Zonal Isolation Improvement through ELViS™ Spacer Treatment and Fluid Rheological Optimization

Case Study: Successful Applied Well Cleaning in Primary Cementing to Improve Zonal Isolation and Cement Bonding Logging (CBL) in SMP #03 Well, South-Sumatera – Indonesia.

Maintaining the density hierarchy for wellbore fluids has long been an accepted engineering practice whereas the rheological hierarchy for mud, spacer and cement is sometimes not achieved due to tedious testing or limitations in the field. Establishing appropriate rheological and friction pressure hierarchies prevent fluid (mud-spacer-cement slurry) intermixing, especially in deviated and horizontal wells. The objective of this paper is to present a spacer rheological properties model along with a new spacer technology that improves well integrity. The water-based spacer system, ELViS™ Spacer with densities ranging from 8.5 to 16 ppg, was modeled to temperatures up to 230 degF (BHCT) and provided proper suspension properties, confirming stability at elevated bottom-hole circulating temperatures. In addition, compatibility of this spacer package with various water-based muds, oil-based muds and cement slurries, designed for The China Land, The Europe land, The Iraq Land, The Middle East Land and The Indonesia Land, plays a significant role in maximizing displacement efficiency, wellbore cleanup, long-term effective zonal isolation and sustainable hydrocarbon production.

Introduction

One of operator in Indonesia needed more economical methods to have good zonal isolation and CBL between formation and casing for 13 3/8-in, 9 5/8-in casings and 7-in Liner. On previous wells, the type of the well is vertical wells and they have problem for bad cement bonding between casing and formation especially on 7-in Liner which is Production Zone. Some of depth in production zone have bad CBL result and need to do additional job to repair the zonal isolation before production which additional cost and time to fix it.

Challenges

Effective method and technology to clean-up the well-bore from cutting and mud in deviated well while cementing job and get long term cement integrity & good cement bonding log (CBL) in production zone.

Solution

Applying the recommended practices and new technology spacer, ELViS™ Spacer for effective mud removal to long-term cement integrity and have a good cement bonding log result for 7 in production liner.

Result

Achieved long term zonal isolation with no remedial cementing job and zero QHSE incidents.

The land location of SMP #3 location in Southwest of Indonesia

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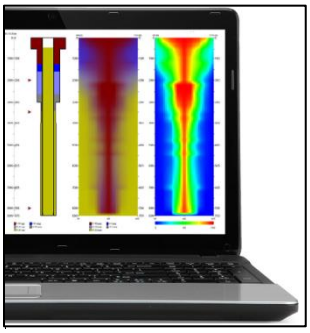
Applying the recommended practices for effective mud removal is crucial to long-term cement integrity. Displacement efficiency is defined as the percentage of annular area filled with cement. The principal goal is to accomplish maximum mud displacement out of the wellbore and provide an annular seal for oil or gas wells. To achieve proper mud displacement, the down-hole forces imposed by the circulating fluids in the well must be sufficient to overcome the yield stress of any viscosities. In fact, the quality of the cement's long-term seal with casing and formation is mainly influenced by effective mud removal. Weighted spacers are between the chemical means with buoyancy effect on mud removal. The volume, rate, and viscosity of such spacers must be sufficient and carefully designed to prevent intermixing with mud or cement, remove drilling mud from the annulus, and water-wet surfaces (casing and formation) critical in facilitating good casing-cement-formation bonds. The viscosity and the displacement rate for best mud removal efficiency can be determined by using fluid friction charts and simulating the job scenario with cement placement software simulators. These simulations typically exhibit laminar or turbulent flow while keeping equivalent circulating density (ECD) across the zone of interest between pore and fracture pressures.



Designing Program

Well Cementing analysis software for effectiveness of mud removal, fluid rheology and effective laminar flow.

Lab Testing

Optimization of properties & rheology of fluids and compatibility against Spacer, Mud and Cement Slurry

ELViS™

Apply the ELViS™ Spacer as water-based spacer to improve the wellbore cleaning for more powerful reaction.

