



FracFocus - A Tool for Disclosing Chemical Usage in Hydraulic Fracturing Fluids

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20th IPEC

San Antonio, TX

November 11-14, 2013

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Topics for Discussion

- Importance of shale gas
- Issues and concerns
- Hydraulic fracturing
- Chemical additives
- Disclosure of chemicals to the public
- FracFocus

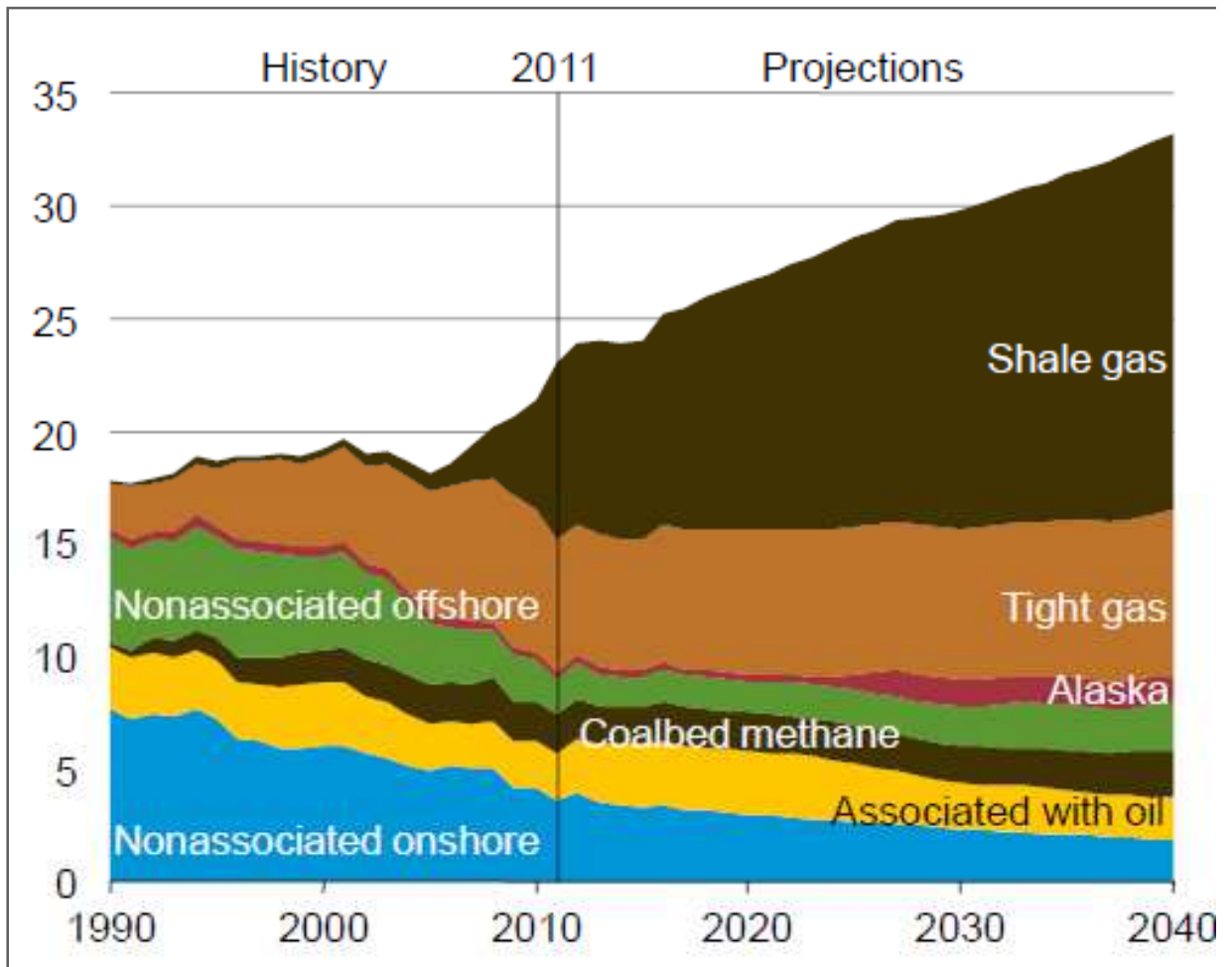




Shale Gas - Introduction

Importance of Shale Gas to the USA

- Natural gas is an important energy source for the United States. Shale formations represent a growing source of natural gas for the nation and are among the busiest oil and gas plays in the country.



