Hydraulic Fracturing 101

December 11, 2012
Overview

- The Early Days of Hydraulic Fracturing
- Why Hydraulic Fracturing is Utilized?
- Creation of Growth “Opening New Doors”
- Frac Fluid Ingredients
- Well Types
- The Process (animation)
- Alaska Regulations
- Frac Focus
- Summary
The Early Days of Frac

- Developed in the 1940s
- Helped produce more than 600 trillion cubic feet of natural gas and 7 billion barrels of oil
- A proven technology used safely for more than 60 years
- Utilized in more than a million wells
- Used to create spaces in the rock pores to release oil and natural gas

Source: fracfocus.org: A Historic Perspective
Why Hydraulic Fracturing is Utilized?

1. Improve well production
   Examples:
   Low permeable reservoirs - required to achieve economic production
   Medium permeable reservoirs - accelerate recovery from wells
   High permeable reservoirs - bypass drilling damage, increase reservoir contact

2. Add reserves

3. Make production of low-rate reservoirs economic

4. Improve recovery

5. Contact larger drainage areas
Opening New Doors

- Recovery of oil and natural gas from formations that geologists once believed were impossible to produce

- Extended production in older oil and natural gas fields (West Texas)

- 60 to 80 percent of all wells drilled in the United States in the next ten years will require hydraulic fracturing

- 25 percent of all wells to date in Alaska have been hydraulically fractured
# Frac Fluid (Common Household Ingredients)

<table>
<thead>
<tr>
<th>Compound</th>
<th>Purpose</th>
<th>Common application</th>
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</thead>
<tbody>
<tr>
<td>Acids</td>
<td>Helps dissolve minerals and initiate fissure in rock (pre-fracture)</td>
<td>Swimming pool cleaner</td>
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<tr>
<td>Sodium Chloride</td>
<td>Allows a delayed breakdown of the gel polymer chains</td>
<td>Table salt</td>
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<tr>
<td>Polyacrylamide</td>
<td>Minimizes the friction between fluid and pipe</td>
<td>Water treatment, soil conditioner</td>
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<tr>
<td>Ethylene Glycol</td>
<td>Prevents scale deposits in the pipe</td>
<td>Automotive anti-freeze, deicing agent, household cleaners</td>
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<tr>
<td>Borate Salts</td>
<td>Maintains fluid viscosity as temperature increases</td>
<td>Laundry detergent, hand soap, cosmetics</td>
</tr>
<tr>
<td>Sodium/Potassium</td>
<td>Maintains effectiveness of other components, such as crosslinkers</td>
<td>Washing soda, detergent, soap, water softener, glass,</td>
</tr>
<tr>
<td>Carbonate</td>
<td></td>
<td>ceramics</td>
</tr>
<tr>
<td>Glutaraldehyde</td>
<td>Eliminates bacteria in the water</td>
<td>Disinfectant, sterilization of medical and dental</td>
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<tr>
<td>Guar Gum</td>
<td>Thickens the water to suspend the sand</td>
<td>Thickener in cosmetics, baked goods, ice cream, toothpaste, sauces</td>
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<tr>
<td>Citric Acid</td>
<td>Prevents precipitation of metal oxides</td>
<td>Food additive; food and beverages; lemon juice</td>
</tr>
<tr>
<td>Isopropanol</td>
<td>Used to increase the viscosity of the fracture fluid</td>
<td>Glass cleaner, antiperspirant, hair coloring</td>
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Well Types

Vertical Wells
  – Single well from a surface location
  – Applicable for multiple vertical reservoir targets, multi-layer sands

Horizontal Wells
  – Primary drilling technique for oil and gas reservoirs
  – Multiple directional wells from a surface location: Smaller footprint
  – Applicable for single reservoir targets
Vertical & Horizontal Well Comparison

From ~4,000 to 11,000 feet (0.75 – 2 miles)

Source: American Petroleum Institute
Alaska Regulations

The AOGCC’s statutes and regulations

- Chapter 5 of Title 31 of the Alaska Statues
- Title 20, Chapter 25 of Alaska’s Administrative Code

These statutes and regulations include:

- Stringent well construction requirements
- Designed to protect underground sources of water
- Ensure mechanical integrity during production and injection operations

The AOGCC is required by statute to take extra measures to protect underground sources of drinking water in “nonconventional gas” operations, including hydraulic fracturing operations.

Frac Focus (www.fracfocus.org)

Pioneer is a participating company

What is Frac Focus?
A National hydraulic fracturing chemical registry
Managed by:
- The Ground Water Protection Council
- Interstate Oil & Gas Compact Commission

What is the purpose of Frac Focus?
To provide factual information concerning hydraulic fracturing and groundwater protection.

Source: www.fracfocus.org/welcome: About Us
Summary

History:
- A proven technology used safely for more than 60 years

Why is it used?
- To improve well production

Frac fluid ingredients:
- Water and sand make up 98 to 99.5 percent of the fluid
- Everyday common household goods

Regulations:
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References

- http://fracfocus.org
- http://api.org