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

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
# Current Well Design – Deep Intermediate Casing

<table>
<thead>
<tr>
<th>FORM / CSG</th>
<th>TVD</th>
<th>MD</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>
<td>50’</td>
<td>50’</td>
<td></td>
<td>20”</td>
<td>100% Excess</td>
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<td>Vertical</td>
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<tr>
<td>13 3/8” Shoe</td>
<td>1,500’</td>
<td>1,500’</td>
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<td>13 3/8”, J-55</td>
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<tr>
<td>Base/Heebner Shale (GDS)</td>
<td>6,861’</td>
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<tr>
<td>9 5/8” TOC</td>
<td>7,500’</td>
<td>7,500’</td>
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<td></td>
<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” TOC</td>
<td>10,800’</td>
<td>10,800’</td>
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<td>9 5/8”, 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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<td>Springer Shale</td>
<td>11,838’</td>
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<td>Swell packer @ 7,000’ TOC 1,000 into</td>
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<tr>
<td>9 5/8” Shoe</td>
<td>11,900’</td>
<td>11,900’</td>
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<td></td>
<td>8 3/4”</td>
<td>9 5/8” Csg</td>
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<td>Black Marker</td>
<td>13,174’</td>
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<td>Build: 14-16º/100</td>
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<tr>
<td>Springer 2 (false caney)</td>
<td>13,743’</td>
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<td>Springer 3 (false caney)</td>
<td>14,059’</td>
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<tr>
<td>KOP</td>
<td>14,400’</td>
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<td>23#, P-110, Blue</td>
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<tr>
<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 |
**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, 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.