Source: DOE/EIA Annual Energy Outlook 2013

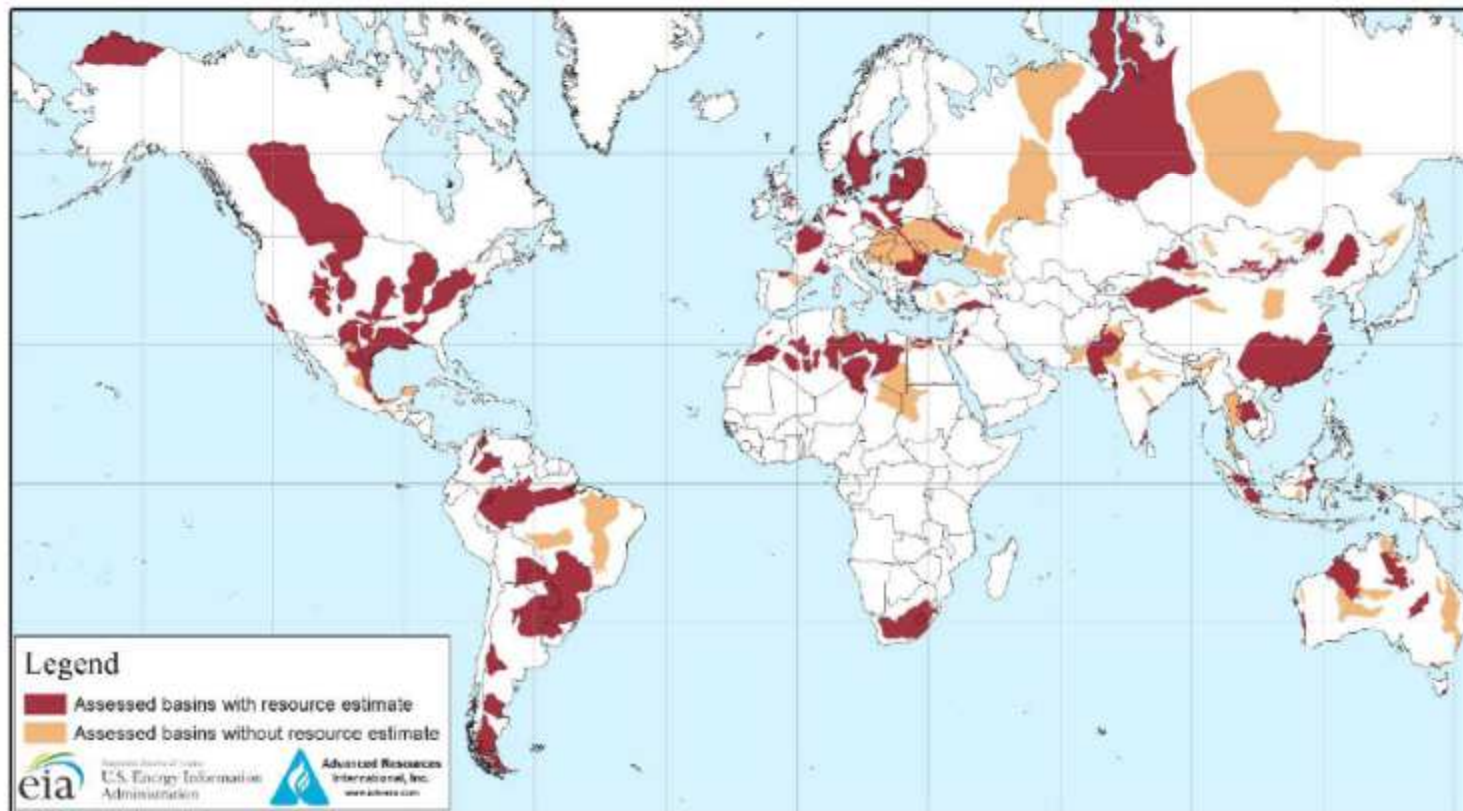


Shale Plays in Other Parts of the World

2013 Report on Global Shale Oil and Gas Reserves

- U.S. Department of Energy released a new report in June 2013 that assessed 137 shale formations in 41 countries.
 - Prepared by Advanced Resources International

<http://www.eia.gov/analysis/studies/worldshalegas/>



Risked Shale Gas and Oil In-Place and Technically Recoverable - by Continent

Continent	Shale Gas (Tcf)	Shale Oil (billion bbl)
North America (Ex. U.S.)	1,118	21.9
Australia	437	17.5
South America	1,431	59.7
Europe	883	88.6
Africa	1,361	38.1
Asia	1,403	61.1
Sub-Total	6,634	286.9
U.S.	1,161	47.7
Total	7,795	334.6

Source: Advanced Resources 2013

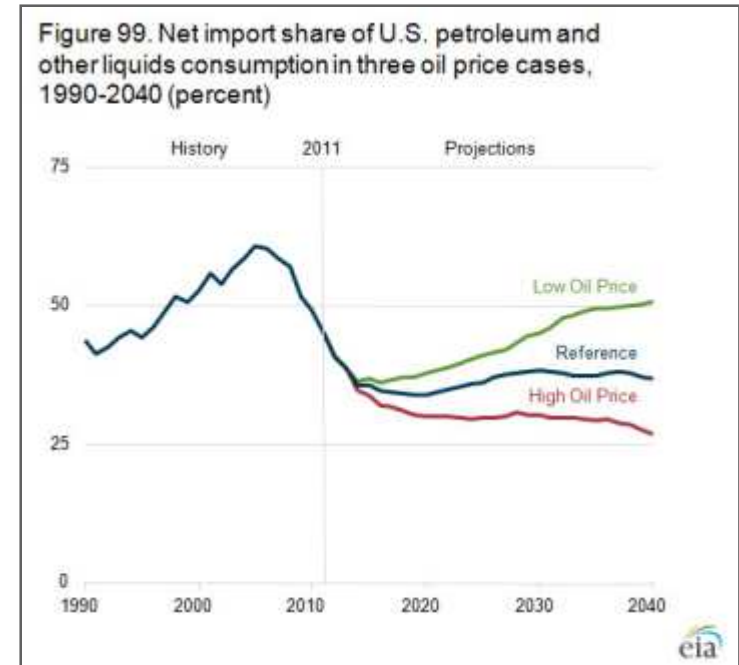
Estimated Technically Recoverable Shale Oil and Gas Resources - Top 10 Countries

