Concurrent *In-situ* Measurement of Flow Capacity & Gas Content

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Agenda

• Summary of Field Trial
• Equipment used for trial
• Mixed gas measurement
• Field trail results
• Conclusions
Field Trial

• Real Application
  – Measuring flow capacity
  – Measuring gas content
  – Testing in a PQ borehole
Field Trial

• **Real Application**
  – Measuring flow capacity
  – Measuring gas content
  – Testing in a PQ borehole

• **Real Client**
  – Large mining company
  – Queensland, Australia
Field Trial

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  - Measuring flow capacity
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• **Real Results**
  - Blind trial
Technical Service #1 – Drill Stem Test

- DST technology established and widely used to measure flow capacity and other seam characteristics
- Straddle packers used to isolate the test interval
- System design allows integration of real time surface read out of coal seam pressure using wireless E-M telemetry
Technical Service #2 – Raman Spectroscopy Gas Testing

- Raman spectroscopy used to detect and measure trace gases dissolved in coal seam fluids
Gas Testing Mixed Gases

- RS has the ability to detect the concentration of different gases like CO2
- During dewatering, bicarbonate can revert to CO2 resulting in a higher % of CO2
- Create a mixed gas isotherm based on borehole concentrations
Technologies - RS

• Result are related to gas content in coal seam
  – Gas concentration → gas partial pressure = critical desorption pressure (CDP) → gas content $G_c$

• For example:

\[
\begin{align*}
[\text{CH}_4] & \quad P(\text{CH}_4) = \text{CDP} & \Gamma(\text{CH}_4)
\end{align*}
\]

• An adsorption isotherm is needed to calculate gas content from CDP
Pressure, temperature and conductivity used to calculate solubility relationship for Henry’s constant

Total Dissolved Solids indicates self-consistent fluid

Methane log shows under-saturated fluid, maximum gas content has been measured
Derivation of Gas Content

Formula: 
\[ y = 0.0122x + 1.2124 \]

\[ R^2 = 0.9908 \]

<table>
<thead>
<tr>
<th>Seam no.</th>
<th>Average density (g/cc)</th>
<th>Average ash (%)</th>
<th>V(L)—DAF (psi)</th>
<th>Synthetic V(L)—AR (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seam 1</td>
<td>1.57</td>
<td>29</td>
<td>27.00</td>
<td>19.21</td>
</tr>
<tr>
<td>Seam 2</td>
<td>1.63</td>
<td>34</td>
<td>29.74</td>
<td>19.65</td>
</tr>
<tr>
<td>Seam 3</td>
<td>1.60</td>
<td>23</td>
<td>32.57</td>
<td>25.17</td>
</tr>
<tr>
<td>Seam 4</td>
<td>1.62</td>
<td>33</td>
<td>29.84</td>
<td>19.93</td>
</tr>
</tbody>
</table>
Test Results

Water column supported by P*

DST no.  | Interval name | Interval (m BS) | Flow capacity (mD-ft) | Skin | Pressure (psia) | CDP (psia) | Std. Dev (%) spectra (no.) | V_L (m^3/ton) / L_p (psia) | G_C (m^3/ton) | G_S (m^3/ton) | G_C/G_S (%) | Drainage dP (psi) | P_abandon (psia) | Recovery (m^3/ton) | R.F. (%)
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
1 | Seam 1 | 114.6–118.2 | 960 | 3.8 | 50 | 20 | 12.5/26 | 23.1/269.0 | 1.5 | 5.49 | 27 | 70 | 10 | 0.72 | 48

x.xx m^3/ton gas content
xxx psia CDP
xxx psia P*
xxx mD.ft kh
xxx psi required drawdown

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WellDog
Your new best friend

Public release 12
WellDog vs Traditional Gas Content

Blind Trial Results

WellDog Gas Content vs Traditional Method Gas Content
Conclusions

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  – Successful integration
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✓ Safe
  – Operations conducted safely
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  – Increase available hole for gas content testing
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✔ Immediate Results
  - Results available while testing
References

Concurrent *In Situ* Measurement for Measuring Permeability, Gas Content and Saturation, Quentin Morgan, John Pope and Peter Ramsay, 2014 Coal Operators Conference, The University of Wollongong
2014 Gas and Coal Outburst Seminar

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