SQUEEZE CEMENTING

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Squeeze Cementing - Definition

Injection of Cement Slurry into the voids behind the casing or into permeable formations

Dehydration of cement requires: fluid-loss, porous (permeable) matrix, differential pressure, time.

Injection below or above fracture pressure
Effect of Fluid Loss Control

Node build-up after 45 min, slurries with different fluid-loss, dP=1000psi

- 800 ml/30min: Completely bridged casing
- 150 ml/30min: Partially bridged casing
- 50 ml/30min: Completely filled perforations
- 15 ml/30min: Partially filled perforations
Squeeze Cementing - Applications

Formation Losses

Insufficient cement top

Repair Improper Zonal Isolation

Eliminate Intrusion of Unwanted Fluids

Repair Casing Leaks

Abandon Nonproductive or Depleted Zones
Repair cement channels

Liner-Top Leaks

Injection Profile Modification
  ● In injection wells

Block Squeeze
  ● Above and below the production zone
Remediate Improper Zonal Isolation

Deficient primary cementing jobs may require repair when channeling leaves pockets or channels of mud behind the casing through which communication can occur. Serious problems may occur during the life of the well should such defects in zonal isolation not be corrected.
Raising the Top of the Cement

The height of the primary cement column in the annulus may be insufficient due to several reasons:

- Lost circulation
- Inaccurate hole-volume calculations
- Incomplete slurry displacement

The top of the cement column can be extended by pumping slurry through perforations just above the cement top.
Eliminating Water Intrusion

Plug Perforations

Water intrusion may occur during the life of a well usually as the result of coning. Cement slurry is squeezed into the perforations to prevent unwanted water entering the well.

Oil and Gas Zone

Cement Squeezed into Perforations

Water Cone
Repair Corroded Casing

Squeeze cementing can repair casing corrosion damage caused by treating pressures and packer-generated stresses. A packer is a tool placed in the wellbore to seal off areas of the wellbore.
Squeeze Cementing - Methods

Pumping technique
- Hesitation
- Running
- Circulating

Placement technique
- High pressure - above formation frac pressure
- Low pressure - below formation frac pressure

Tools
- Packer/Retainer
- Bradenhead

Coiled tubing
Squeeze Techniques

Placement
- Low Pressure
- High Pressure

Pumping
- Running
- Hesitation

Application
- Brandenhead
- Squeeze Tools
Low Pressure Squeeze

Squeeze pressure below fracture pressure
Best way to squeeze the pay zone
Use small volume of slurry
Common applications include but not limited to
  — Multiple zones
  — Long intervals
  — Low BHP wells
  — Naturally fractured formations
High Pressure Squeeze

Fracturing is necessary to place cement in the void
Requires placement of large volumes of slurry
Common applications include but not limited to
- shoe
- liner top
- block squeeze

Wash or acid ahead to minimize pump rates required to initiate fracture
Running Squeeze

Continuous pumping until final squeeze pressure is attained
Clean fluid in the hole
Large slurry volumes with less fluid loss control
Low or high pressure squeeze
Common applications include but not limited to
- Water flow
- Abandon perforations
- Increase cement top
- Casing shoes
- Liner tops
- Block squeeze
- Lost circulation zones
• Usually a large volume of slurry is pumped with this technique
Hesitation Squeeze

Intermittent pumping
Low pump rates
Small slurry volumes
Long job times

Common applications include but not limited to

- Channel repair
- Long perforated interval
- Long splits in casing
- Lost circulation
Hesitation Squeeze

- Rate of 0.25 - 0.5 bpm
- 10-20 min. intervals

Pressure (psi) vs. Time (min) graph with points A, B, C, and D.
Planning the Squeeze Job

Problem determination
- Temperature log
- CBL/CET/USI
- Noise log
- Water-flow log
- Tracer survey

Select tools and location
- Casing integrity
- Type of squeeze
- Volume of the slurry

