NEWFIELD

www.newfield.com

Oil and Gas Well Cementing

D. Steven Tipton, P.E.

April 16-17, 2013

EPA Technical Workshop on Well Construction/Operation and Subsurface Modeling

Research Triangle Park, NC

Protecting Water is Essential For Everyone

Cementing

- Cementing is one of the most critical steps in the drilling and completion of oil or gas wells
- Well cementing technology is the application of many scientific and engineering disciplines

Primary Cementing

- **Process of placing cement in the annulus between the casing and the wellbore**
- **Objectives:**
  - *Provide Hydraulic Seal*
  - *Create Zonal Isolation*
  - *Protect Useable Water*
  - *Provide Structural Support for Casing*
  - *Protect Casing from Corrosion*
  - *Isolate Casing Seat for Subsequent Drilling*

Primary Cementing Starts with a Plan

- **The plan should take well from drilling through plugging**
- **The well plan includes:**
  - *Wellbore Environment*
  - *Well Type*
  - *Casing and Cement Program*
  - *Mud System*
  - *Type of Completion*

Effective Primary Cementing

- Good drilling practices and mud properties
- Casing movement while cementing
- Centralization of the casing
- Optimal borehole pipe clearance
- Use of spacers and mud flushes

Fundamentals of Cement Placement

- **Casing Hardware**
  - *Float Equipment*
  - *Centralizers*
  - *Wiper Plugs*
  - *Multi-stage tools*
- **Hole conditioning and mud properties**
  - *Mud Rheology*
  - *Gel Strength*
  - *Fluid Loss*
  - *Circulation Rate*
  - *Filter cake removal*
- **Casing movement while cementing**
  - *Rotation*
  - *Reciprocation*
- **Use of spacers and mud flushes**

Variables Affecting Zonal Isolation

GEOMECHANICS:

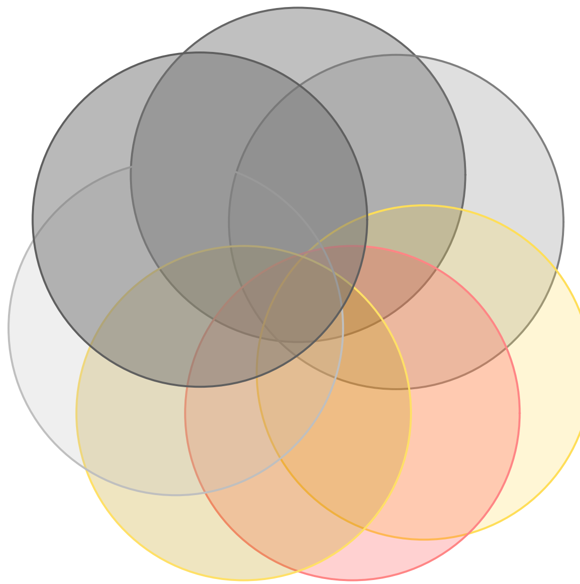
In-situ stresses, change in stresses along borehole, change in stresses in cement and pipe

BOREHOLE:

Size, shape, uniformity

BOREHOLE STABILITY:

Lost circulation, flows, structural integrity and characteristics of formations



CHEMISTRY:
Corrosion and chemical resistance of casing and cement

CEMENTING PROCESS:

Displacement design, job execution, cement volumes, cement material properties

GEOLOGY/GEOCHEMISTRY:

Formation type, structure, formation fluid chemistry

MATERIAL PROPERTIES:

