Oil and Gas Well Cementing

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Protecting Water is Essential For Everyone
Cementing

- Cementing is one of the most critical steps in the drilling and completion of oil or gas wells
- Well cementing technology is the application of many scientific and engineering disciplines
Primary Cementing

• Process of placing cement in the annulus between the casing and the wellbore

• Objectives:
  • *Provide Hydraulic Seal*
  • *Create Zonal Isolation*
  • *Protect Useable Water*
  • *Provide Structural Support for Casing*
  • *Protect Casing from Corrosion*
  • *Isolate Casing Seat for Subsequent Drilling*
Primary Cementing Starts with a Plan

• The plan should take well from drilling through plugging

• The well plan includes:
  • *Wellbore Environment*
  • *Well Type*
  • *Casing and Cement Program*
  • *Mud System*
  • *Type of Completion*
Effective Primary Cementing

- Good drilling practices and mud properties
- Casing movement while cementing
- Centralization of the casing
- Optimal borehole pipe clearance
- Use of spacers and mud flushes
Fundamentals of Cement Placement

- **Casing Hardware**
  - *Float Equipment*
  - *Centralizers*
  - *Wiper Plugs*
  - *Multi-stage tools*

- **Hole conditioning and mud properties**
  - *Mud Rheology*
  - *Gel Strength*
  - *Fluid Loss*
  - *Circulation Rate*
  - *Filter cake removal*

- **Casing movement while cementing**
  - *Rotation*
  - *Reciprocation*

- **Use of spacers and mud flushes**
Variables Affecting Zonal Isolation

GEOMECHANICS:
In-situ stresses, change in stresses along borehole, change in stresses in cement and pipe

BOREHOLE:
Size, shape, uniformity

BOREHOLE STABILITY:
Lost circulation, flows, structural integrity and characteristics of formations

CEMENTING PROCESS:
Displacement design, job execution, cement volumes, cement material properties

MATERIAL PROPERTIES:
Cement, relationships between pipe-cement-formation

CHEMISTRY:
Corrosion and chemical resistance of casing and cement

PRESSURE AND TEMPERATURE CHANGES/CYCLING
Over the life of the well

GEOLOGY/GEOCHEMISTRY:
Formation type, structure, formation fluid chemistry

GEOMECHANICS:
In-situ stresses, change in stresses along borehole, change in stresses in cement and pipe
Benefits of Pipe Rotation During Cementing

3-D Computer Modeling of Displacement of Mud by Spacer and Cement

No Pipe Rotation

20 RPM Pipe Rotation

Courtesy of AXPC ANGA
## Current Well Design – Deep Intermediate Casing

<table>
<thead>
<tr>
<th>FORM. / CSG</th>
<th>TVD 50'</th>
<th>MD 50'</th>
<th>CASING PROFILE</th>
<th>HOLE SIZE</th>
<th>CSG SPECS</th>
<th>MUD INFO</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shallow Shales</td>
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<td>20&quot;</td>
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<tr>
<td>13 3/8&quot; Shoe</td>
<td>1,500'</td>
<td>1,500'</td>
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<td>13 3/8&quot;, J-55</td>
<td>54.5#</td>
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<tr>
<td>Base/Heebner Shale (GDS)</td>
<td>6,861'</td>
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<td>CIT 300 PSI / 30 min</td>
<td>11.0 PPG FIT</td>
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<tr>
<td>9 5/8&quot; TOC</td>
<td>7,500'</td>
<td>7,500'</td>
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<td>TOC ~1,000' above Deese</td>
<td>Vertical</td>
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<tr>
<td>Deese (GDS)</td>
<td>8,789'</td>
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<tr>
<td>5 1/2&quot; TOC</td>
<td>10,800'</td>
<td>10,800'</td>
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<td>9 5/8&quot;, L-80</td>
<td>40#</td>
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<td>Primrose (Morrow)</td>
<td>11,459'</td>
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<td>CIT 1500 PSI / 30 min</td>
<td>12.5 PPG FIT</td>
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<tr>
<td>Springer Shale</td>
<td>11,838'</td>
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<td>Swell packer @ 7,000' TOC 1,000 into Build: 14-16º/100</td>
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<td>Black Marker</td>
<td>13,174'</td>
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<tr>
<td>Springer 2 (false caney)</td>
<td>13,743'</td>
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<tr>
<td>Springer 3 (false caney)</td>
<td>14,059'</td>
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<tr>
<td>KOP</td>
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<td>Caney</td>
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<td>Woodford</td>
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<tr>
<td>EOB</td>
<td>14,901'</td>
<td>15,310'</td>
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LOL: 4,950  TD: 20,260  TD TVD: 14,721
Newfield Mid-Continent Operations

Drilling

• Mud circulated until it has the required properties

• Casing is Centralized

• Casing is reciprocated rotated during cementing

• On the production casing a swell packer is run and set inside intermediate casing string

• Using TergoVis! Efficiency Fluid
Newfield Mid-Continent Operations

Completions

- Test annulus between the production casing and intermediate casing for pressure
- Annular pressure monitored during hydraulic fracture treatment
- Production casing pressure tested to 80% of yield before pumping hydraulic fracture treatment
- Production casing attached to automatic shut downs and relief lines while pumping job
Zonal isolation for each well must be designed and constructed with regard to its unique geological environment.

There is no single fit-for-purpose design, well construction, or barrier verification process that is right for all wells.

The barrier system that protects usable water includes surface casing and cement.

Verification of the barriers is typically accomplished by both pressure testing (direct measurements of casing and shoe cement) and by an operational evaluation (cement placement behind pipe).

There is no direct measurement available to verify a cement barrier behind casing at this time.
Conclusions

• Casing has been cemented in wells for more than 100 years

• Cementing best practices have been known for more than 60 years.

• Best practices have to be used by everyone to
  
  • Protect the environment and community
  
  • Obtain maximum value from your wells
Questions!?!?!

THERE IS NO LIFE WITHOUT WATER.

BECAUSE WATER IS NEEDED TO MAKE COFFEE.