Distinguished Lecturer Program

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Selective Water Reduction Systems: Where Have We Been and Where Are We Going?

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Society of Petroleum Engineers
Distinguished Lecturer Program
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Outline

- General introduction to water issues, water production issues, chemical water control systems
- Discussion of mechanism, chemistry of selective systems
- Past and present selective systems
- Case histories
- Future of selective systems—improvements and new areas of usage

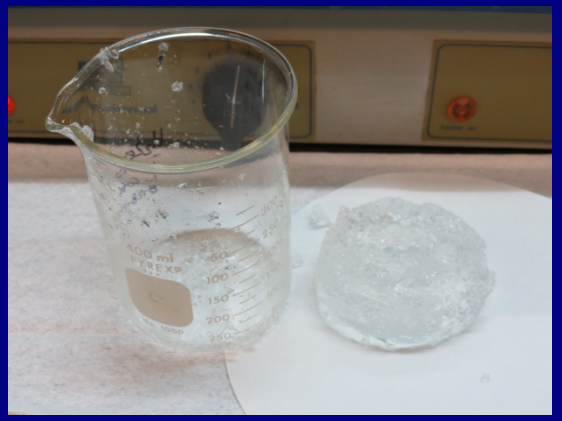
Cost of Water

Average Production of Oil Wells:
~ 3 BWPD/1 BOPD
To ~ 7 BWPD/ 1 BOPD

- Cost of water production
  - Expense to lift, dispose, and re-inject produced water
- Other associated problems
  - Sand production
  - Corrosion
  - Scale
  - OIL/GAS PRODUCTION DECLINE

Water Reduction Chemical Treatments

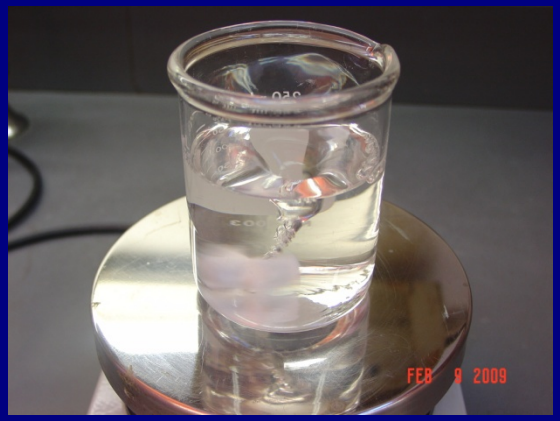
Timed Sealants

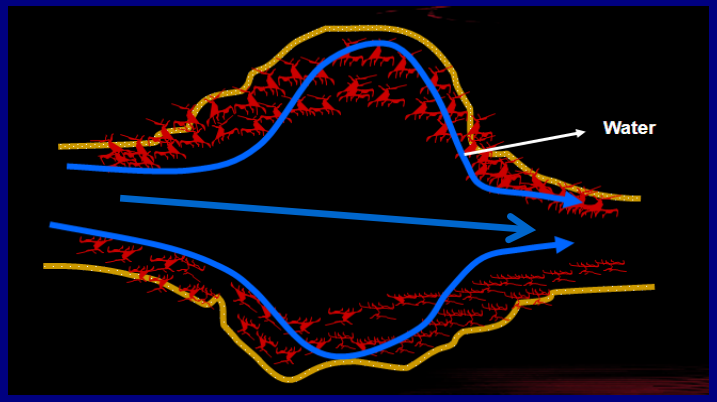


Completely Seal Treated Zone

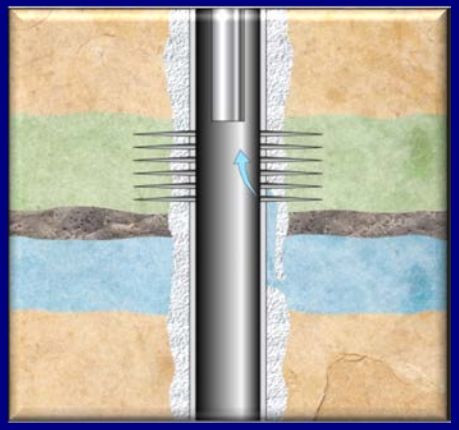
Selective Systems for Reducing Water

- Reduce water permeability more than oil/gas permeability
- Require no zonal isolation, bullhead treatments