Technically Recoverable Shale Gas Resources (Tcf)		Technically Recoverable Shale Oil Resources (Billion Barrels)	
1. U.S.	1,161	1. Russia	75
2. China	1,115	2. U.S.	48
3. Argentina	802	3. China	32
4. Algeria	707	4. Argentina	27
5. Canada	573	5. Libya	26
6. Mexico	545	6. Australia	18
7. Australia	437	7. Venezuela	13
8. South Africa	390	8. Mexico	13
9. Russia	285	9. Pakistan	9
10. Brazil	245	10. Canada	9
11. Others	1,535	11. Others	65
TOTAL	7,795	TOTAL	335

Source: Advanced Resources 2013

Implications of Shale Oil and Gas Production for the USA

- Significantly lowered our imports (often from unsettled parts of the world)
- Less than a decade ago, the U.S. planned to open a series of LNG import terminals. Now those are no longer being planned. Instead, there are plans for LNG exports (pending political approval).
- Natural gas prices remain low for home owners and factories.
- Energy policy is shifting to rely more heavily on gas-fired power plants and vehicles.
- Jobs are brought to previously depressed areas
- Tax revenue make substantial contributions to state and local governments



Perceived Issues and Concerns Relating to Shale Oil and Gas Production

1. Increasing production of inexpensive oil and gas delays the transition to renewable energy sources.
2. Shale gas uses too much water – often in arid areas
3. Opponents have various vested interests against additional oil and gas development
4. Slickly made Hollywood productions (e.g., Gasland, Promised Land) use photogenic and likeable actors to convey a message that is only partially based on facts
5. Shale gas wastewater (flowback and produced water) are a serious problem
6. Shale gas and frac jobs create too much air emissions and greenhouse gases
7. Increased truck traffic on rural roads
8. Other socioeconomic issues
9. Use of chemicals in drilling and fracturing



Hydraulic Fracturing (HF)



Frac Job Pumps Large Volume of Water, Sand, and Additives into the Well in Stages





Why Is Hydraulic Fracturing Used?

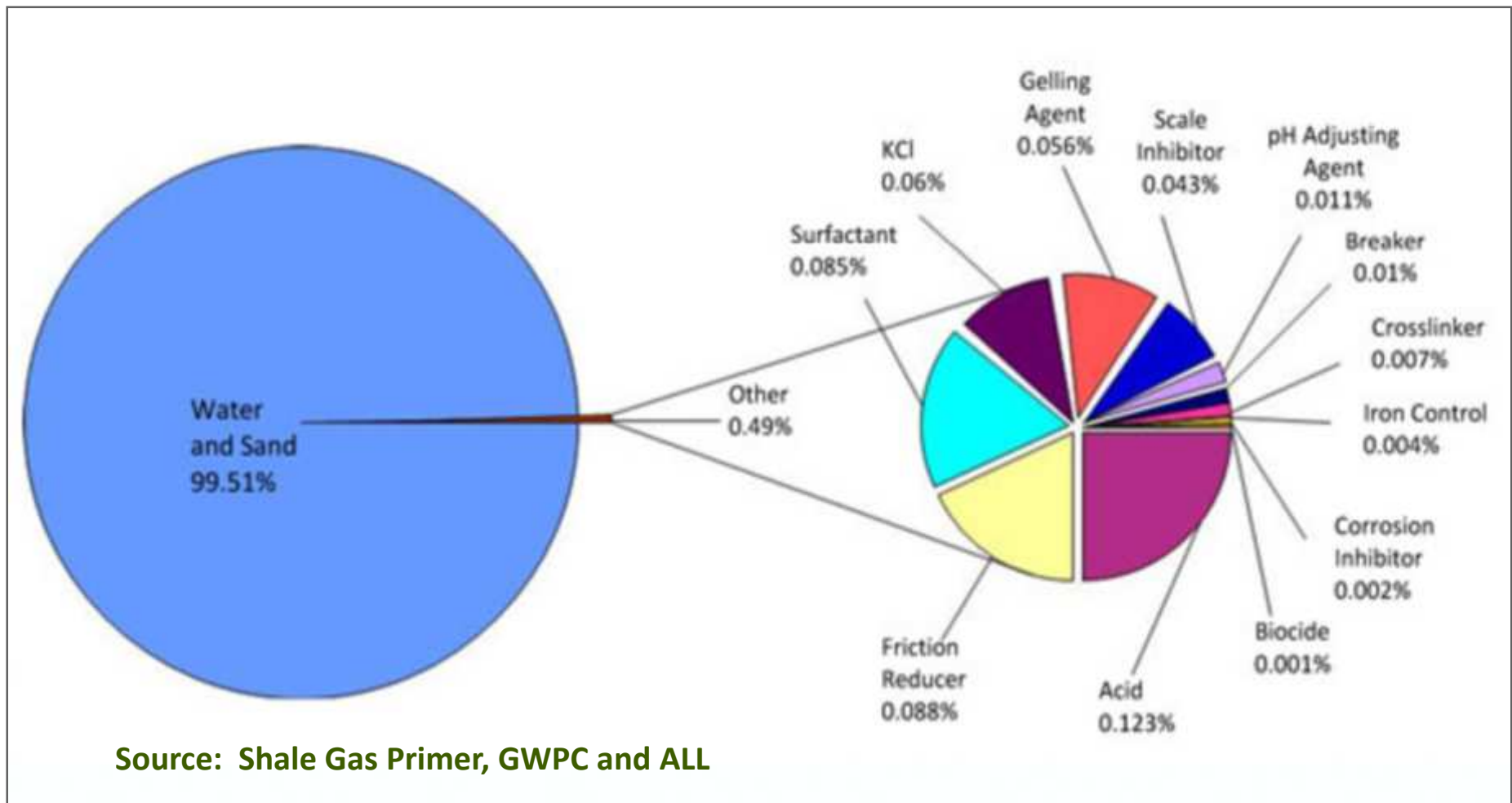
- Shale rock is very dense and has low permeability
 - Hydraulic fracturing creates a network of small cracks in the rock that extend out as far as 1,000 feet laterally and vertically away from the well
- Virtually no shale gas wells in the U.S. would be developed unless hydraulic fracturing is done
- It is controversial and expensive, but is a critical element in cost-effective production



