Development of predictive models and go-forward strategies for micro-particle injection in naturally fractured reservoirs

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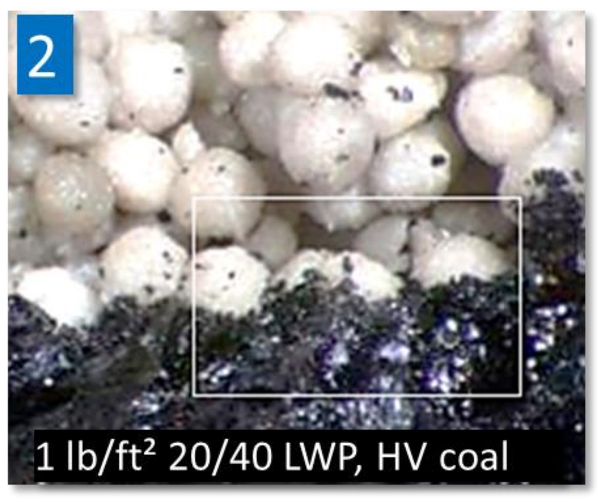
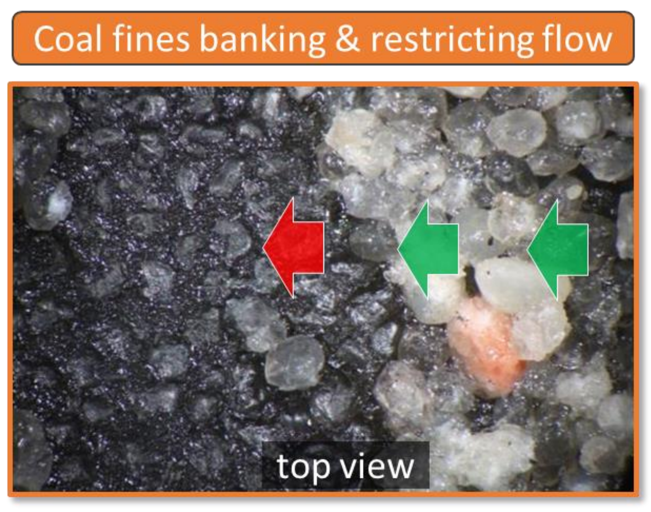
Introduction

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.

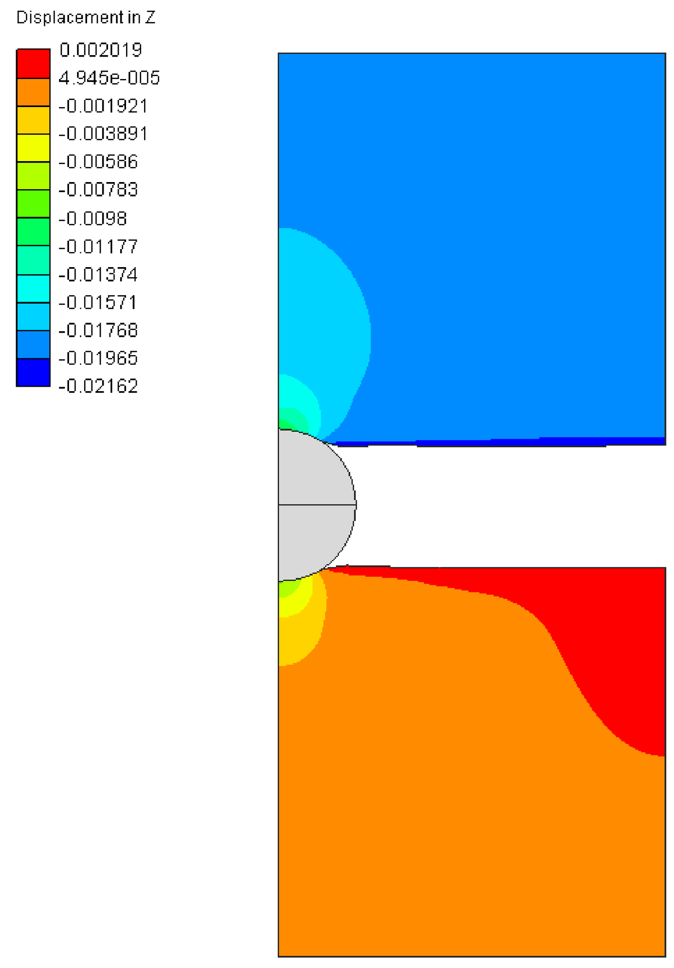
Particle embedment occurs when penetrating into formation due to the closure stress during the fracking operation. Fracture width may decrease by 10% to 60%, reducing productivity by 50%.



