Horizontal Wells
Target the Source

Horizontal Environmental Well
Drilling Fluids – Is Bentonite a Four Letter Word?
Horizontal Well Drilling Fluids

- **Consolidated formations**
  - Air or water based drilling fluid

- **Unconsolidated formations**
  - Water based drilling fluids
    - Clay based – bentonite
    - Organic polymer based – guar/xanthan
Functions of Drilling Mud

- Maintain borehole stability
- Clean the drill bit
- Remove cuttings from the borehole
- Cool and lubricate the drill bit
- Cool the locating tools
- Minimize fluid loss to the formation
Two Most Common Drilling Fluids

- **Bentonite based**
  - Naturally occurring volcanic clay mineral
  - Cost effective
  - Used in most water well construction
  - Requires specific well development activities

- **Bio-polymers**
  - Based on long chained starches (guar, xanthan)
  - More expensive than clay
  - Will bio degrade over time
    - dispersal accelerated with enzyme breaker
  - Requires specific well development activities
Bentonite vs. Bio-Polymer

• The question asked by consultants and regulators – Which is best?
• The answer...

IT DEPENDS
Which Mud to Choose?

• **Type of well**
  – Fluid extraction/injection
  – Soil vapor extraction (SVE)
  – Sparge/Bio-sparge

• **Location of well**
  – Below water table
  – Vadose zone
Which Mud to Choose?

• Well construction
  – Screen open area %
  – Filter sock/pre-pack screen
  – Diameter

• Development methodology
  – Physical
  – Chemical
Which Mud to Choose?

- Interplay of
  - Well type
  - Well screen
  - Well location
  - Well development
Well Development

• ANY DRILLING METHOD/DRILLING FLUID DAMAGES THE FORMATION

• Purpose of well development
  – Remove drilling fluid from the borehole and near borehole formation
  – Increase hydraulic conductivity in the near borehole formation
Well Development

• Physical
  – Swab
  – Bail
  – Over-pump
  – Jet

• Chemical
  – Low pH/surfactant for bentonite
  – Enzyme/calcium hypochlorite
Physical Swabbing

Free water surface

Well casing

Surge block. Surge block moves up and down to create in-out movement of water through screen.

Screen
Let’s Put the Pieces Together

• Screens below the water table with high open area and adequate yield
  – Aggressive physical and chemical development methods can be used
    • “Swabbing” and fresh water/chemical jetting, over-pumping
  – Break down and remove both bentonite and polymer fluids
High Open Area?

- 4” Sch. 80 PVC screen – 0.020” slot, standard pattern – 4.1% open area
Let’s Put the Pieces Together

• Screens above the water table
  – Aggressive physical and chemical treatment
    • Over-pumping ineffective
  – Solid bentonite may be left in the formation
  – Biopolymer best solution
Let’s Put the Pieces Together

• Wells below the water table with low open area
  – Sparge or biosparge may have open area less than 1%
  – Impossible to get physical energy outside of screen to bore hole well/near borehole formation
  – Biopolymer best solution
Let’s Put the Pieces Together

• Filter sock based screens
  – Fabric make physical development difficult
  – Fabric may trap solids

Biopolymer recommended
The Bottom Line

- Both clay based and biopolymer drilling fluids can be utilized in the correct situation.
- In low open area screens and screens installed in the vadose zone biopolymers are recommended.
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