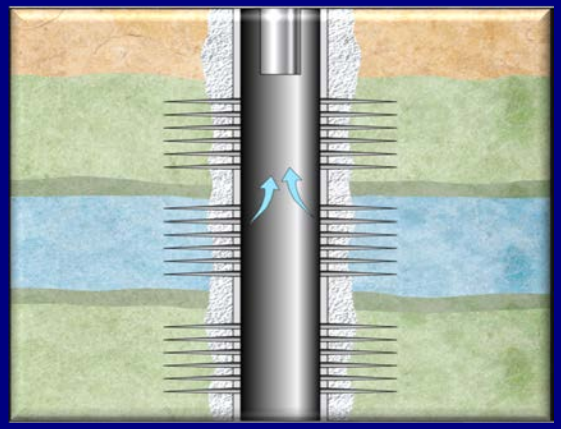




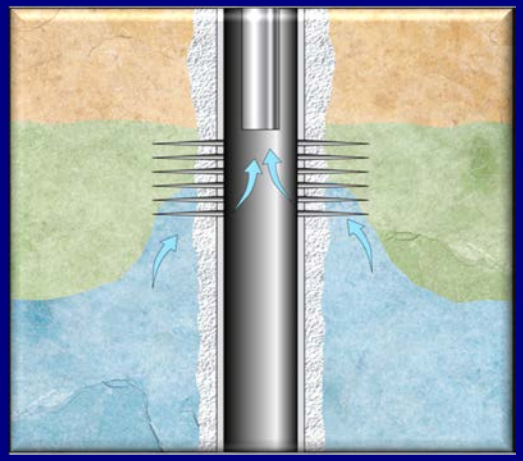
Water Production Problems
Near Wellbore/Reservoir