Chemicals in Frac Fluids

Frac Fluid Composition

- Water makes up ~90% of volume
- Sand makes up ~10% of volume
- All other chemical additives make up ~0.5% of volume



Why Chemical Additives Are Used

Additive Type	Main Compound(s)	Purpose	Common Use of Main Compound
Diluted Acid (15%)	Hydrochloric acid or muriatic acid	Help dissolve minerals and initiate cracks in the rock	Swimming pool chemical and cleaner
Biocide	Glutaraldehyde	Eliminates bacteria in the water that produce corrosive byproducts	Disinfectant; sterilize medical and dental equipment
Breaker	Ammonium persulfate	Allows a delayed break down of the gel polymer chains	Bleaching agent in detergent and hair cosmetics, manufacture of household plastics
Corrosion Inhibitor	N,n-dimethyl formamide	Prevents the corrosion of the pipe	Used in pharmaceuticals, acrylic fibers, plastics
Crosslinker	Borate salts	Maintains fluid viscosity as temperature increases	Laundry detergents, hand soaps, and cosmetics
Friction Reducer	Polyacrylamide	Minimizes friction between the fluid and the pipe	Water treatment, soil conditioner
	Mineral oil		Make-up remover, laxatives, and candy
Gel	Guar gum or hydroxyethyl cellulose	Thickens the water in order to suspend the sand	Cosmetics, toothpaste, sauces, baked goods, ice cream

Source: Shale Gas Primer, GWPC and ALL

Why Chemical Additives Are Used (2)

Iron Control	Citric acid	Prevents precipitation of metal oxides	Food additive, flavoring in food and beverages; Lemon Juice ~7% Citric Acid
KCl	Potassium chloride	Creates a brine carrier fluid	Low sodium table salt substitute
Oxygen Scavenger	Ammonium bisulfite	Removes oxygen from the water to protect the pipe from corrosion	Cosmetics, food and beverage processing, water treatment
pH Adjusting Agent	Sodium or potassium carbonate	Maintains the effectiveness of other components, such as crosslinkers	Washing soda, detergents, soap, water softener, glass and ceramics
Proppant	Silica, quartz sand	Allows the fractures to remain open so the gas can escape	Drinking water filtration, play sand, concrete, brick mortar
Scale Inhibitor	Ethylene glycol	Prevents scale deposits in the pipe	Automotive antifreeze, household cleansers, and de-icing agent
Surfactant	Isopropanol	Used to increase the viscosity of the fracture fluid	Glass cleaner, antiperspirant, and hair color

Source: Shale Gas Primer, GWPC and ALL




Disclosure of Chemical Additives

- One of the most contentious issues surrounding HF is that companies have not historically shared detailed information with regulators or the public on which chemicals are actually used in frac jobs
- Even if the chemicals used are not harmful, the public has concerns over the unknown and does not trust the industry to safeguard them
- Some information can be obtained from the Material Safety Data Sheets (MSDSs)

Example MSDS

- Selected sections of the MSDS for NALCO EC 6116A are shown here

9. PHYSICAL AND CHEMICAL PROPERTIES	
PHYSICAL STATE	Liquid
APPEARANCE	Clear Colorless Amber
ODOR	Mild, Disinfectant
SPECIFIC GRAVITY	1.20 - 1.30 @ 73 °F / 23 °C
DENSITY	10.0 - 10.8 lb/gal
SOLUBILITY IN WATER	Complete
pH (100 %)	1.5 - 5.0
VISCOSITY	138 cps @ 68 °F / 20 °C
POUR POINT	-49 °F / -45 °C
FREEZING POINT	-58 °F / -50 °C
BOILING POINT	> 158 °F / > 70 °C Decomposes
VAPOR PRESSURE	< 0.1 mm Hg @ 70 °F / 21 °C
VOC CONTENT	9.85 % EPA Method 24