Cement, relationships between pipe-cement-formation

PRESSURE AND TEMPERATURE CHANGES/CYCLING

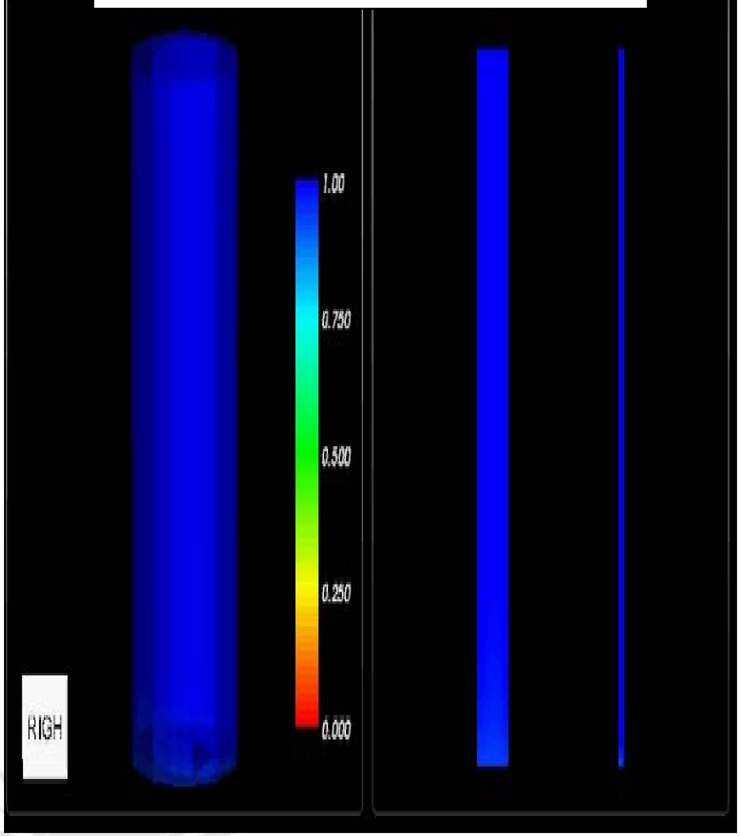
Over the life of the well

Benefits of Pipe Rotation During Cementing

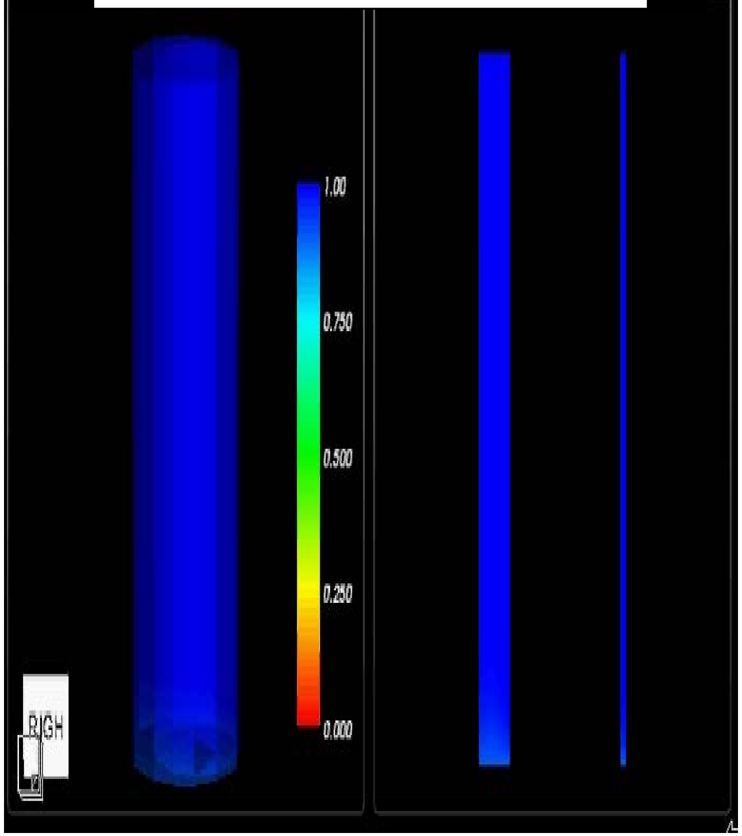
3-D Computer Modeling of Displacement of Mud by Spacer and Cement