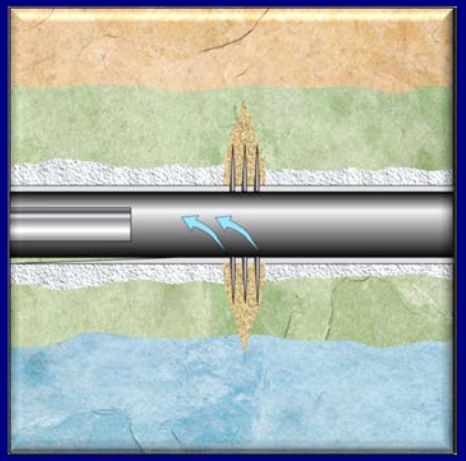
Fluid Flow Behind the Casing



Watered out zone

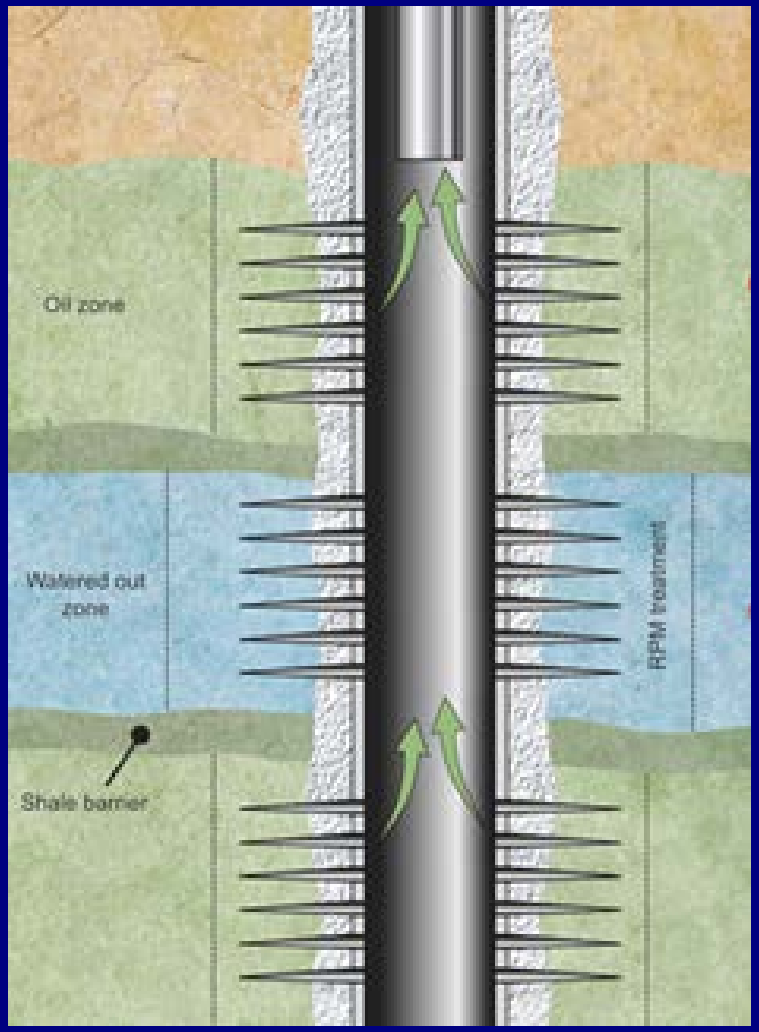


Water Coning

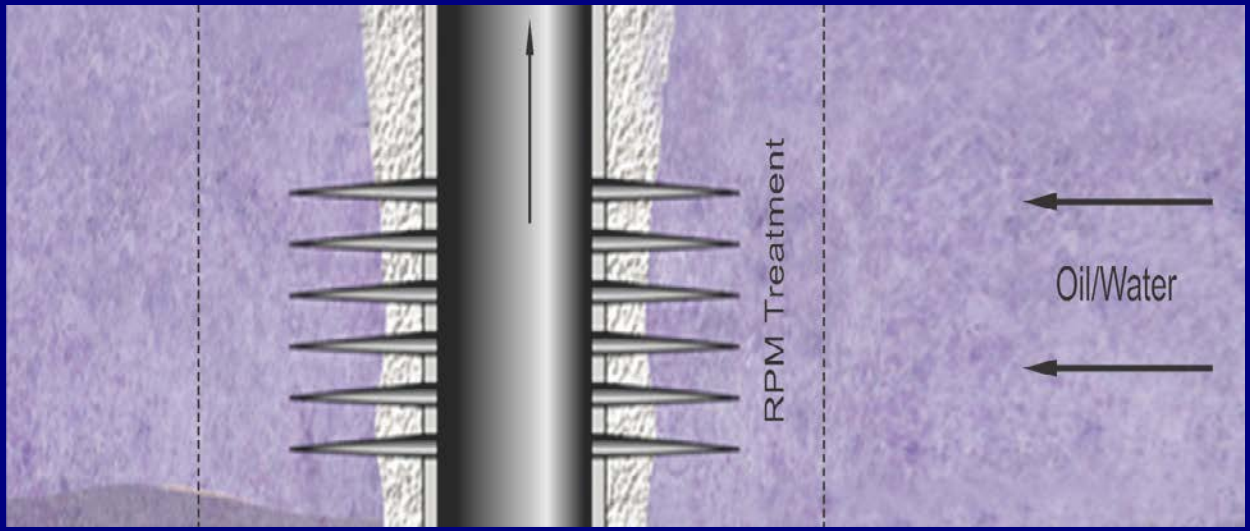


Hydraulic fracture intercepting
