DrillWell

Australia's Well Engineering & Operations Forum

SPE 158092

High-Strength, Low-Density Cement Pumped On-The-Fly using Volumetric Mixing Achieves Cement to Surface in Heavy Loss Coal Seam Gas Field

Hui San Yap, Halliburton

presenting on behalf of

Brendon Tan, Halliburton, Matthew Lang, Halliburton and Devin Harshad, Santos

HALLIBURTON

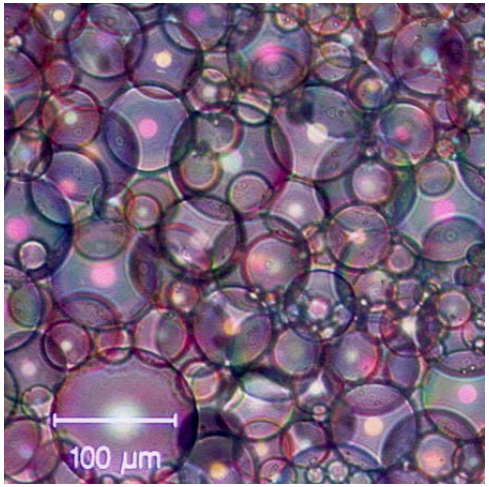
Cementing

CSG Cementing Considerations

- Cement properties must satisfy isolation standards with the ability to support future loads
  - Slurry Density
  - Short thickening time
  - Fast compressive strength development
  - Fluid loss
  - Thixotropic
- Compared to conventional cementing, there is a greater need to control slurry invasion into the formation/coal cleats
- Lightweight cementing
  - Water-extended
  - Nitrified (Foam)
  - Hollow spheres (High-Strength, Low-Density)
- Lost circulation material
- Reactive Spacers
- Excess slurry volume

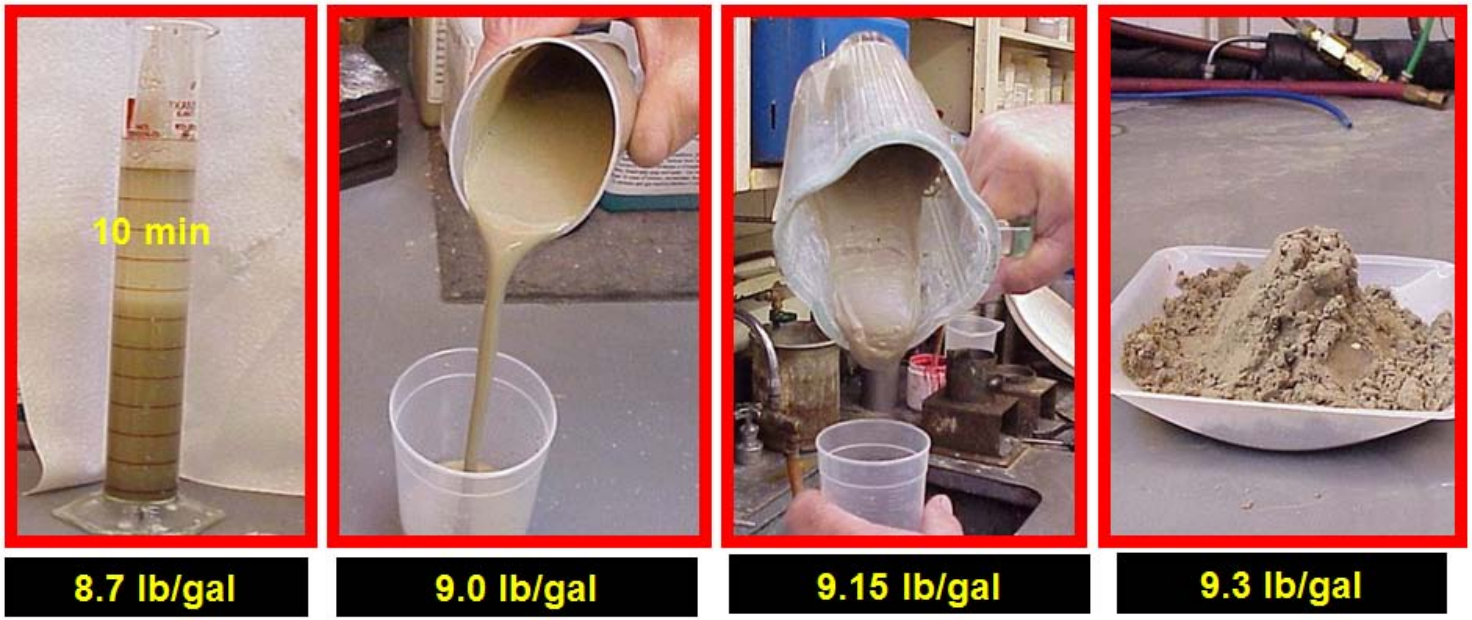
High-Strength, Low-Density (HSLD) Cement Design

