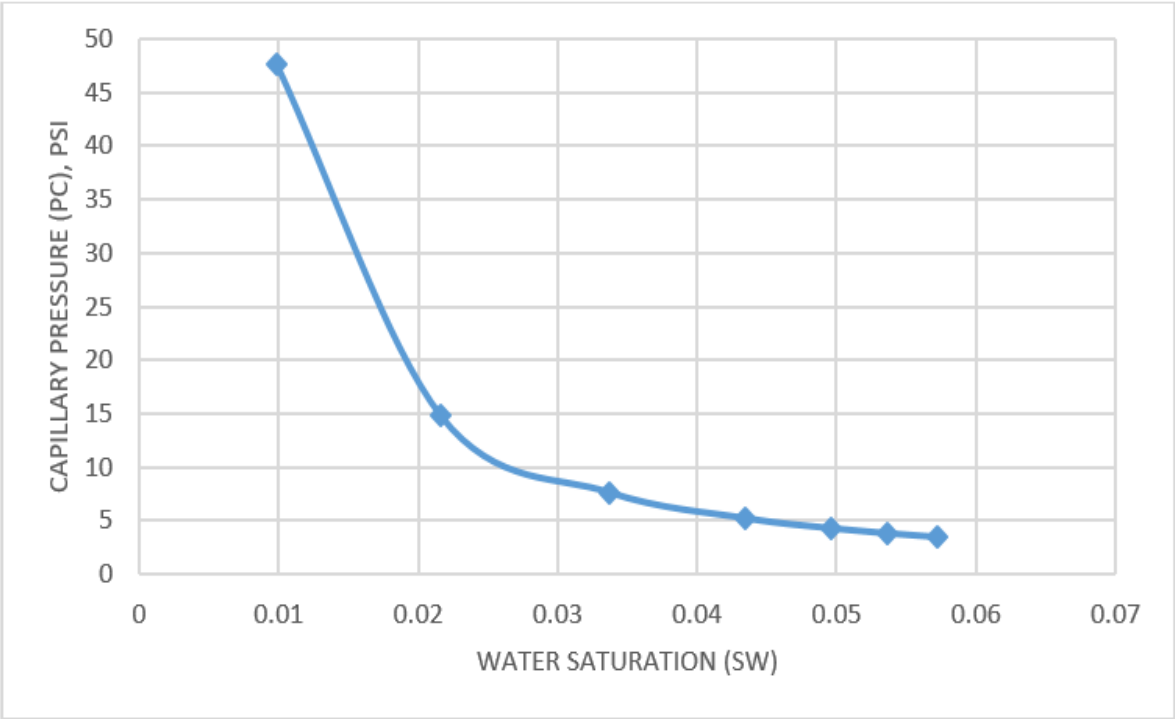


Figure: Comparison of the cumulative outflow results found from the Model 1 and Model 2 with the Berea Sandstone core flooding experimental data.

Results and Discussion

(A)



(B)