SAFETY DATA SHEET

PRODUCT
EC6116A

EMERGENCY TELEPHONE NUMBER(S)
(800) 424-9300 (24 Hours) CHEMTREC

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME : EC6116A
 APPLICATION : BIOCIDES

COMPANY IDENTIFICATION : Nalco Company
 1601 W. Diehl Road
 Naperville, Illinois
 60563-1198

EMERGENCY TELEPHONE NUMBER(S) : (800) 424-9300 (24 Hours) CHEMTREC

NFPA 704M/HMIS RATING
 HEALTH : 3/3* FLAMMABILITY : 1/1 INSTABILITY : 1/1 OTHER :
 0 = Insignificant 1 = Slight 2 = Moderate 3 = High 4 = Extreme * = Chronic Health Hazard

2. COMPOSITION/INFORMATION ON INGREDIENTS

Our hazard evaluation has identified the following chemical substance(s) as hazardous. Consult Section 15 for the nature of the hazard(s).

Hazardous Substance(s)	CAS NO	% (w/w)
Dibromoacetonitrile	3252-43-5	1.0 - 5.0
2,2-Dibromo-3-nitropropionamide	10222-01-2	10.0 - 30.0
Polyethylene Glycol	25322-68-3	30.0 - 60.0

Chemical Disclosure Registry

- MSDSs provide some but not necessarily all of the information that regulators and the public want or need
- In April 2011, the Ground Water Protection Council and the Interstate Oil and Gas Compact Commission opened a new online system to host information about the chemical additives used in frac fluids and their ingredients
- Any interested person can visit the website and search for data on a specific well
- As of mid-October 2013, data had been entered on more than 57,000 wells representing over 540 oil and gas companies

www.fracfocus.org

Frac Focus Homepage

[Home](#) / [Welcome](#) / [Publications](#) / [News & Updates](#) / [Links](#)



HYDRAULIC FRACTURING
HOW IT WORKS

GROUNDWATER PROTECTION

CHEMICAL USE

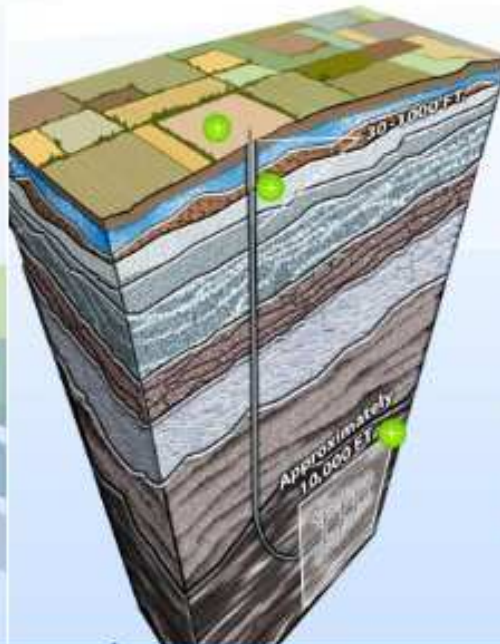
REGULATIONS BY STATE

FIND A WELL BY STATE

FREQUENT QUESTIONS



[LEARN MORE >](#)



Hydraulic Fracturing

This technique uses a fluid pumped into a well under pressure to create fractures in rock formations. These fractures allow oil and gas to flow more easily to the wellbore for production.

[MORE ABOUT IT](#)

Looking for information about a well site near you?



Search for nearby well sites that have been hydraulically fractured to see what chemicals were used in the process.

FAQs

1 / 3

any area that I search for?

Q. Do states conduct ongoing monitoring of water wells and oil and gas construction?

it either the wells are new or they are part of an existing system. Any 1st will be