Field Execution

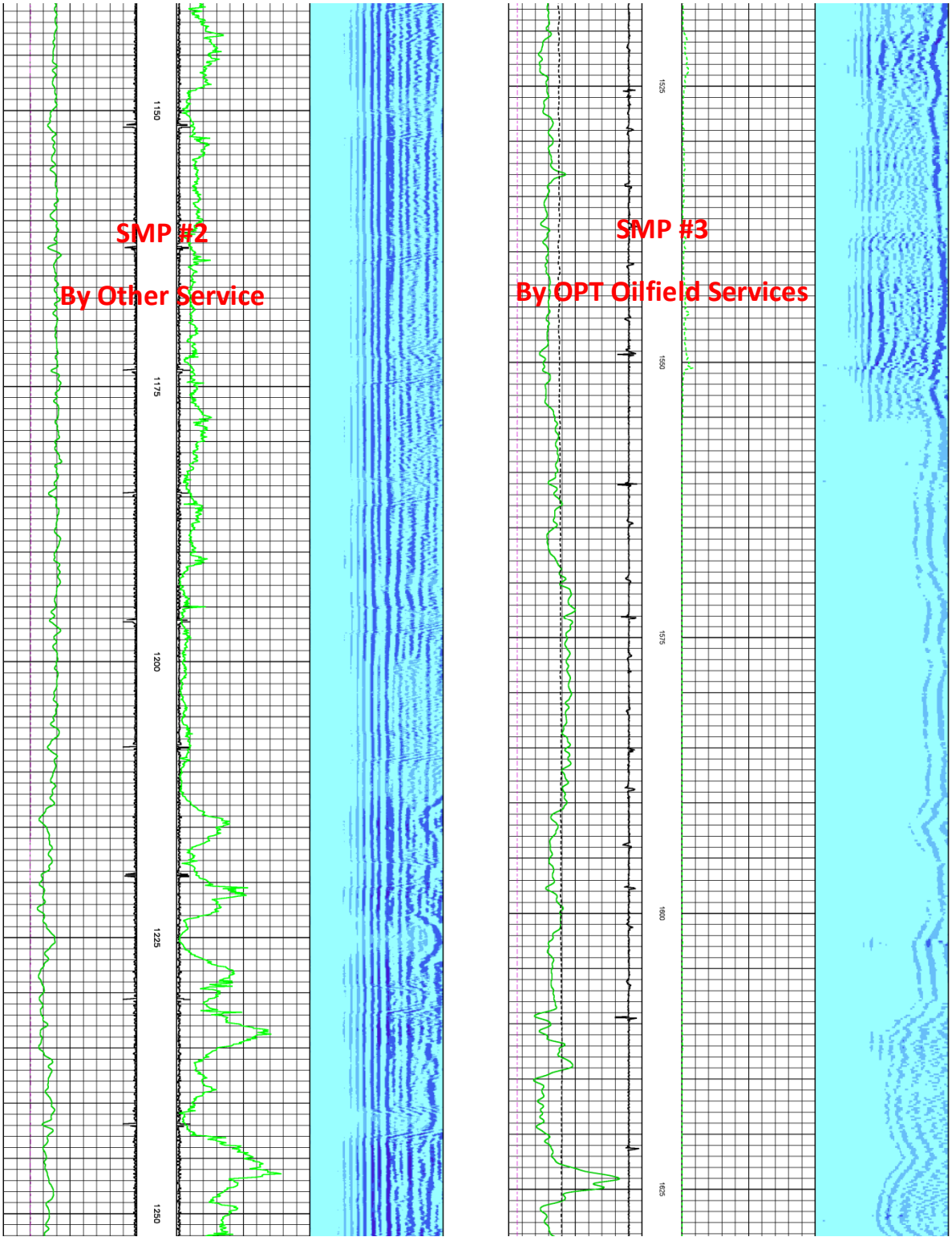
Mix the ELViS™ Spacer with proper design as per lab testing information with check the properties before pump to the well.

RESULT

- GOOD CEMENT BONDING LOG (CBL)
- NO REMEDIAL CEMENTING REQUIRED
- LONG TERM ZONAL ISOLATION

Good Cement Bonding Log (CBL)

The Cement Bonding Log comparison between SMP #2 and SMP #3 Well in 7 in Production Liner;



No Remedial Cementing Required

Since the cement bonding log in production zone is good, accordingly OPT has some benefit such as;

1. Reducing Client operational cost (no need remedial cementing)
2. Reducing Client operational time (shorten operation rig time)
3. Client has satisfied with the cementing job result
4. Increasing OPT's credibility from client as well services company in Indonesia

Long-Term Zonal Isolation

Zonal isolation was achieved on this well, preventing channeling from each formation and requiring no remedial cementing for cement to surface, the cement slurry's short compressive strength development saved waiting on cement time. In addition, there were no QHSE incidents during the process. The success of this new technology from OPT services proved that this technology can be applied at any location around the world to ensure safer, properly executed cementing jobs and long term zonal isolation.

Conclusion

1. A high performance of ELViS™ Spacer water-based spacer was formulated. This spacer system effectively removes the water-based fluid in the annulus, improves fluid compatibility, optimizes displacement efficiencies, optimizes well cleaning efficiencies and improves cement bonding.
2. A model was developed to engineer the rheological properties of this spacer system for bottom hole circulating temperatures (BHCT) up to 230 degF. This work flow optimizes spacer design with an ideal mud-spacer cement rheological hierarchy.
3. The spacer system promotes effective mud removal with adequate friction pressure hierarchy for multiple scenarios, adjusting KCM006 composition form 7 to 9 lbs/ bbl of spacer to has desire rheology properties.
4. The case study showed engineering the rheological hierarchy of mud-spacer-cement helped achieving great zonal isolation.
5. Cementing Design Engineers has to adjust several parameters for efficient mud removal and long-term wellbore integrity;
   a. Spacer design and optimization
      - ✓ *Mud-spacer-cement density hierarchy*
      - ✓ *Mud-spacer-cement rheological hierarchy*
      - ✓ *Mud-spacer and spacer-cement compatibility*
      - ✓ *Effect of fluid intermixing on thickening time*
      - ✓ *Effect of fluid intermixing on compressive strength*

   b. Cement slurry properties
   c. Casing stand-off (centralizer placement)
   d. Pipe movement (rotation or reciprocation)