A water zone nearby

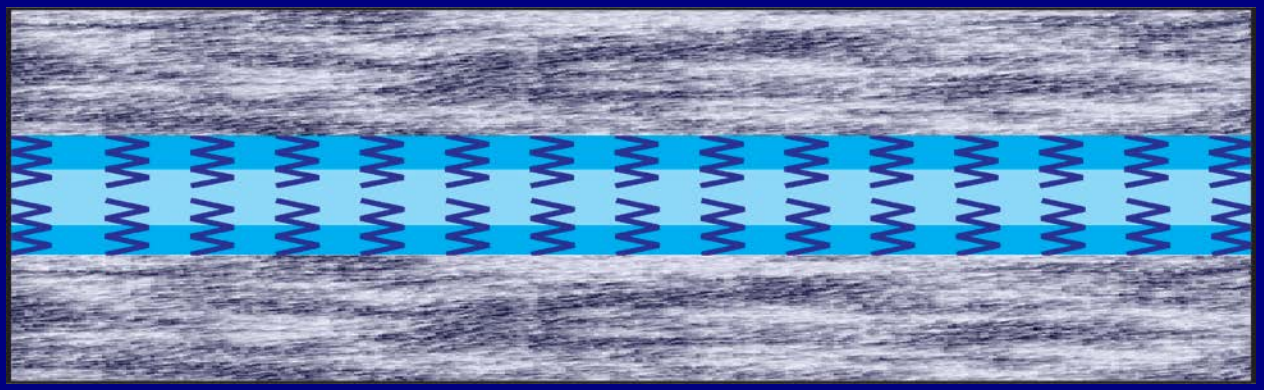
Ideal Candidate for a Water Control Treatment



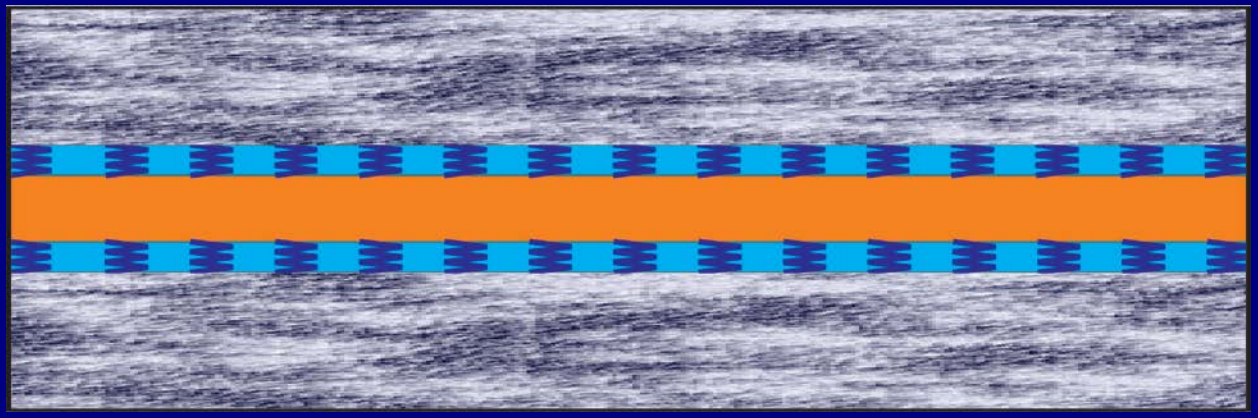
Poor Candidate for a Water Control Treatment



