CEMENT EVALUATION – ITS NOT JUST ABOUT A BOND LOG

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CEMENT EVALUATION OBJECTIVES

Is the material behind the pipe a solid or liquid
   - Solids can’t be “fixed”
Is there isolation in the annulus
Where is the cement (TOC)
CEMENT EVALUATION

To properly perform a cement evaluation, the **objectives** of the cement job must be understood, and a **decision** made as to how the success of the operation will be determined.
CEMENT EVALUATION REQUIREMENTS

The type of cement system used, hole conditions, wellbore architecture and the future completion plans for the well will all impact the type of evaluation required.
LOOKING AT THE TOTAL PICTURE

There are multiple data sets available for cement evaluation.

There must be an understanding of the importance and credibility of the data sets.

And “conflicts’ between results of the evaluation of the different data sets should be resolved.
EVALUATION TECHNIQUES

Radioactive Tracer Surveys
Hydraulic (Pressure) Testing
Temperature Surveys
Acoustic Logging
TEMPERATURE LOGS

Generally used for determining top of cement or lost circulation zone

Can be used to determine underground flow

– Flow must be sufficient to change well temperatures

– Often run in conjunction with noise log
TEMPERATURE LOGS

The lighter the slurry – the less exotherm when the cement sets

The higher the well temperature, the more difficult it will be to see a change in temperature from the cement

The smaller the annulus, the less the mass of cement, the more difficult it will be to see a change in temperature

Precise determination of top of cement can be difficult due to heat flux up the wellbore
Acoustic logging

Noise Logs
Sonic Logs
  – Conventional CBL
  – Advanced Sonic Tools
Ultrasonic Logs
  – USIT, CAST V, ISO Scanner
SONIC LOGS
CONVENTIONAL CBL

- 20 kHz Transmitter
- 3 ft. receiver
- 5 ft. receiver

Diagram showing the location of Casing, Cement, and Formation.

Amplitude and VDL graphs.
CONVENTIONAL CBL

Assumes the cement is homogeneous
   – same density, same strength, same annular gap throughout the well
Signal is transmitted and picked up on receivers spaced at 3 and 5 feet
3 foot receiver used for pipe / cement “bonding”
5 foot receiver used to get a qualitative indication of formation bonding
CBL

The CBL is an **AVERAGE** around the wellbore

Do not depend on a conventional CBL to evaluate isolation over short intervals

Advanced sonic tools give more data with less averaging
ULTRASONIC LOGS
ULTRASONIC LOGS

Send a directional 200-700 kHz signal from a rotating transmitter/receiver.
Can infer the acoustic impedance of the material directly behind the pipe.
  – Function of density and velocity.
Also measures casing ID, OD and thickness.
Comparison

SONIC TOOLS
- Work in virtually any mud weight
- Qualitative formation evaluation
- Sensitive to microannulus
- Sensitive to material contacting pipe

ULTRASONIC TOOLS
- Limited mud weights
- No formation evaluation
- Insensitive to microannulus
- Independent of cement properties
## Comparison

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<tr>
<th>SONIC TOOLS</th>
<th>ULTRASONIC TOOLS</th>
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<tr>
<td>Very limited in lightweight cmts</td>
<td>Can include casing inspection</td>
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<td>Average over 3’ of wellbore</td>
<td>No averaging of the wellbore</td>
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<td>Advanced tool resolution is 6”</td>
<td>Preferred for low density, low strength cement systems</td>
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THE IMPACT ON LOG RESPONSES FROM VARIOUS CEMENT DESIGNS
CEMENT DESIGN IMPACTS ON LOG RESPONSE

The basis for most cement evaluation logs is “neat” cement
Compressive strength is assumed to be 3,000 psi
There is some “compensation” for lower strengths and lower densities
CEMENT DESIGN IMPACTS ON LOG RESPONSE

The closer the cement density is to that of the drilling fluid used, the more difficult it is to distinguish between a solid & a liquid.

The lower the compressive strength of the cement, the more difficult it is to “find” on a log, and requires use of specialty tools and evaluation software.
CEMENT EVALUATION

To properly perform a cement evaluation, the objectives of the cement job must be understood, and a decision made as to how the success of the operation will be determined.