The Marcellus and Fracturing (or fracking)

The Fiction and the Facts

Greg Kozera- Superior Well Services
Navy Chief Master At Arms Corey M. Kozera is with Riverine Group ONE. This photograph was taken on May 31, 2011, at Fort Knox, Ky., while conducting high-risk live fire “boots on ground” training for a Riverine Detachment prior to deployment.
United States Shale Gas Plays

~600 TCF of Estimated Gas in Place in the Marcellus Shale
False Evidence Appearing Real
Marcellus Activity – Active Drilling Rigs Across Play

155 Marcellus rigs
The Fiction

Hydraulic Fracturing ....
Is Not a Drilling Technique

It is part of the well completion process
Is Not New

First Fracs were in the 1940s
Is Not Explosive

We create a crack in the rock hydraulically with fluid
Does Not Cause Breast Cancer
Does Not Cause Hair Loss
Does Not Cause Homosexuality
Does NOT Pollute Ground Water

A little science and logic proves it
Casing Off Water and Coal
Does NOT, Cause Earthquakes

After 60 years of fracturing, come on
Hydraulic Fracturing IS Regulated
THE FACTS DON’T COUNT

UNLESS...
People Make Decisions on *Emotion* NOT Logic
Let’s Replace Fear with Facts
The Facts about Hydraulic Fracturing...
Over 90% of wells in the US require fracturing
Wells drilled in West Virginia

Over 140,000 wells in WV

Shallow wells hydraulically fractured
Where Does Natural Gas Really Come From?

Gas reside in the pores of the shale formation
Why do we frac?
Hydraulic Fracturing

- The process of injecting a fluid under pressure through wellbore to overcome native stresses and create a fracture or a fracture system in a porous medium.

- Generally a propping agent is also injected along with the fluid since hydraulically formed fractures tend to heal after parting pressure is released.
Photo 1 A hydraulic fracture propped with white sand in the roof coal at Dartbrook Coal Mine, NSW.

By placing sufficient proppant in a hydraulic fracture that extends a sufficient distance, a conductive channel is
HydraulicallyFractured Horizontal Well

Horizontal drilling has enabled higher well efficiencies despite the higher costs versus traditional vertical wells.
Fracturing Fluids

- Water
- Foam
- Crosslinked foam or water
- Nitrogen
- Other
Treatment Control Center
What about those chemicals?
A FLUID SITUATION: TYPICAL SOLUTION* USED IN HYDRAULIC FRACTURING

0.49% ADDITIVES*

99.51% WATER AND SAND

<table>
<thead>
<tr>
<th>Compound*</th>
<th>Purpose</th>
<th>Common application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquea</td>
<td>Helps dissolve minerals and biocides/tissues in rock [pre-fracture]</td>
<td>Swimming pool cleaner</td>
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<tr>
<td>Glutaraldehyde</td>
<td>Eliminates bacteria in the water</td>
<td>Disinfectant, sterilizer for medical and dental equipment</td>
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<tr>
<td>Sodium Chloride</td>
<td>Allows a delayed break down of the gel polymer chains</td>
<td>Table Salt</td>
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<tr>
<td>N, n-Dimethyl formamide</td>
<td>Prevents the corrosion of the pipe</td>
<td>Used in pharmaceuticals, acrylic fibers and plastics</td>
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<tr>
<td>Borate salts</td>
<td>Maintains fluid viscosity as temperature increases</td>
<td>Used in laundry detergents, hand soaps and cosmetics</td>
</tr>
<tr>
<td>Polyacrylamide</td>
<td>Minimizes friction between fluid and pipe</td>
<td>Water treatment, soil conditioner</td>
</tr>
<tr>
<td>Petroleum distillates</td>
<td>&quot;Slips&quot; the water to minimize friction</td>
<td>Make-up remover, laxative, and candy</td>
</tr>
<tr>
<td>Guar gum</td>
<td>Thickens the water to suspend the sand</td>
<td>Thicker used in cosmetics, baked goods, ice cream, toothpaste, cereals, and oil drilling</td>
</tr>
<tr>
<td>Citric Acid</td>
<td>Prevents precipitation of metal cations</td>
<td>Food additive, food and beverages, lemon juice</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>Creates a brine carrier fluid</td>
<td>Low sodium table salt substitute</td>
</tr>
<tr>
<td>Ammonium bisulfite</td>
<td>Removes oxygen from the water to protect the pipe from corrosion</td>
<td>Cosmetics, food and beverage processing, water treatment</td>
</tr>
<tr>
<td>Sodium or potassium carbonate</td>
<td>Maintains the effectiveness of other components, such as crosslinkers</td>
<td>Washing soda, detergents, soap, water softener, glass and ceramics</td>
</tr>
<tr>
<td>Proppant</td>
<td>Allows the fluids to remain open so the gas can escape</td>
<td>Drinking water, filtration, play sand</td>
</tr>
<tr>
<td>Ethylene glycol</td>
<td>Prevents scale deposits in the pipe</td>
<td>Automotive and food, household cleaners, delinking, and cast iron</td>
</tr>
<tr>
<td>Isopropanol</td>
<td>Used to increase the viscosity of the fracture fluid</td>
<td>Glass cleaner, antiperspirant, and hair color</td>
</tr>
</tbody>
</table>

On average, 99.5% of fracturing fluids are comprised of freshwater and compounds are injected into deep shale gas formations and are typically confined by many thousands of feet or rock layers.


*The specific compounds used in a given fracturing operation will vary depending on source water quality and site-specific parameters of the target formation. The compounds listed above are representative of the major material components used in hydraulic fracturing of natural gas shales. Composition is approximate.
WFR-3B

- 2009 World Oil Award Winner
  - Best Drilling Completion and Production Fluid
- 2010 Hart Award for Innovation.
- Base Polymer has NSF Approval
- No EDC Issues
- Patented FR chemical
- Thermal Stability
- Application Dosages 4.5% of LC50 for C. dubia and P. promelas
- Designed to be used in flow back water so subsequent jobs require less fresh water withdraw from environment
1. Fresh Water

2. Frac

3. Store Flow Back

4. Analyze and Treat Flow Back

5. Store Treated Water

6. Determine Chemical Loading for Frac Fluids.

7. Reuse Treated Flow Back Water

stationary facility or mobile remediation
Mobil remediation strategy for flow back water reuse

- Reuse rather than release
- Transportation savings
As Americans we have access to unlimited information.

For the Sake of our Children and Grandchildren shouldn’t we make sure what we believe is true?
We are Americans

Anything is Possible!
Special Thanks to

Energy in Depth
IPAA
Just Beneath the Surface
Superior Well Services
The Virginia Oil & Gas Assoc.
WVONGA
WVU Petroleum Engineering