

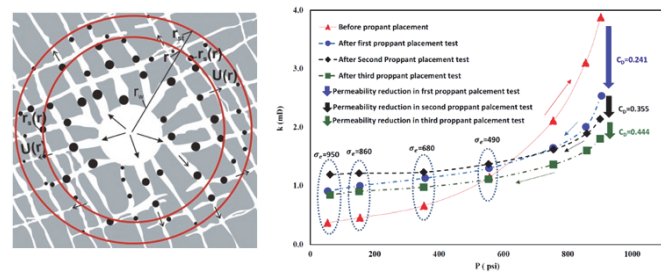
Influence of elastoplastic embedment on CSG production enhancement using graded particle injection

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Introduction

Negative responses in well productivity related to production / drawdown has been observed in the Bowen and Surat basins.

Graded particle injection (GPI), which uses staged injection of microscale particles coupled with improved modelling of hydraulic fracturing treatments, can improve post-fracturing results in low-permeability coal intervals.

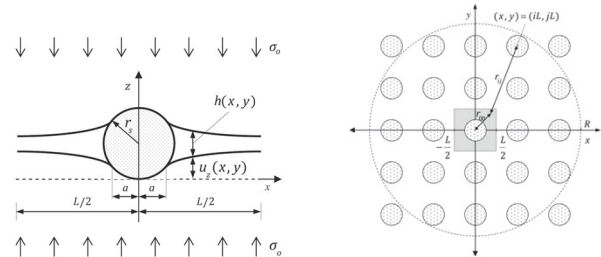


Methodology

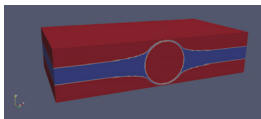
Elastoplastic finite element model (FEM): Predicts the embedment and surface deformation under a range of packing densities, closure stress and material properties.

Lattice Boltzmann method (LBM): Simulates the fluid flow within fractures and calculates fracture permeability with particle embedment.

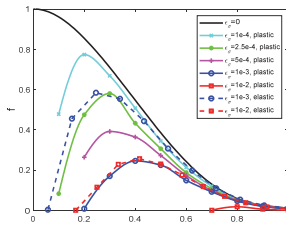
Mathematical model for axisymmetric flow: Predicts the pressure profile, permeability distribution and well productivity index (PI).



Particle embedment and permeability reduction modelling

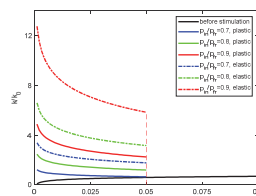


Fracture surface deformation with coal and particle shown in red and flow region in blue

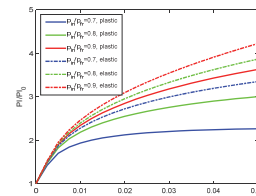


Permeability reduction factor versus particle aspect ratio for different effective stresses

Well productivity analysis



Permeability profiles for different injection pressures



Productivity index versus stimulation radius for different injection pressures

Conclusions

1. Compared to elastic deformation of the coal fracture surface, elastoplastic deformation results in reduced fracture width and decreased fracture permeability.
2. Fracture permeability tends to zero at a very dense or a loose particle packing in coal fractures. An optimal value of particle aspect ratio yields the maximum permeability for each effective stress value.
3. Elastoplastic embedment leads to lower permeability enhancement, larger pressure drawdown and smaller production improvement, as compared to elastic embedment modelling results.

Acknowledgements

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