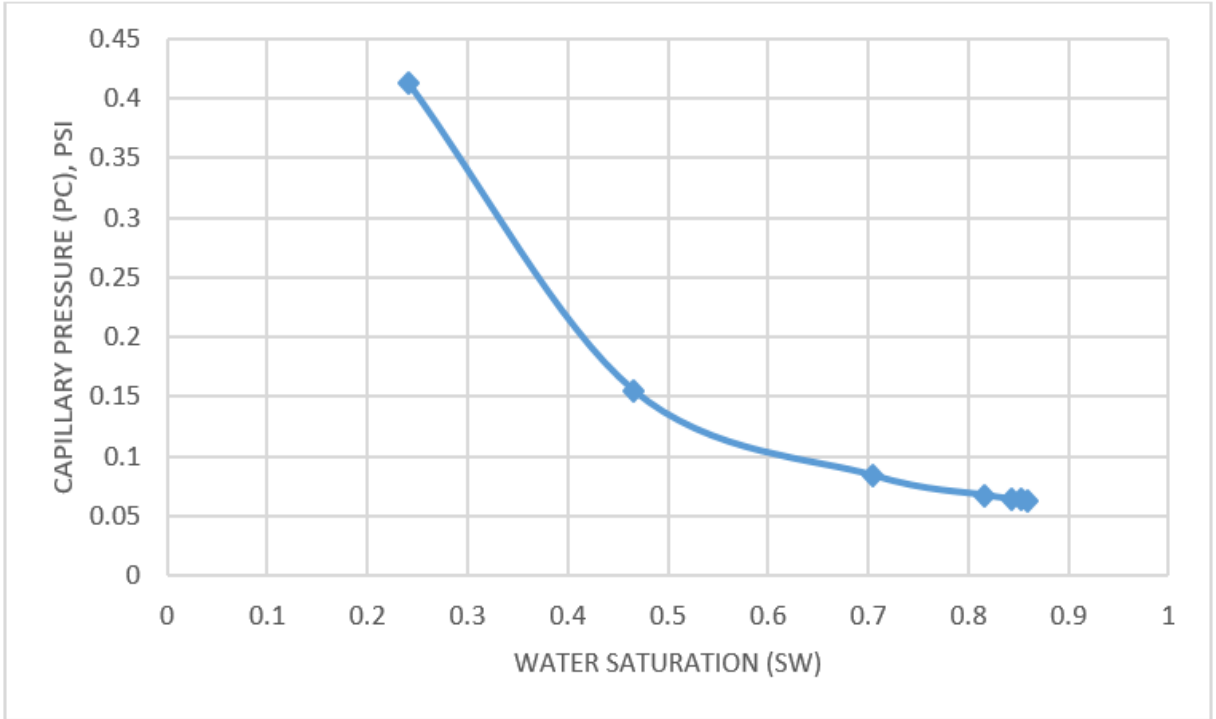


Figure: capillary pressure vs. water saturation within **(A)** the porous matrix **(B)** at fracture matrix interaction after injecting of 70 per cent of the pore volume.

Results and Discussion

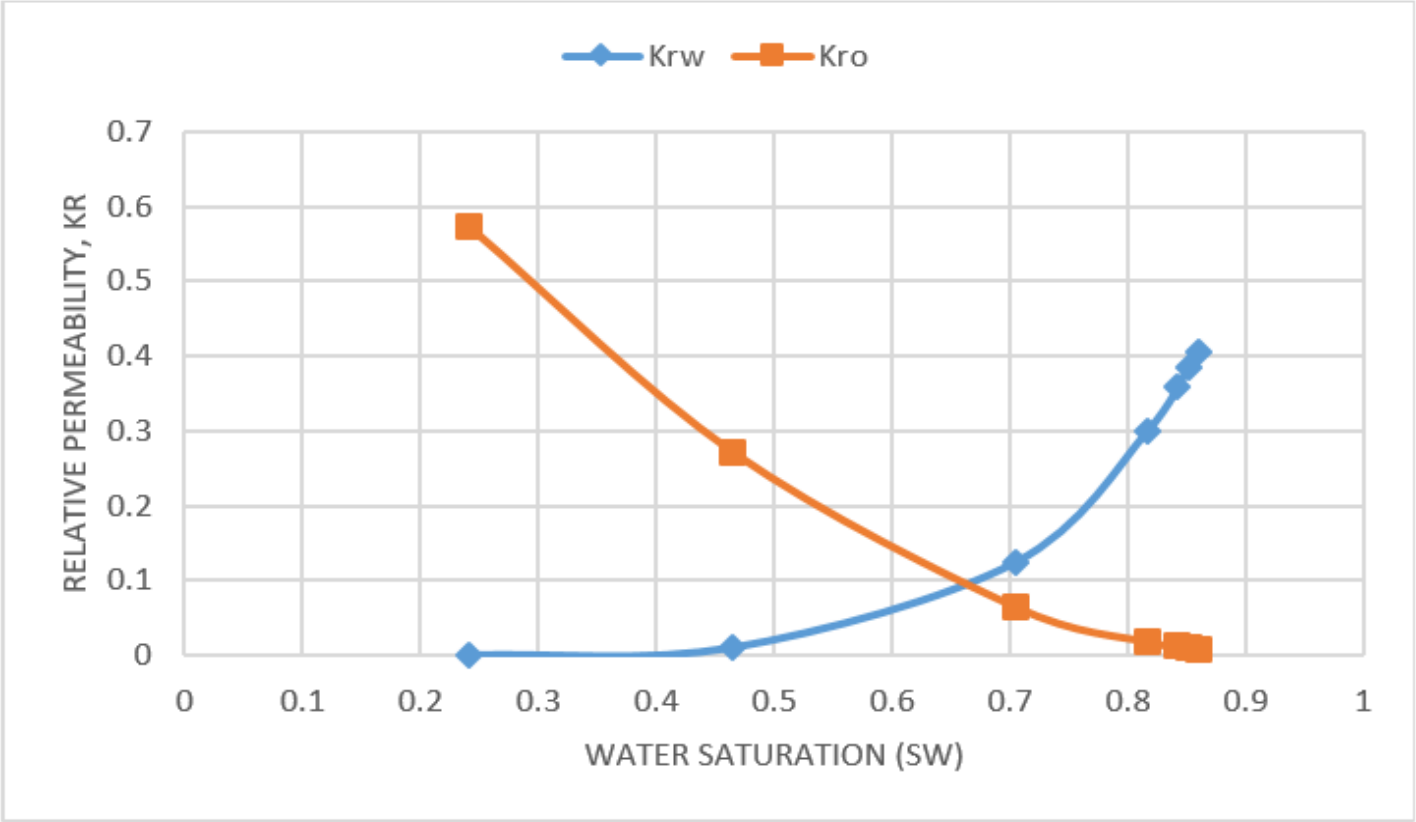


Figure: Relative permeability versus water saturation at fracture matrix interaction after injecting of 70 per cent of the pore volume