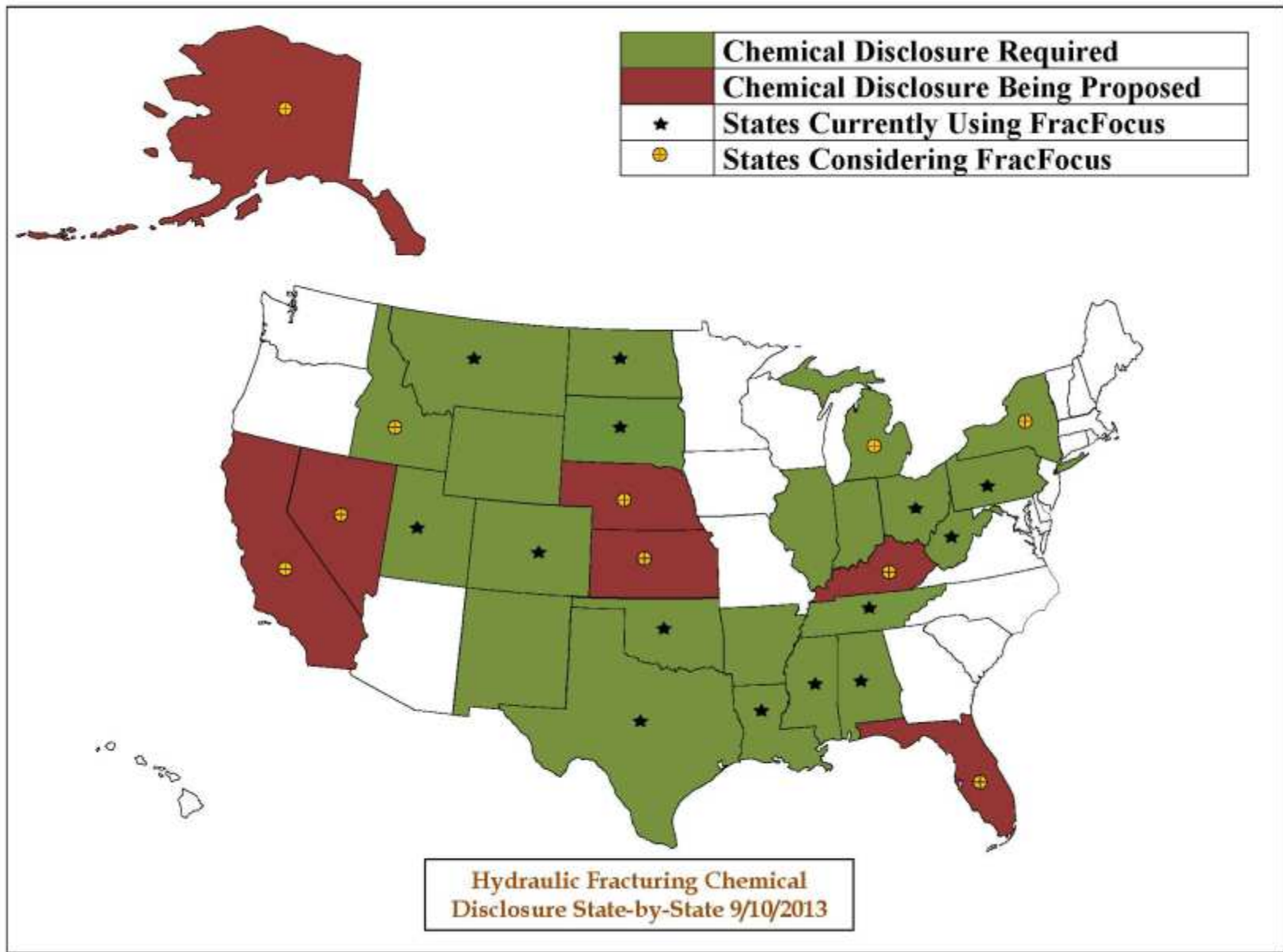
A. It depends on the state. When water wells, many states have construction standards but not requirements. As regards the c

Is groundwater

Groundwater Protection: Priority Number One

Example of Registry Record for Well in Texas

Trade Name	Supplier	Purpose	Ingredients	Chemical Abstract Service Number (CAS #)	Maximum Ingredient Concentration in Additive (% by Mass)**	Maximum Ingredient Concentration in HF Fluid (% by Mass)**
Fresh Water		Carrier/Base Fluid				86.12803%
Sand (Proppant)		Proppant				12.83614%
Acid, 15% HCl	CUDD ENERGY SERVICES	Acid	Water	007732-18-5	85.00%	0.06070%
			Hydrochloric Acid	007647-01-0	15.00%	0.01071%
I-22	CUDD ENERGY SERVICES	Corrosion Inhibitor	Formic Acid	000064-18-6	60.00%	0.00053%
			Aromatic aldehyde	N/A	30.00%	0.00026%
			Haloalkyl heteropolycycle salt	N/A	30.00%	0.00026%
			Oxyalkylated Fatty Acid	N/A	30.00%	0.00026%
			Isopropanol	000067-63-0	5.00%	0.00004%
			Methanol	000067-56-1	5.00%	0.00004%
			Organic sulfur compound	N/A	5.00%	0.00004%
			Quaternary ammonium compound	N/A	5.00%	0.00004%
			Benzyl Chloride	000100-44-7	1.00%	0.00001%
SG-15M	CUDD ENERGY SERVICES	Gelling Agent	Petroleum Distillate	064742-47-8	55.00%	0.06860%
			Guar Gum	009000-30-0	50.00%	0.06236%
			Clay	014808-60-7	2.00%	0.00249%
			Surfactant	068439-51-0	2.00%	0.00249%
BUFFER H	CUDD ENERGY SERVICES	pH Adjusting Agent	Water	007732-18-5	94.50%	0.02070%
			Sodium Hydroxide	001310-73-2	51.50%	0.01128%
			Sodium Chloride	007647-14-5	5.00%	0.00110%
GB-4	CUDD ENERGY SERVICES	Breaker	Proprietary	N/A	100.00%	0.00120%
CX-14G	CUDD ENERGY SERVICES	Cross Linker	Petroleum Distillate Hydrotreated Light	064742-47-8	60.00%	0.01454%
GB-2	CUDD ENERGY SERVICES	Breaker	Ammonium Persulfate	007727-54-0	100.00%	0.00083%
NE-21	CUDD ENERGY SERVICES	Non-Emulsifier	Methanol	000067-56-1	30.00%	0.01218%
			Oxyalkylated alcohols	N/A	30.00%	0.01218%
			Ethoxylated Alcohols	N/A	10.00%	0.00406%
CX-14A	CUDD ENERGY SERVICES	Cross Linker	Sodium Tetraborate	001330-43-4	25.00%	0.00056%
CS-125C	CUDD ENERGY SERVICES	Clay Stabilizer	No Hazardous Components	NONE		0.00000%
FRA-4	CUDD ENERGY SERVICES	Friction Reducer	No Hazardous Components	NONE		0.00000%
MC B-8642 (WS)	MULTI-CHEM GROUP LLC	Anti-Bacterial Agent	Glutaraldehyde (Pentanediol)	000111-30-8	60.00%	0.01180%
			Quaternary Ammonium Compound	068424-85-1	10.00%	0.00197%
			Ethanol	000064-17-5	1.00%	0.00020%
MC S-2510T (WS)	MULTI-CHEM GROUP LLC	Scale Inhibitor	Ethylene Glycol	000107-21-1	60.00%	0.00605%
			Sodium Hydroxide	001310-73-2	5.00%	0.00050%



