Pulsed Arc Electrohydraulic Discharge Stimulation of Coal Seam Interburden for Gas Development

Background & Objectives

Interburden is the mixture layer located between the coal measures. Many existing coalbed methane (CBM) wells have already drilled through these undeveloped layers (Fig. 1). However, the potential of coal seam interburden reservoirs (Fig. 2), mainly consisting of mud, clay and organic matter, has not yet been well researched or developed, when compared to that of coal or shale. This project aims at developing and validating an alternative stimulation method to replace traditional fracturing techniques, such as hydraulic fracturing, to effectively crack the thick but malleable mudstone layers without forming any outside chemical fluids into the subsurface or causing clay swelling, to improve the gas recovery from CBM wells.

Experimental Setup

Develop and employ PAED stimulation technique to crack the interburden specimens at the labscale. The schematic of PAED setup is shown in Fig. 3.

Results

After the stimulation on C2 by PAED (Fig. 5), the permeability (Fig. 8) and porosity (Fig. 9) of testing C2 mortar specimen have both increased due to the impact of shock waves compared to the properties before PAED.

Acknowledgement & References

The funding and assistance from ARC, the School of ITEE, and CCG at UQ is highly appreciated.


Parameter settings for testing

- Shockwave generation:
  - Charging voltage: 20 ~ 60 KV
  - Capacitance: 2 ~ 12 uF
  - Discharging period: nanoseconds ~ 70 us
  - Pulse number: adjustable
  - Electrodes gap: 5 mm

- Permeability measurement:
  - Confining pressure: 20 bar
  - Inlet pressure: 2 bar
  - Outlet pressure: atmosphere

Testing Sample Information

In the current stage, to explore and summarize the most efficient discharging circuit and parameter settings for strong shock wave fracking, preliminary tests on homogeneous mortar sample (Fig. 5) and identified coal sample (Fig. 7) were carried out. The testing specimens here are homogenous mortars with the compressive strength of approx. 6 MPa (Fig. 6).

Before stimulation

Porosity = 3.11%

After stimulation

Porosity = 3.34%

The testing and X-ray CT scanning was utilized to analyse the fracture and void evolution before and after PAED stimulation on Gluluguba-2 coal (Fig. 7).

Both fracture and void of coal specimen after PAED stimulation have increased (Fig. 10), particularly the front part which is close to the shockwave source (Fig. 11).

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