Results and Discussion

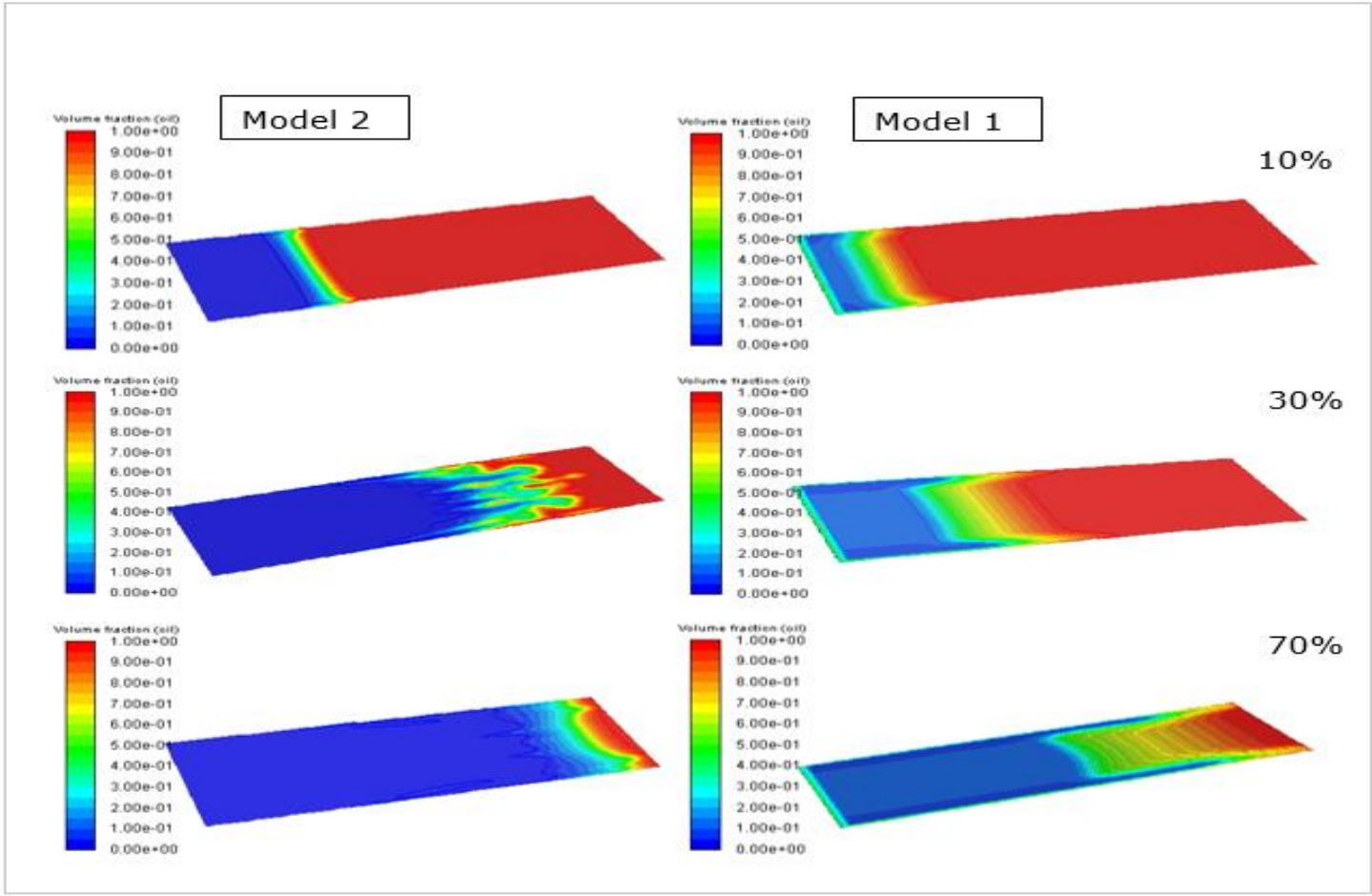


Figure: Comparison of the oil volume fraction results found from the Model 1 and Model 2 at fracture matrix interface after injecting of 10%, 30% and 70% of the pore volume respectively.

Conclusions

- Modelling of naturally fractured reservoirs are still a challenging issues.
- The multiphase flow behavior should be explored at fracture matrix interface to reduce GOR and water cut.
- The coupled geomechanics and fluid flow are recommended for fractured and tight rock reservoirs.