Source: GWPC

FracFocus 2.0

- The original FracFocus (now referred to as FracFocus 1.0) was developed to fill an important gap in public disclosure information
 - The programming and system design were done in a way that allowed FracFocus 1.0 to get underway quickly in early 2011
- As the volume of information entered into the system grew, industry, GWPC, and IOGCC realized that a more efficient data management system was needed
 - This led to the development of FracFocus 2.0 during 2012
- As of June 1, 2013 all data needed to be entered using the FracFocus 2.0 mechanism

Public Output of FracFocus 2.0

- External FracFocus users (the public) can search for wells using a map or a standard interface (standard is faster)



The screenshot shows the FracFocus 2.0 website homepage. The top navigation bar includes links for Home, About Us, Publications, News & Updates, Links, Operator Training Website, Register A Reporting Company, and Log in. The main navigation menu features: HYDRAULIC FRACTURING, GROUNDWATER PROTECTION, CHEMICAL USE, REGULATIONS BY STATE, FIND A WELL BY STATE, and FREQUENTLY ASKED QUESTIONS. The main content area is divided into several sections:

- 1st Year:** A large section titled "1st YEAR" with the subtitle "COMPANIES. THOUSANDS OF WELLS." It includes text about the site's national impact and a "WATCH THE VIDEO" button.
- Geological Diagram:** A 3D cross-section of the earth's subsurface layers.
- Map:** A map of the United States with a "FIND A WELL" button overlaid. A red arrow points to this button.
- Statistics:** A section titled "TOTAL WELL SITES REGISTERED" with a digital display showing "34489".
- FAQs:** A section titled "FAQs" with a question: "How much information is contained in the backfiring records?" and a question mark icon.

At the bottom, there is a section titled "Is groundwater protected?" with the subtitle "Groundwater Protection: Priority Number One" and text stating that oil and natural gas producers have stringent requirements for how wells must be constructed.

Use Standard Search

Find a Well

Map Search Standard Search

SEARCH OPTIONS

STATE:

Pennsylvania

COUNTY:

Bradford

WELLS IN COUNTY:

Choose a Well Name

OPERATOR:

VE Producer

API WELL NUMBER:

____-____-____

WELL NAME:

FIND CAS NUMBER

____-____-____

[clear](#)

BUILD DATE FILTER

[clear](#)

INGREDIENT LIST

[clear](#)


SEARCH


RESET

(Note: One search option is required to do a search.)

Results of Search

Find a Well

 Back To Search



API No.	Job Start Dt	Job End Dt	State	County	Operator	WellName	Latitude	Longitude	Datum
 37-015-22148-00-00	12/3/2012	12/6/2012	Pennsylvania	Bradford	VE Producer	Test Well #1	41.803613	-76.223895	NAD27

- Click on .pdf icon

Display the Public Disclosure Report in .pdf Format

- Header information
- Additives with MSDSs
- Additives without MSDSs

Hydraulic Fracturing Fluid Product Component Information Disclosure

Job Start Date	12/3/2012
Job End Date	12/6/2012
State	Pennsylvania
County	Bradford
API Number	37-015-22148
Operator Name	VE Producer
Well Name and Number	Test Well #1
Longitude	-78.22386000
Latitude	41.80361300
Datum	NAD27
Federal Well	NO
Total Base Water Volume (gal)	8,200,802
Total Base Non Water Volume	

Hydraulic Fracturing Fluid Composition:

