Coalbed Methane Extraction in the Sydney Basin

Gas and Coal Outburst Seminar
November 20, 2002
Presentation Outline

- Sydney Gas Company
- What is CBM?
- Exploration Process
- Understanding the Rock Mechanics/Stress profiles
- Fracturing Process
- Conclusion
SYDNEY GAS COMPANY

• Public company listed on the Australian Stock Exchange

• 5,800 shareholders
  – 45% live in New South Wales
  – 25% of NSW shareholders live the south west of Sydney

• Aims to become a leading Australian gas producer through development of Coal Bed Methane (CBM) from the Sydney Basin
SGC’s PROJECT

- Sydney Gas Company owns controlling interests in PELs 2 (100%), 4 (100%) and 267 (82.5%) in the Sydney Basin

- 90% of the entire Basin area, exceeding two million hectares, enveloping the entire Sydney gas market

- Focused primarily on the Camden Gas Project. Stage 2 development has commenced with 10 new wells to be drilled by Christmas, 40 wells by June
Camden Pilot Project
WHAT IS COAL BED METHANE?

- Coal Bed Methane (CBM) is a clean burning natural gas generated during the coal forming process.
- For the mining industry it can be a pain in the backside that introduces safety, environmental and cost issues.
- For a gas producer it is a clean viable energy source, typically a resource with technical challenges but is becoming a new growth industry not only in Australia, but many other countries.
- 14% of all gas now consumed in the US is derived from CBM – 2000 PJ/year.
- Total gas Consumption NSW 120 PJ.
EXPLORATION PROCESS

• Define geological production fairway – critical process as this can make or break a CBM producer, use existing available data – DRM, core holes, multiphase testing etc

• Define well spacing, minimize interference while maximizing recoverable reserves

• Drilling technology that is geared for the shallow gas market, cost is critical

• Run casing program that allows access to multiple seams and can withstand high fracturing pressures

• Fracturing Issues
Cleats and fractures developed in Bulli Seam, Wandinong #1
Acoustic scanner image of the Bulli Seam shows the flat screen and 360° wrapped view from Kay Park #1 well.
Logan Brae-5 was drilled with air/foam/oil. Exact MW is not known.
Hydraulic Fracture Initiation

“Effect of Perforations on Fracture Initiation” SPE 20661
“Theoretical Model and Numerical Investigation of Near-Wellbore Effects in Hydraulic Fracturing” SPE 30506
Hydraulic Fracture Improvement

- Orient the perforations in the direction of the maximum horizontal stress

- Create a single, bi-wing fracture in the Preferred Fracture Plane (PFP)

- Reduce near-wellbore complexities (tortuosity)
  - multiple, competing fractures
  - microannulus effects (pinch points)
Coal Seam Fracture Stimulation

- Main purpose of hydraulic fracture treatment is to connect the wellbore with the cleat system
- A highly conductive fracture must be created under in-situ conditions to minimize bottomhole producing pressure and effectively dewater the coal
- Due to complexities when fracturing coals, the Engineer must be prepared to make changes on the fly
  - complex fracturing as a result of stresses, shear slippage, coal fines, poroelastic effects
- Optimization of fracture treatments should focus on costs
  - observe trends
  - fluids/proppants
  - remove near wellbore tortuosity to lower treating pressures
Fracturing Process

- Coalseam is perforated or slotted, API casing rated to 5000 psi with good cement behind casing
- Start pumping down casing, observe formation break, Increase rate – Pad fluid
- Pump at 8000 to 8700 litres/min. Pressure range 3000 to 4500 psi (21000kpa – 31000kpa)
- Start the addition of frac sand (API 16/40mesh) at concentrations between 60 to 140 kg/m3.
- Amount of frac sand – typically 10T/m of pay
- When using water as the carrying fluid, may have to perform the job in 2 to 4 stages with flush treatments
- Shut Down monitor pressure – initiate flow back through choke
Kay Park 1 - Sydney Gas
Bulli Coal Seam - Water Frac

Casing Pressure (psi)  A  Slurry Rate (bpm)  B
Sand Concentration (lb/gal)  D  Bottomhole Proppant Conc (lb/gal)  D

Stages
1. Start Pad
2. Start Sand @ 0.25 ppg
3. Increase Sand to 0.5 ppg
4. Increase Sand to 0.75 ppg
5. Increase Sand to 0.9 ppg
6. Increase Sand to 1 ppg
7. Sweep
8. Start Sand @ 0.25 ppg
9. Increase Sand to 0.5 ppg
10. Increase Sand to 0.75 ppg
11. Increase Sand to 0.85 ppg
12. Sweep
13. Start Sand @ 0.5 ppg
14. Increase Sand to 0.75 ppg
15. Increase Sand to 1 ppg
16. Sweep
17. Stop, Flow Back
18. Start Pumping
19. Start Sand @ 0.3 ppg
20. Increase Sand to 0.5 ppg
21. Increase Sand to 0.75 ppg
22. Sweep
23. Stop, Flow Back
24. Start Pumping
25. Start Sand @ 0.5 ppg
26. Flush
27. Stop, Monitor Decline

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Potential Fracturing Problems

• Tortuosity caused by fracture reorientation
• Pinch points and micro annulus
• Narrow fracture widths
• Early screen outs
• Higher pumping pressures
  – higher HHP charges ($)
• Fracture job not optimized
Production / Dewatering Well
Conclusion

• Similar technologies used between the mining industry and the petroleum industry with different objectives

• A good understanding of the Geology, stress profiles, geophysical data, and gas/water compositions are required

• Most coal seams need to be stimulated in some way to enhance production: fracturing, inseam drilling, cavity completion

• CBM gas producer focuses on a production fairway with high permeability and will drill on tight spacing to deplete the resource