Recommendations to Ensure Proper Cement Placement

Bryce London
Tech. Professional-Lead
Ideal Conditions
Market Challenge
Market Challenge
Industry Best Practices

In completion of oil and gas wells, cement isolates the wellbore, prevents casing failure, and keeps wellbore fluids from contaminating freshwater aquifers.

The basic factors engineers and operators must consider for successful cementing jobs have not changed in more than 50 years. These factors are summarized in eight basic ideas:

1. Condition the drilling fluid.
2. Use spacers and flushes.
3. Move the pipe.
4. Centralize the casing.
5. Maximize the displacement rate.
6. Design slurry for proper temperature.
7. Select and test cement compositions.
8. Select a proper cementing system.

The industry has conducted numerous projects over the years to validate the importance of these factors. The projects have also provided quantitative data for more precisely defining the recipe for good zone isolation.

Drilling fluid

The drilling fluid condition is the most important variable in achieving good displacement during a cement job.

As rig crews pull drill pipe, run casing, and prepare for cementing operations, the drilling fluid in the wellbore essentially remains static and becomes gelled. Pockets of gelled mud, which commonly exist after a wellbore is drilled, make displacement difficult. One must ensure the pockets of gelled fluid are broken up.

Regaining and maintaining good fluid mobility after running the casing is key. Drilling fluids with low gel strengths and low fluid loss are the easiest to displace.

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1. OptiCem™ Software
   Cement Job Simulation
   Finite Element Analysis

2. Displace 3D® Simulator
   Displacement models in 3D
   Computational Fluid Dynamics

3. WellLife® Express Service
   Cement Sheath Stress Analysis
   Finite Element Analysis

4. Data Acquisition
   Field data acquisition and monitoring
Variables Affecting Cement Placement

1. Centralization
2. Spacers
3. Mud Properties
4. Casing Movement
5. Pump Rates
Centralization Recommendation

Formation
Cement
Mud
Casing

High As ECD’s Allow

“Sag Point”

Casing
Hole
Standoff Comparison

30% casing standoff. 70% casing standoff.
Standoff Comparison

Desired Cement Top

 Actual Top of Cement

Mud Channeling

Cross Section

30% casing standoff. 70% casing standoff.
Standoff Comparison

30%  50%  77%
Poor Mud Displacement on Low Side of the Hole
Variables Affecting Cement Placement

1. Centralization
2. Mud Properties
3. Spacers
4. Casing Movement
5. Pump Rates
Effective Mud Removal
Basic Mud Displacement Factors

- **Optimal Mud Properties**
  - Low as possible
  - Flat Profile

- **Circulate and move pipe until**:
  - Free of cuttings
  - Required mud properties achieved in/out of well
  - Gas free
  - No lost circulation
  - At least two hole volumes pumped, or as dictated by hole conditions

### MUD PROPERTIES

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Variables Affecting Cement Placement

1. Centralization
2. Mud Properties
3. Spacers
4. Casing Movement
5. Pump Rates
Need for Spacers

3 major functions:

1. Remove mud from the hole
2. Keeps mud and cement separated
3. Water wet the pipe for good bond
Spacer Volume Recommendation

Old Statement

1000 ft or 10 min Contact Time

My Statement

It Depends…

1. Mud properties
2. Spacer used
3. Rate pumped
4. Wellbore profile
Mud / Cement Compatibility

50:50

75:25
Determining Optimal Spacer Volume

Small volume of spacer is consumed by mud and cement
Determining ideal spacer volume

Adequate spacer volume maintains fluid separation
Spacer Properties

- Density Hierarchy - “Heavier displaces Lighter”
- Rheological Hierarchy - “Thicker displaces Thinner”
- Water Wetting
- Compatibility
  - Incompatible fluids may cause:
    - Thinning of mixed fluids resulting in settling of solids/ adverse effect on cement mechanical properties
    - Gellation resulting in increased frictional pressures (ECD’s) and an adverse effect on cement pumpability
Fluid Train Rheology

Water Spacer

Tuned® Spacer III fluid
Variables Affecting Cement Placement

1. Centralization
2. Mud Properties
3. Spacers
4. Casing Movement
5. Pump Rates
Casing Rotation

Narrow Side

No casing rotation.

With casing rotation.

100% Mud
100% Spacer
100% Lead

Mixture / None

Cross Section
Rotation Effects on Standoff

Standoff: 77%  51%  28%
No Rotation

10 rpm Rotation

Standoff: 77%  51%  28%
Variables Affecting Cement Placement

1. Centralization
2. Mud Properties
3. Spacers
4. Casing Movement
5. Pump Rates
Recommendation

- Pump as fast as wellbore conditions & equipment allows

Factors Effecting Pump Rates

1. Formation Pressures
2. Horsepower requirement
3. On location operations
4. Surface Iron limitations
Pump Rates

6 BPM

10 BPM

18 BPM
Pump Rate Risk / Reward

Pump Rate → 4-bpm  12-bpm  24-bpm

1000 ft

Mud Spacer Cement
Experiment vs. Displace 3D® Simulator

After 10-sec

After 20-sec

After 30-sec
Experiment vs. 3D Displace
Wrap Up

Five Factors for Effective Cement Placement

1. Centralization
2. Fluid Properties
3. Fluid Volumes
4. Pipe Movement
5. Pump Rate