Courtesy of AXPC anga

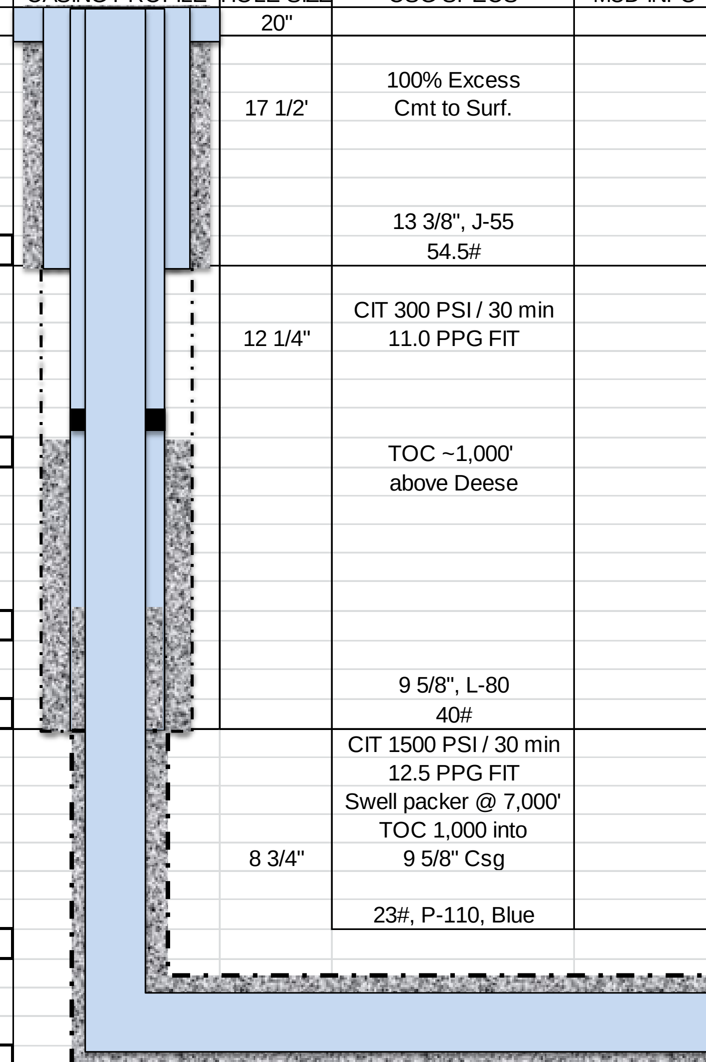
No Pipe Rotation



20 RPM Pipe Rotation



Current Well Design – Deep Intermediate Casing



FORM. / CSG	TVD	MD	CASING PROFILE	HOLE SIZE	CSG SPECS	MUD INFO	NOTES
	50'	50'		20"			
Shallow Shales				17 1/2'	100% Excess Cmt to Surf.		Vertical < 2º
					13 3/8", J-55		
13 3/8" Shoe	1,500'	1,500'			54.5#		
				12 1/4"	CIT 300 PSI / 30 min 11.0 PPG FIT		
Base/Heebner Shale (GDS)	6,861'						
9 5/8" TOC	7,500'	7,500'			TOC ~1,000' above Deese		Vertical
Deese (GDS)	8,789'						
5 1/2" TOC	10,800'	10,800'					
Primrose (Morrow)	11,459'						
Springer Shale	11,838'				9 5/8", L-80		
9 5/8" Shoe	11,900'	11,900'			40#		
					CIT 1500 PSI / 30 min 12.5 PPG FIT Swell packer @ 7,000' TOC 1,000 into		
Black Marker	13,174'			8 3/4"	9 5/8" Csg		Build: 14-16º/100
Springer 2 (false caney)	13,743'						
Springer 3 (false caney)	14,059'				23#, P-110, Blue		
KOP	14,400'	14,400'					
Caney	14,414'						
Woodford	14,731'						
EOB	14,901'	15,310'					
				LOL:	4,950	TD:	20,260
						TD TVD:	14,721

Newfield Mid-Continent Operations

Drilling

- *Mud circulated until it has the required properties*
- *Casing is Centralized*
- *Casing is reciprocated rotated during cementing*
- *On the production casing a swell packer is run and set inside intermediate casing string*
- *Using TergoVis! Efficiency Fluid*