Selective System Mechanisms



polymer adsorption in water layer



polymer adsorption in oil layer

Where Have We Been: Chemistry, Lithology, Problems

Few products have seen sustained usage

Polyacrylamide

Xanthan

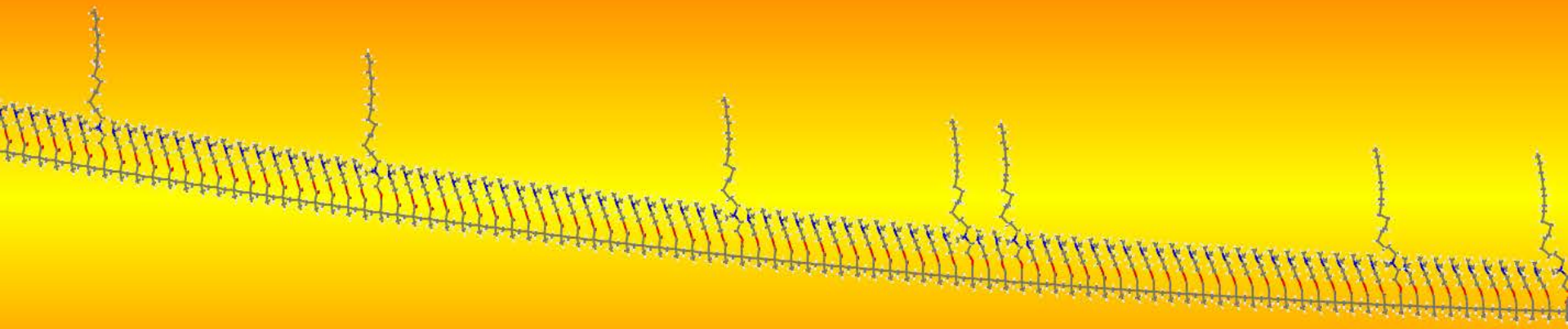
Scleroglucan

Acrylate copolymers

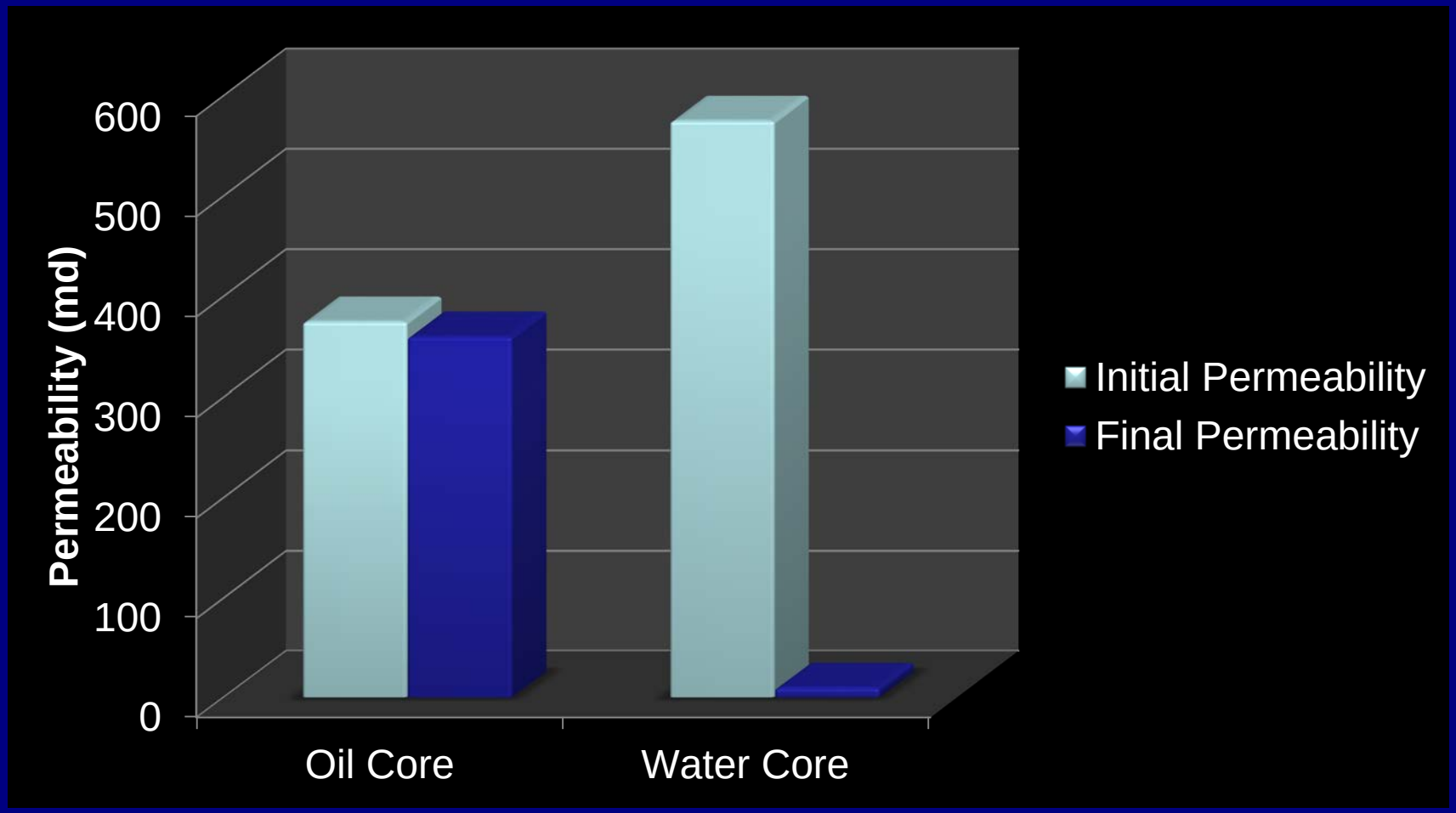
Sandstone, Carbonate

High-permeability streaks, coning, interwell communication, stimulation into water

Hydrophobically Modified Polymers



