

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

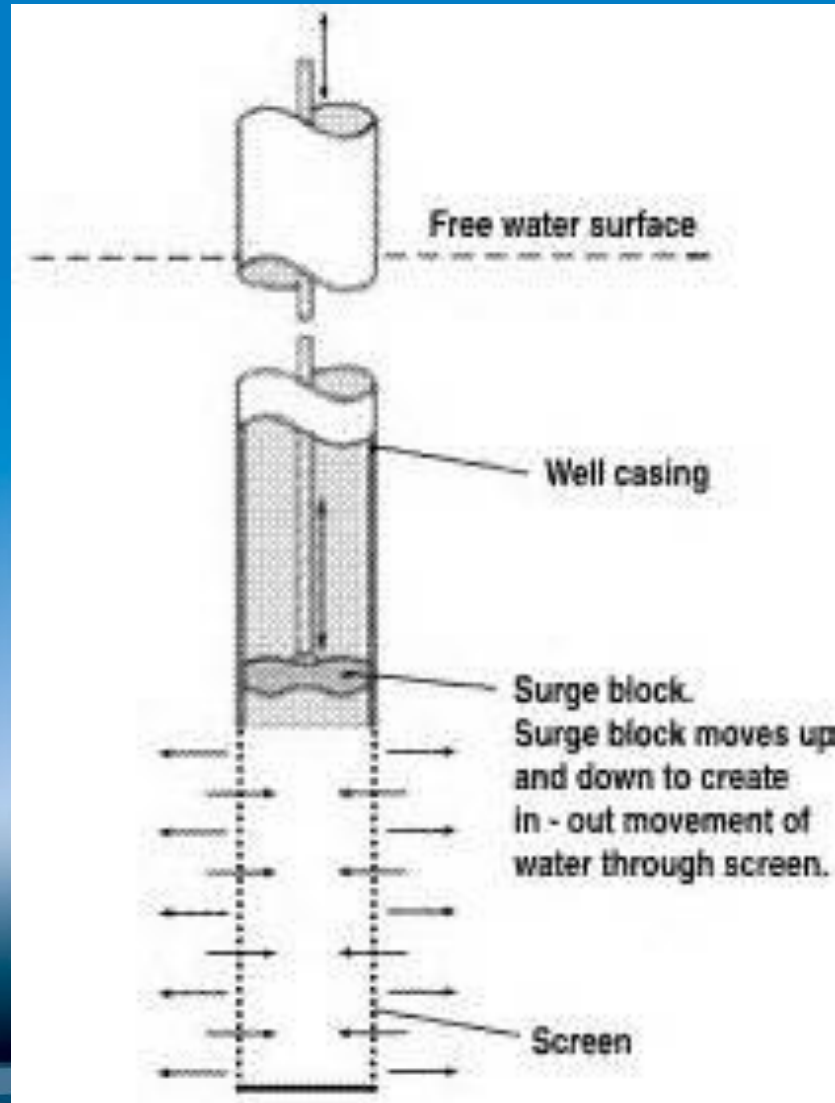
Well Development

- **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

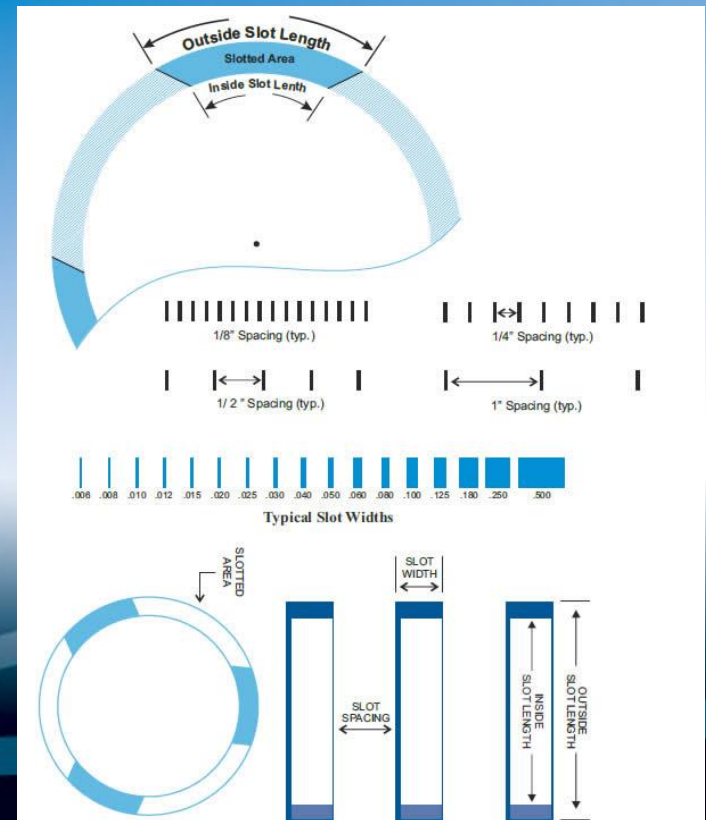


Let's Put the Pieces Together

- **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**

- **David Bardsley, P.G.**
- **Directed Technologies Drilling**
- **www.horizontaldrill.com**
- **david@horizontaldrill.com**
- **800.239.5950**