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 a 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

**CHEMISTRY:**
Corrosion and chemical resistance of casing and cement

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

**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

**PRESSURE AND TEMPERATURE CHANGES/CYCLING**
Over the life of the well
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 20&quot;</th>
<th>HOLE SIZE</th>
<th>CSG SPECS</th>
<th>MUD INFO</th>
<th>NOTES</th>
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</thead>
<tbody>
<tr>
<td>Shallow Shales</td>
<td>50'</td>
<td>50'</td>
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<tr>
<td>13 3/8&quot; Shoe</td>
<td>1,500'</td>
<td>1,500'</td>
<td>CIF 300 PSI / 30 min</td>
<td>13 3/8&quot;, J-55</td>
<td>54.5#</td>
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<td>Base/Heebner Shale (GDS)</td>
<td>6,861'</td>
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<td>9 5/8&quot; TOC</td>
<td>7,500'</td>
<td>7,500'</td>
<td>TOC ~1,000' above Deese</td>
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<tr>
<td>Deese (GDS)</td>
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<td>5 1/2&quot; TOC</td>
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<td>Primrose (Morrow)</td>
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<td>Springer Shale</td>
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<tr>
<td>9 5/8&quot; Shoe</td>
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<td>11,900'</td>
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<td>Black Marker</td>
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<tr>
<td>Springer 2 (false caney)</td>
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<td>Springer 3 (false caney)</td>
<td>14,059'</td>
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<td>KOP</td>
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<td>Caney</td>
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<td>Woodford</td>
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<td>EOB</td>
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<td>15,310'</td>
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LOL: 4,950  TD: 20,260  TD TVD: 14,721

- 100% Excess
- Cmt to Surf.
- Vertical < 2º
- CIT 300 PSI / 30 min
- 11.0 PPG FIT
- Build: 14-16º/100
- Swell packer @ 7,000'
- TOC 1,000 into
- 8 3/4" 9 5/8" Csg
- 23#, P-110, Blue

**NEWFIELD EXPLORATION COMPANY NYSE:NFX**
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**
Summary

• 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 technique, or barrier verification process that is right for all wells.
• The barrier system that protects usable water includes both 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!?!?!