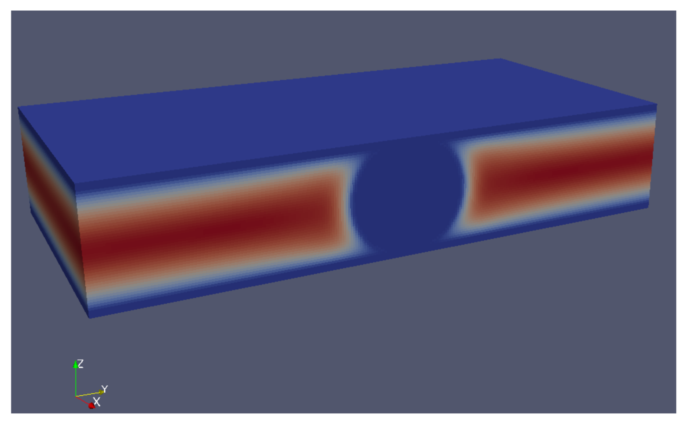


Microscopic images of sand embedment and fines generation in a HV Bituminous coal

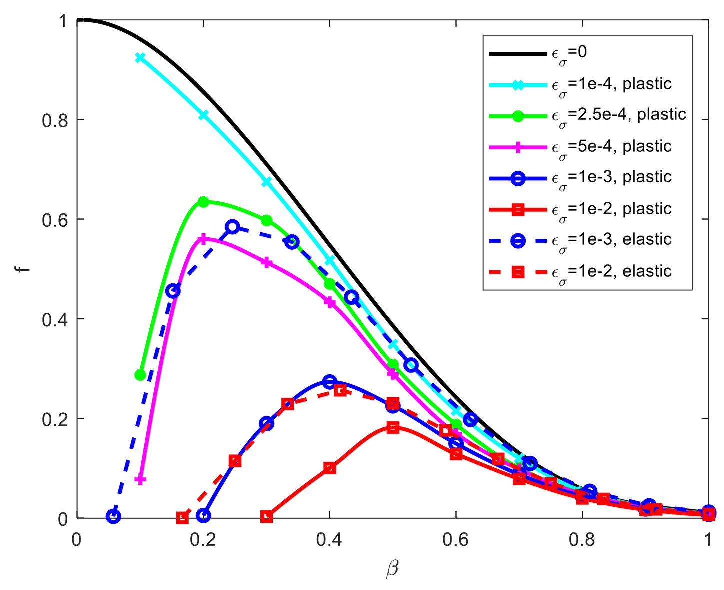
Particle embedment modelling



Vertical displacement of fracture surface under embedment (Surat coal)