- Lightweight slurry using hollow spheres
- Hollow microspheres SG is less than water
- Maintaining a high solids volume content which gives higher compressive strengths
- Highest short term compressive strengths
- Strength of cement is dependent on the Solids to Water Ratio (SWR)
- Typical densities of 8.6ppg to 13.0ppg



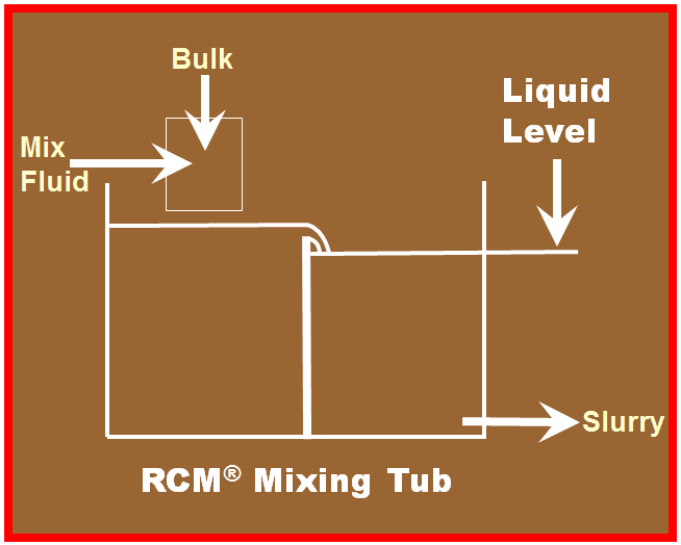
Solids to Water Ratio (SWR)

- For conventional-weight slurries, SWR varies only slightly with minor density changes
- For some lightweight slurries, minor density changes result in drastic changes in SWR since SG of the solids is approaching SG of water
- SWR affects all major slurry characteristics



Volumetric Mixing

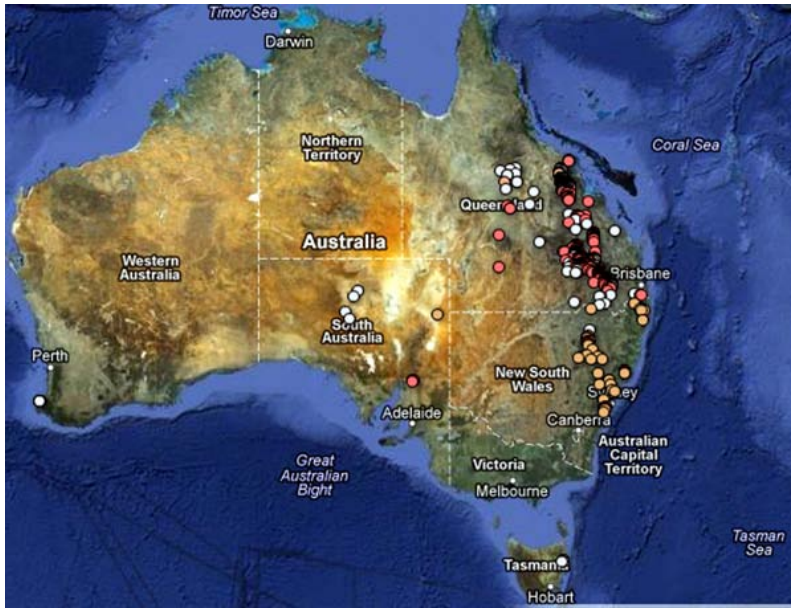
- Slurry mixing is conventionally based on density control
  - Density, water requirement, yield are inputs
  - Solids and water are adjusted until desired density is achieved
- Lightweight slurries should either be mixed in a batch mixer (if volume permits), or volumetrically mixed on-the-fly
- Volumetric mixing examines changes in volume of the mixing tub, and then changes the volume of solids while keeping mix water rate constant.



Bulk = Slurry – Mix Fluid

Field Implementation

- A trial was set up over a 3 well pad in a Queensland CSG field which is prone to heavy losses
- Objective was to achieve cement returns to surface and sufficient zonal isolation for future fracturing operations on each well's production casing
- Improved methods of cementing were used on each subsequent well



Case Study

	Well 1	Well 2	Well 3
Spacer Type	Standard	Reactive	Reactive
Slurry Density	12.0 ppg HSLD	12.0 ppg HSLD	11.0 ppg HSLD
Mixing System	Density-Control	Density-Control	Volumetric
LCM Additives	No	No	Yes
Excess Volume	50%	100%	125%
Cement Returns to Surface	No	No	**Yes**
Top of Cement Achieved	Below Previous Shoe	Above Previous Shoe	**Surface**

Acknowledgements / Thank You / Questions

David Bedford
William Farrelly
Jordan Bunning
Jonathan Martin
Simon Hann