Fluid in the well
Well conditions (pre-squeeze clean-up, if necessary)
- Formation lithology
- Formation permeability
- Squeeze temperature

Slurry design and amount
Pressure limitations
- Pore and frac

Plan the injection test
Perforations are open and ready to accept fluid

Estimate of the proper cement slurry injection rate

Estimate the pressure during squeeze

Estimate the amount of slurry to be used

Low Injection rates may require pumping an acid / solvent treatment ahead
Washes and Spacers

Three main roles in squeeze cementing:

- Prevent contamination of the cement slurry
- Help clean voids and perforations to be filled with cement
- Remove rust and debris from tubular and push them ahead of cement slurry
Wash/Spacer Selection

Compatible with hole fluid and squeeze treatment

Effectiveness in mud removal

Size of gap to squeeze

Maintains overbalance during placement
Squeeze Slurry Requirement

Three critical squeeze slurry properties

The slurry must:
- Allow proper placement from surface to downhole
- Allow fluid placement behind casing / perforations
- Attain the desired set properties
General Attributes for Squeeze Slurry

Low viscosity
Low gel strength during placement
Appropriate cement particle size
No free water
Appropriate fluid loss control
Proper thickening time
Slurry Properties to Consider

- Fluid loss & filtercake development
- Rheology & sedimentation
- Density
- Size of particles in the slurry
- Thickening time and temperature
- Chemical resistance
Slurry Volume Selection

Best Practices and Local Experience

Type of repair planned

Length of the interval and number of perforations to be squeezed

Placement technique to be used

- Low pressure
- High pressure

Injection Rate
Slurry Volume Limiting Factors

Cement column too high to breakdown formation
Volume should not exceed the string capacity
Volume limited to ensure reverse circulation is possible
In case of placement thru CT, the weight of CT filled with cement not to exceed CT tensile strength
Bradenhead Squeeze

Done through tubing or drill pipe without packer
Referred as “Poor Boy Squeeze”

Advantages
● No tool are used (simplicity)
● Cost
● Used in open hole

Disadvantages
● Casing and wellhead are exposed to pressure
● Old casing
Squeeze Tool Technique

Retrievable tools
- Positrieve Packer
- Hurricane Packer
- Shorty Squeeze Tool
- RBP
- DLT

Drillable tools
- Cement Retainer
- Drillable Bridge Plug
Packer with Tailpipe Squeeze

- Downhole Isolation tool
- Casing and wellhead protection
- Tailpipe for placement
- Long intervals
- Multiple setting of packer
Other Considerations
(Brandenhead & Packer with Tailpipe)

Decision to reverse circulate OR circulate excess slurry

Excessive pressures during circulation may over-displace slurry below perforations

Excessive pressures may frac formation

Plug Post Placement Circulation module MUST always be run to evaluate dynamic security
Packer without Tailpipe Squeeze

Downhole Isolation tool
Casing and wellhead protection
Short intervals
No tailpipe
Suicide squeeze
  ● Continuous pumping
  ● Running squeeze
Annulus needs close monitoring for leak
Cement Retainer Squeeze

Drillable Isolation Tool
Similar to packer without tailpipe
Squeeze pressure trapped
● Internal control valve
No pressure exerted on perforations during post squeeze circulation.
Annulus needs close monitoring for leak
Coiled Tubing Squeeze

Applications
● Producing wells
● Through tubing

Advantages
● Cost
● Accurate placement

Critical slurry design parameters
● Slurry Stability
● Rheology
● Fluid Loss
● Thickening Time
Squeeze Cementing - Job Cycle

Design
- Well conditions
- Slurry properties

Execution
- Slurry placement
- Surface pressures
- Equipment

Evaluation
- Final squeeze pressure
- Positive Pressure test
- Inflow test
- Logs (CBL/Temp)
Other Materials

Resins
Micro-fine cements
Polymers
Slurry oil
NRT (Novel Remedial Technologies)
   Nano particles activated by set cement
Biomineralization
Questions??????