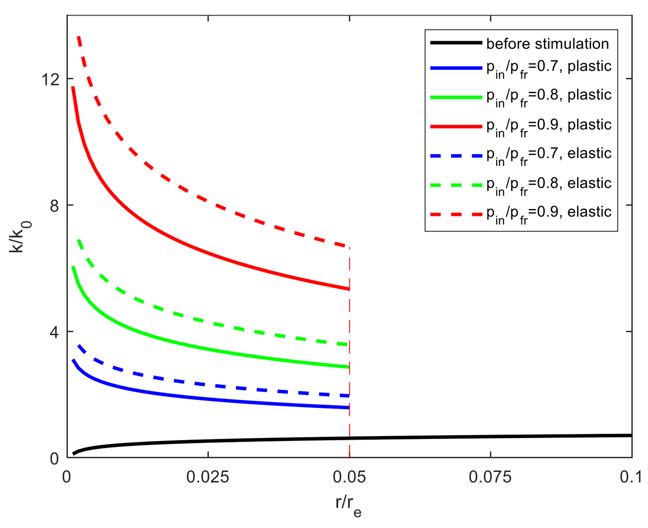


Flow velocity contour within the fracture

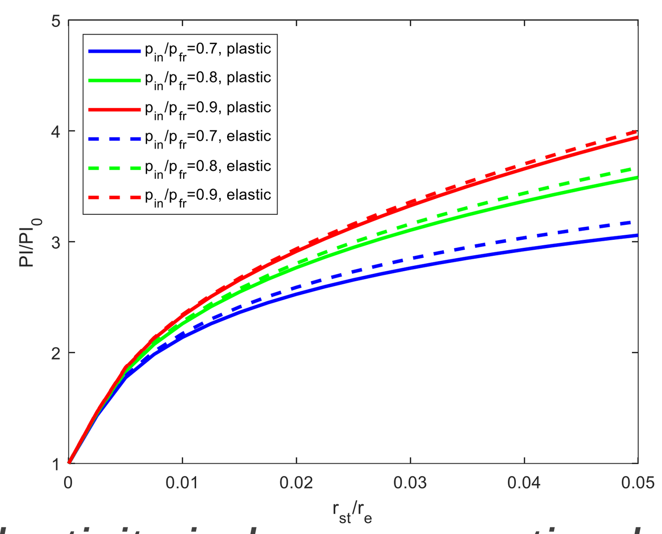


Permeability reduction factor versus particle aspect ratio

Well productivity modelling

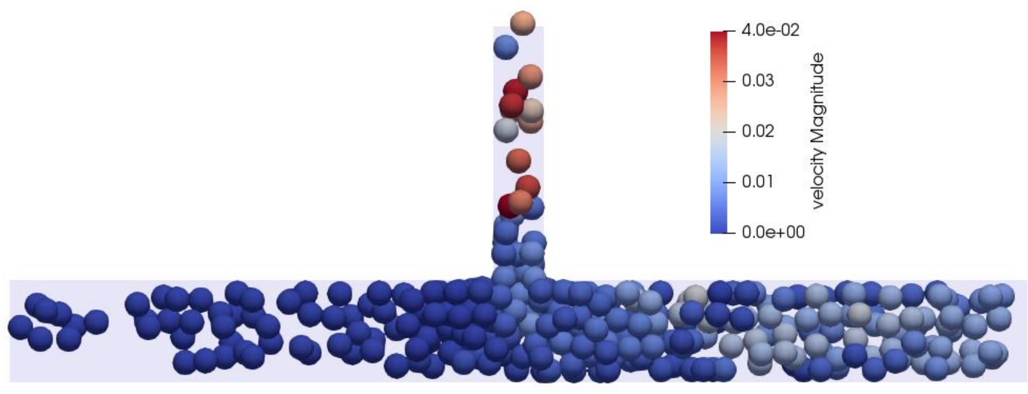


Permeability profiles for different injection pressures

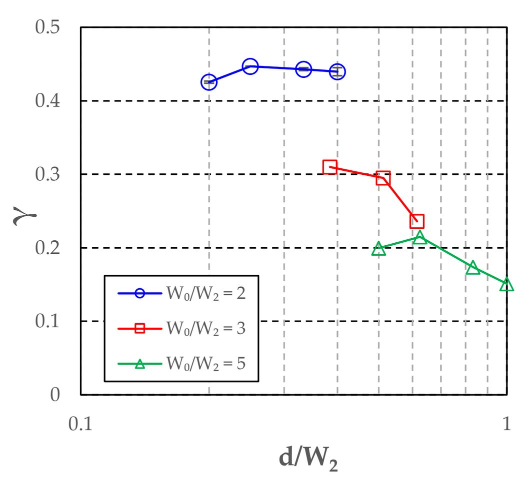


Productivity index versus stimulation radius for different injection pressures

Particle transport and leak-off in fracture



Large particles result in fracture bridging (i.e. screenout)



Variation of particle leak-off for different particle and cleat sizes

Conclusions

- Elastoplastic deformation leads to smaller fracture width and lower permeability compared to elastic coal fracture deformation
- An optimal value of particle aspect ratio yields the maximum permeability for each effective stress value
- Effect of particle size on leak-off is significant only if it approaches the cleat aperture; higher concentration results in higher leak-off
- Modelling implementation : DFIT Model => Reservoir model => Frac model w/proppant => Reservoir modelling results

Acknowledgement

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References

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3. You Z., Wang D, Di Vaira N, Johnson RL Jr, Bedrikovetsky P & Leonardi C (2019), Development of Predictive Models in Support of Micro-particle Injection in Naturally Fractured Reservoirs, Asia Pacific Unconventional Resources Technology Conference, Brisbane, Australia, URTEC-198276.