Newfield Mid-Continent Operations

Completions

- *Test annulus between the production casing and intermediate casing for pressure*
- *Annular pressure monitored during hydraulic fracture treatment*
- *Production casing pressure tested to 80% of yield before pumping hydraulic fracture treatment*
- *Production casing attached to automatic shut downs and relief lines while pumping job*

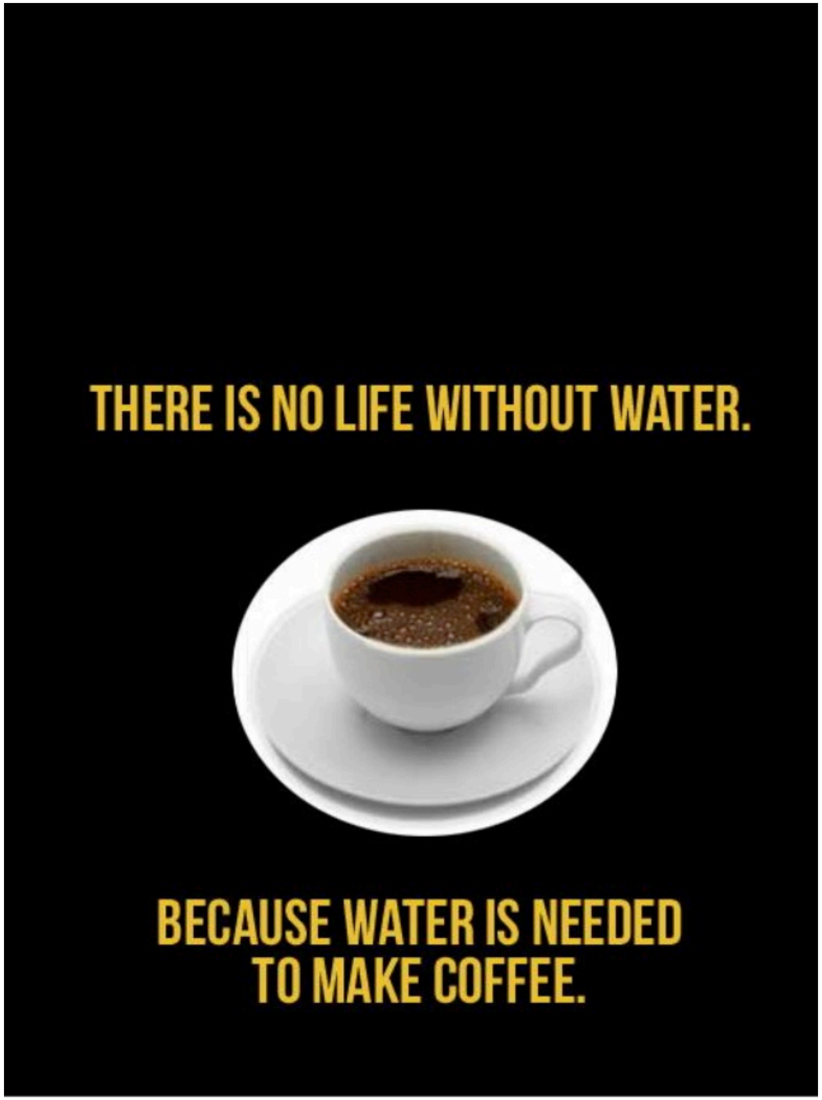
Summary

- Zonal isolation for each well must be designed and constructed with regard to its unique geological environment.
- There is no single fit-for-purpose design, well construction, or barrier verification process that is right for all wells.
- The barrier system that protects usable water includes surface casing and cement.
- Verification of the barriers is typically accomplished by both pressure testing (direct measurements of casing and shoe cement) and by an operational evaluation (cement placement behind pipe).
- There is no direct measurement available to verify a cement barrier behind casing at this time.

Conclusions

- **Casing has been cemented in wells for more than 100 years**
- **Cementing best practices have been known for more than 60 years.**
- **Best practices have to be used by everyone to**
  - *Protect the environment and community*
  - *Obtain maximum value from your wells*

Questions!?!?!



THERE IS NO LIFE WITHOUT WATER.
BECAUSE WATER IS NEEDED
TO MAKE COFFEE.