Tergovis II Efficiency Fluid

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Topics in this presentation

New settable spacer – Tergovis II Efficiency Fluid

1. Closing remarks 2012 – setting the scene
2. Geopolymer confusion?
3. Barrier material requirements
4. Tergovis II Efficiency Fluid – complementary to cement
   - Primary
   - Well plugging
5. Tergovis II Efficiency Fluid – barrier material?
Portland cement is well known and proven as sealant barrier element!

- Shortcomings, but reliable, environmentally compliant and cost effective material
- For critical barriers - modify to mitigate shortcomings
- Modified Portland cement is a highly competent barrier material!

1. Place plug properly, make it stay there
2. Reduce shrinkage, post set expansion  
   - Ensure external water source in one end of plug  
   - Allow expansion time
3. Hydrocarbon response – self healing
Realistic expectations

It is about recognizing what a material is suitable for
Some times we have to compromise

The best solution is often a hybrid
If you need a hybrid for your well

Buy one!

Portland

Hybrid

Elastomers ++
Six different definitions of the term geopolymer

For chemists
'...It is known that alkali-activated aluminosilicates are able to produce alumino-silicate geopolymers. The hardening mechanism involves the chemical reaction of geopolymeric precursors, such as alumino-silicate oxides, with alkali polysilicates yielding polymeric Si–O–Al bonds.'

For geopolymer chemists
'...Geopolymers consist of a polymeric Si–O–Al framework, similar to zeolites. The main difference to zeolite is geopolymers are amorphous instead of crystalline. The microstructure of geopolymers on a nanometer scale observed by TEM comprises small aluminosilicate clusters with pores dispersed within a highly porous network. The clusters sizes are between 5 and 10 nanometers.'

For geopolymer material chemists
'...The reaction produces SiO₄ and AlO₄, tetrahedral frameworks linked by shared oxygens as poly(sialates) or poly(sialate–siloxo) or poly(sialate–disiloxo) depending on the SiO₂/Al₂O₃ ratio in the system. The connection of the tetrahedral frameworks is occurred via long-range covalent bonds. Thus, geopolymer structure is perceived as dense amorphous phase consisting of semi-crystalline 3-D aluminosilicate microstructure.'

For geopolymer ceramic chemists
'...Although geopolymer is generally X-ray amorphous if cured at standard pressures and temperatures, it will convert into crystalline ceramic phases like leucite or pollucite upon heating.'

For alkali-cement scientists
'... Geopolymers are framework structures produced by condensation of tetrahedral aluminosilicate units, with alkali metal ions balancing the charge associated with tetrahedral Al. Conventionally, geopolymers are synthesized from a two-part mix, consisting of an alkaline solution (often soluble silicate) and solid aluminosilicate materials. Geopolimerization occurs at ambient or slightly elevated temperature, where the leaching of solid aluminosilicate raw materials in alkaline solutions leads to the transfer of leached species from the solid surfaces into a growing gel phase, followed by nucleation and condensation of the gel phase to form a solid binder.'

For ceramic scientists
'...Geopolymers are a class of totally inorganic, alumino-silicate based ceramics that are charge balanced by group I oxides. They are rigid gels, which are made under relatively ambient conditions of temperature and pressure into near-net dimension bodies, and which can subsequently be converted to crystalline or glass-ceramic materials.'
Definitions of the term geopolymer

For everybody:

• Geopolymerization is the process of combining many small molecules known as oligomers into a covalently bonded network

• Geopolymerization forms aluminosilicate frameworks that are similar to those of rock-forming minerals

• From a terminological point of view, geopolymer cement is a binding system that hardens at room temperature, like regular Portland cement. If a geopolymer compound requires heat setting it may not be called geopolymer cement but rather geopolymer binder.

• Tergovis II EF is not a geopolymer cement
• Or is it?
• It may in fact not be a geopolymer
• But it looks like one..