Typical Lab Results



Selective System

Sandstone Gas Reservoir

- 25 millidarcy
- 10 ft interval
- Bullhead treatment, 3% polymer solution, KCl brine + surfactant spearhead preflush

Selective System, Sandstone Gas Reservoir

	Water (BWPD)	**Gas (mscfd)**	**Water/Gas Ratio**
Before treatment	14	254	56
2 months after treatment	9	396	23
5 months after treatment	0	380	0

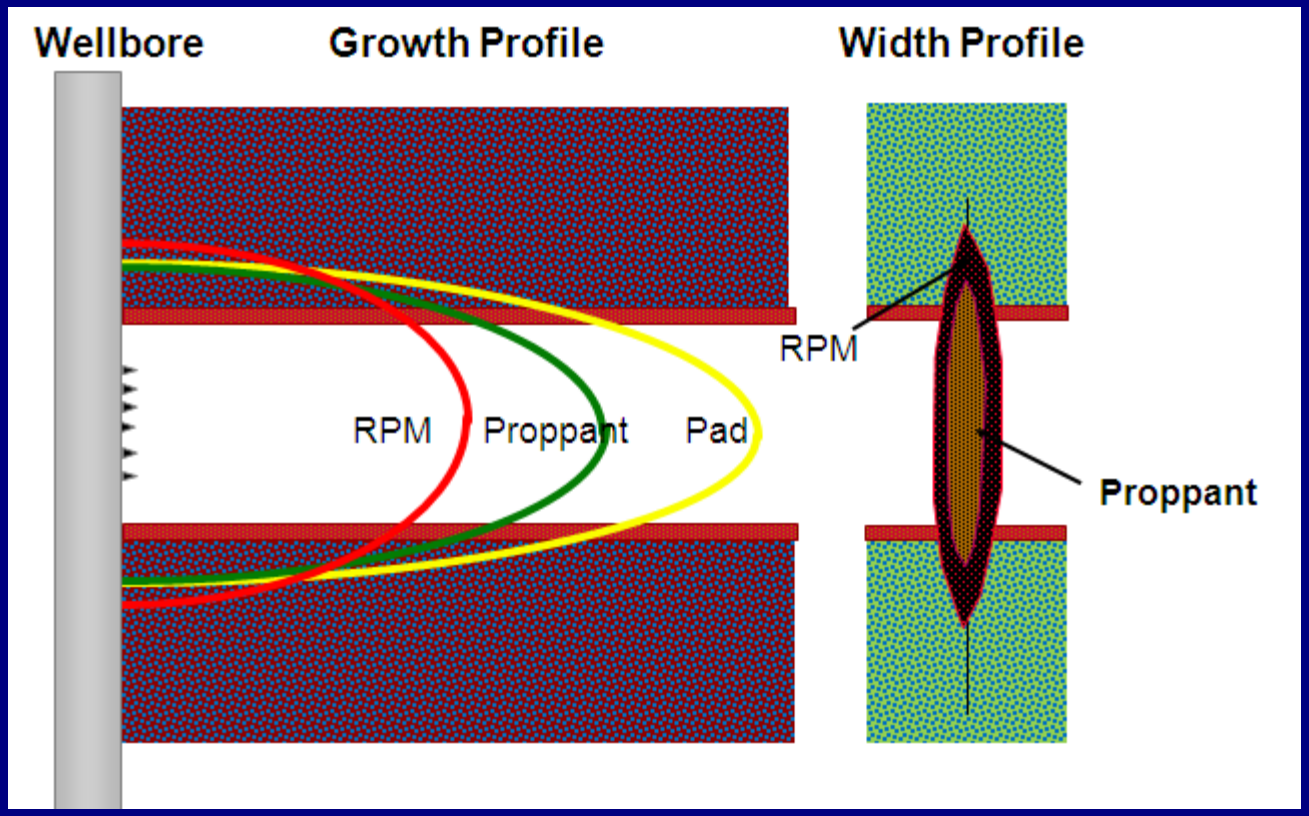
- ROI in 2 months
- Added value from less frequent de-watering