Trade Name	Supplier	Purpose	Ingredients	Chemical Abstract Service Number (CAS #)	Maximum Ingredient Concentration in Additive (% by mass)**	Maximum Ingredient Concentration in HF Fluid (% by mass)**	Comments
water	VE Chem	carrier					
			H2O	7732-18-6	100.00	90.59700	
sand	VE Chem	proppant					
			crystalline silica	14608-80-7	100.00	8.48850	
15% HCl	Veil Chem	acid					
			hydrochloric acid	7647-01-6	15.00	0.13219	
FRA-405	Cleanwater	Friction reducer					
			petroleum distillates	64742-47-8	27.50	0.02385	
			sodium chloride	7647-14-8	7.50	0.00951	
			ammonium chloride	12125-02-6	5.00	0.00434	
			alcohols, C12-16, ethoxylated	68951-12-2	5.00	0.00434	
EOE116A	Nisco	biocide					
			polyethylene glycol	25322-68-3	85.00	0.01516	
			3,3'-diisobutylpropane-1,3-dithione	10222-01-2	30.00	0.00758	
			dibromocyclohexane	3252-43-5	5.00	0.00127	
AL-250	Cleanwater	acid inhibitor					
			isopropanol	67-63-0	40.00	0.00068	
			propargyl alcohol	107-19-7	40.00	0.00068	
			glycol ethers	111-78-2	40.00	0.00068	
SI-115	Cleanwater	Scale Inhibitor					
			Phosphoric acid	22042-96-2	20.00	0.00631	
			Sodium chloride	7647-14-5	5.00	0.00068	

Ingredients shown above are subject to 29 CFR 1910.1200 and appear on Material Safety Data Sheets (MSDS). Ingredients shown below are Non-MSDS.

* Total Water Volume sources may include fresh water, produced water, and/or recycled water
 ** Information is based on the maximum potential for concentration and thus the total may be over 100%
 Note: For Field Development Products (products that begin with FDP), MSDS level only information has been provided. Ingredient information for chemicals subject to 29 CFR 1910.1200 and Appendix D are obtained from upstream Material Safety Data Sheets (MSDS)

Activator 2	VE Chemicals	activator					
			Diethylenetriamine	111-40-0	60.00	0.00376	
Activator 1	VE Chemicals	activator					
			EDTA/copper chelate	CB1	30.00	0.00273	
Breaker 2	VE Chemicals	breaker					
			sodium persulfate	7775-27-1	100.00	0.00015	

Ingredients shown above are subject to 29 CFR 1910.1200 and appear on Material Safety Data Sheets (MSDS). Ingredients shown below are Non-MSDS.

Composite of 15 ingredients	VE Chemicals	miscellaneous					
			Miscellaneous	144-55-8	100.00	0.54128	

Closer View of Disclosure Report

Hydraulic Fracturing Fluid Product Component Information Disclosure

Job Start Date:	12/3/2012
Job End Date:	12/6/2012
State:	Pennsylvania
County:	Bradford
API Number:	37-015-22148
Operator Name:	VE Producer
Well Name and Number:	Test Well #1
Longitude:	-76.22389500
Latitude:	41.80361300
Datum:	NAD27
Federal Well:	NO
Total Base Water Volume (gal):	6,290,802
Total Base Non Water Volume:	



Great source of water volume data

Hydraulic Fracturing Fluid Composition:

Trade Name	Supplier	Purpose	Ingredients	Chemical Abstract Service Number (CAS #)	Maximum Ingredient Concentration in Additive (% by mass)**	Maximum Ingredient Concentration in HF Fluid (% by mass)**	Comments
water	VE Chem	carrier					
			H2O	7732-18-5	100.00	90.59700	
sand	VE Chem	proppant					
			crystalline silica	14808-80-7	100.00	8.48850	
15% HCl	Veil Chem	acid					
			hydrochloric acid	7647-01-0	15.00	0.13219	

Other Ways to Search for Wells

- FracFocus 2.0 has several additional ways for users to search for wells
 - CAS number
 - Date range
 - Specific ingredients

Find a Well Map Search Standard Search

SEARCH OPTIONS

STATE: Pennsylvania COUNTY: Bradford WELLS IN COUNTY: Choose a Well Name OPERATOR: VE Producer

API WELL NUMBER: WELL NAME:

FIND CAS NUMBER [clear](#)

BUILD DATE FILTER [clear](#)

INGREDIENT LIST [clear](#)

SEARCH **RESET** (Note: One search option is required to do a search.)

Issues and Concerns Raised about FracFocus

- Does not give enough information to public
- Encourages more natural gas development instead of renewable energy sources
- Cannot directly compile records from multiple wells in a spreadsheet
 - Some organizations have developed algorithms to “scrape” the data from FracFocus and make them available in a more user-friendly format
 - SkyTruth
 - ScraperWiki
- Harvard University report – April 2013
 - Companies have deadline to file disclosure reports
 - FracFocus does not allow states to determine if disclosure was timely
 - FracFocus uses a single set of forms that does not necessarily allow customized reporting for different states
 - Allows companies to claim confidential status for too many chemicals

Final Thoughts

- Hydraulic fracturing used in combination with horizontal drilling technology has been a game-changer for U.S. oil and gas production
- Hydraulic fracturing requires a lot of water and sand combined with small amounts of other chemicals
- The FracFocus website provides a very useful source of information on the names, types, and volumes of chemicals actually used in each well
- FracFocus is not perfect, but it does fill a large niche of needed information
 - Opponents of continued oil and gas development do not like FracFocus because it provides some justification for ongoing oil and gas activity