• That is quite OK, as long as it works!
Barrier material requirements

- D-010 R4 will be released any time now
- Lack of industry agreed requirements, or requirements at all

So what do we use to qualify our materials?
Who can say this is OK or not OK?
Improving zonal isolation on primary jobs

Tergovis II EF to reclaim spacer/cement interface

Issue:
Primary cementing implies large interfaces plus long spacer interval

May not be possible to improve parameters or increase cement volume → This is what you have
Improving zonal isolation on primary jobs

Tergovis II EF to reclaim spacer/cement interface

Issue:

- Primary cementing implies large interfaces plus long spacer interval
- Mud to spacer interface/transition is “lost” for zonal isolation
- Spacer to cement interface/transition and spacer interval is lost, but can be reclaimed with a settable spacer

➤ Tergovis II EF can salvage zonal isolation interval otherwise lost
➤ Tergovis II EF can prevent remedial work or lost section
➤ Tergovis II EF can reduce risk when long setting time is needed
➤ Reward is saved unproductive time
Improving Perforate-Wash-Cement method

Challenge:
- Method “forces” spacer into annulus with wash tool
- Cement placement dependent on buoyancy driven displacement
- plus optional post placement “stirring”
- → 100% cement placement cannot be guaranteed

Solution 1:
- Different placement method
- → force cement into annulus
- Risk vs reward considerations

Solution 2:
- Spacer becomes a barrier
- But still acts like a spacer
- → Tergovis II EF
P&A methods – Perforate-Wash-Cement method

Tailored AbandaCem & Tergovis Efficiency Fluid solutions

AbandaCem K:
- Special expanding cement
- Compatible with TergoVis EF spacer and wash fluid
- Clay inhibitive (KCl to match Tergovis II EF)
- Intended for use on P-W-C jobs

TergoVis II Efficiency Fluid K (spacer):
- Clay inhibitive (KCl to match wash fluid)
- New XXX based sealant (no cement, patented)
- Works as spacer with the WBM used on P-W-C jobs
- If left in well will develop strength and solidify with time
- If mixed with cement will contribute to strength and isolation

These fluids are designed to be used together on any job where spacer can contaminate the cement or spacer pockets may be left in the well.
P&A methods – Hydrawash cementing solutions

Tailored AbandaCem & Tergovis II EF spacer solutions

AbandaCem shrinkage test

AbandaCem integrity test

Portland cement shrinkage test
P&A methods – Hydrawash cementing solutions

Tailored AbandaCem & Tergovis II EF spacer solutions

Tergovis II EF shrinkage test

Step up dP

End of cooling

Initiate cooling

Viscosity increase impacts flow → 0.01 mD equivalent
P&A methods – Hydrawash cementing solutions

Tailored AbandaCem & Tergovis II EF spacer solutions

Rapid strength development at elevated temperature

Controlled with retarders
P&A methods – Hydrawash cementing solutions

AbandaCem & Tergovis II EF mixture strength development
Tergovis II EF as barrier material?

Tergovis II EF has properties needed for barrier material:

- Non-reversible reaction
- Stays fluid until activator is added
- Controllable set time at high temperature
- Low hydration shrinkage
- Sufficient strength
- Favorable mechanical properties
- Acceptable permeability
- Potential for expansion?

Stress-strain curve

Permeability test

Tergovis II EF shrinkage test (no water access)
Can one log Tergovis II EF properly?

- Acoustic impedance in the range 3.8 – 4.2 MRayl
- Drilling fluid typically has AI of 2 – 2.5 MRayl
- Relatively low strength
- Low Young’s Modulus
- ➔ Should be possible to recognize (as for low density cement slurries)
Summary & questions

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- Several projects ongoing
- Patents pending
- Looking for partners and funding
- Looking for cases to work on

Thomas Alva Edison:
I haven’t failed, I’ve found 10,000 ways that don’t work.”

Stay tuned for more great solutions to come!