Where Are We Going?

- Selective systems have seen growth into new areas
  - Fracturing
  - Acidizing
  - Sand control
  - Coiled-tubing applications
- These have greatly increased the usage of these chemicals

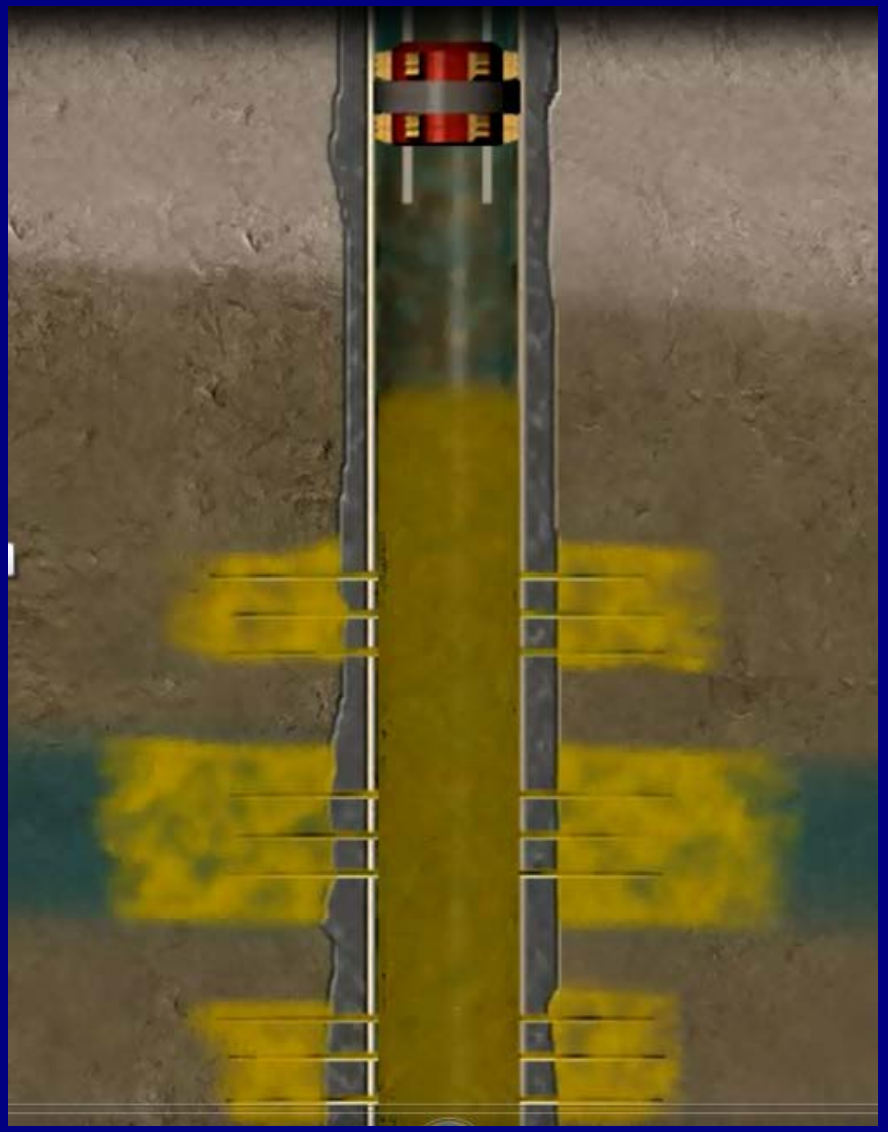
Combinations with Stimulation

Fracturing Applications

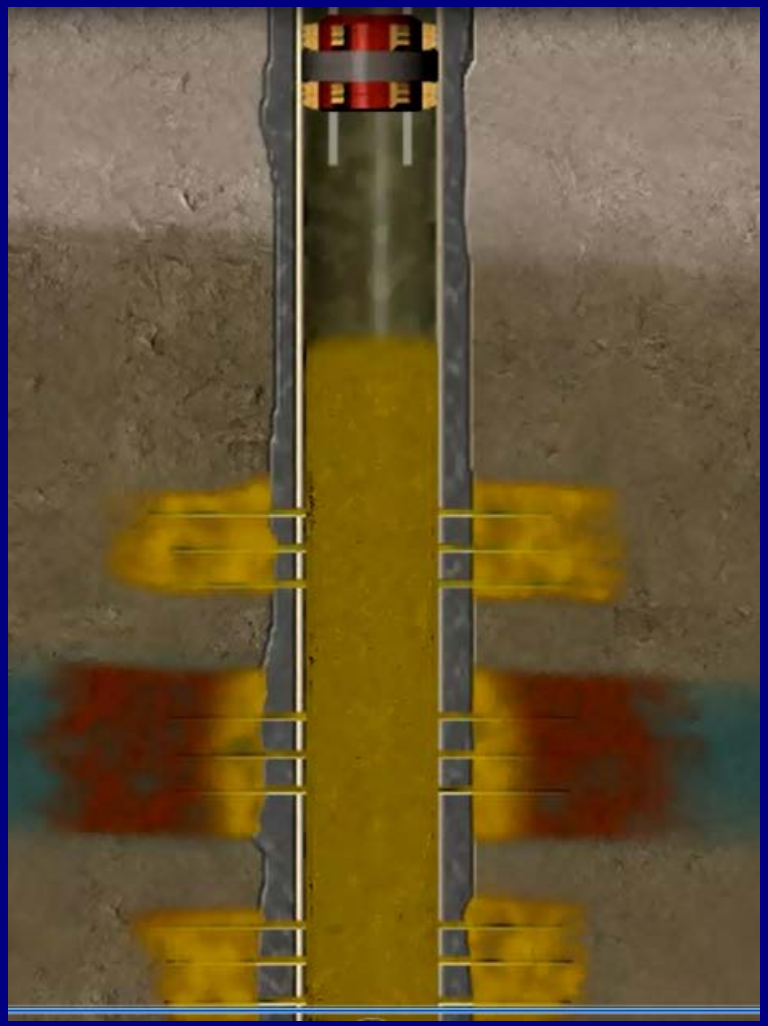


- SPE 84511
- Treated well had ~1/2 BWPD vs offset
- Treated well had 53% more oil vs offset

Acidizing Applications



Acidizing Applications



- SPE 103771
- Carbonate reservoir, 100% of acid treatments result in increased water cut
- 22% of treated wells showed decreased water cut, 67% no change in water cut, 11% increased water cut
- All treated wells showed substantially higher oil production than non-treated wells

Coiled Tubing Applications

- Coiled tubing & nitrogen clean out
- Horizontal open hole
- Could not maintain circulation
- Full circulation after 10 bbl Selective System pill

Where Are We Going?

- Improvements for water reduction are still needed
  - improved chemistries
  - more attention to candidate selection
    - Biggest obstacle may be over-selling
    - selective systems are not a cure-all for water production
- Growth areas – injection wells

Conclusions

- Conformance treatments can have many positive impacts
- Selective Systems are not the answer to all water production problems
- While numerous chemicals have been proposed as selective systems, few have seen sustained usage
- Major advancements for these systems have been seen in stimulation, sand control and coiled tubing applications and there appear to be growth opportunities into other areas

Take Home Thought

- **Selective Systems DO work and can be used for more than standard water reduction operations**
- **Think OUTSIDE THE BOX for new applications**

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