

The Safety of Fracturing Fluids – A Quantitative Assessment

by Steve Coffman, member of the Committee to Preserve the Finger Lakes --
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In response to a FOIL request to New York State's Department of Environmental Conservation, the Committee to Preserve the Finger Lakes received a list of 48 toxic substances (as defined by the DEC or EPA) permitted for use in hydraulic fracture drilling of gas wells in the Marcellus Shale formation in Yates, Schuyler, Steuben, Broome and Cortland Counties. The received materials came in the form of documents submitted by the drilling companies themselves: Material Safety Data Sheets (MSDS) and Company Drilling Data Sheets.

The Hazardous Materials Identification System was developed to help employers comply with OSHA standards. The MSDS documents have the Hazardous Materials Identification System (HMIS) ratings for most of the 48 products. Additionally, extensive data is presented for each product about its chemical composition.

Some of the products listed in the documents are antimicrobials, microbiocides, corrosion inhibitors, surfactants, hydrochloric acid, and liquid nitrogen. Very low doses of some of them can cause cancer, damage kidney and immune systems and affect reproductive development. Some of them are very harmful to plant and marine life. Many are highly flammable.

Gas drilling companies say they use such tiny amounts of chemicals in the drilling---of the million or so gallons of liquid pumped into a well, only one percent or so are chemicals, and that they are diluted beyond harmful levels. But on some fracturing sites that tiny percentage of one percent translates to 5,000 or more gallons of chemicals highly concentrated in a few acres.

Method

While all 48 products received from DEC are toxic to some degree, this analysis limits its scope to 34 materials that are highly toxic in one or more ways, or that have specific relevance to the drilling operations in Part II.

Part I describes these products in terms the toxic chemicals they contain, their use, precautions, decomposition dangers, and methods of disposal. [Numbered "NOTES" provide additional information on toxicity of certain chemicals within these described products.]

Part II describes the use of toxic chemicals, also information about water use and disposal, as reported from the 12 gas drilling operations that, according to DEC, have taken place in the Marcellus Shale formation in Yates, Schuyler, Steuben, Broome and Cortland Counties.

Part III provides a brief summary and poses some of the obvious questions prompted by this information.

Disclaimer: While several members of the Committee to Preserve the Finger Lakes have strong industrial engineering backgrounds, none of the members is a chemist, geologist or a gas drilling expert. The purpose here is not to present ultimate answers, but rather to pose important and necessary questions about the safety of these products; not only to the humans directly exposed to these materials, but also in the air and water of our region's environment. All of the information presented herein comes from the companies themselves, either from the DEC or from other Material Safety Data Sheets.

Note: The "Composition" of products refers only to listed toxic ingredients as supplied in company MSDS.

PART I -- HIGHLY HAZARDOUS PRODUCTS LISTED BY DEC FOR USE IN FRACKING FLUIDS IN YATES, SCHUYLER, STEUBEN, BROOME AND CORTLAND COUNTIES

1. BIO CLEAR 200

Composition: 2,2Dibromo-3-Nitrilopropionamide; Polyethelene Glycol Mixture.

Precautions: Corrosive. Will cause eye burns and permanent tissue damage. **Ingestion may be fatal.**

Decomposition: May include hazardous carbon dioxide, bromine, **cyanogen bromide.**

Highly toxic to aquatic organisms. Disposal in streams or sewers may be prohibited by Federal, State and Local laws.

Disposal: Consult local, state, federal agencies for acceptable procedures and locations.

<http://www.epa.gov/enviro/html/emci/chemref/10222012.html>

NOTE 1. Cyanogen bromide

May be fatal if swallowed, inhaled or absorbed through skin. Corrosive. Vapors cause severe irritation to eyes and respiratory tract. Causes burns to any area of contact. Contact with acids liberates poisonous gas. Affects blood, cardiovascular system, central nervous system and thyroid. **Impure material may explode.**

Health Rating: 4 - Extreme (Poison); Reactivity Rating: 3 - Severe (Explosive); Contact Rating: 4 - Extreme (Corrosive) --
MSDS Number: C6600

2. CL-14

Composition: **Methanol, Propargyl alcohol**

Precautions: **Highly Flammable.** Toxic: may be absorbed through skin in harmful amounts. Inhalation of high levels of vapors may affect central nervous system or cause unconsciousness. Ingestion may be harmful. Chronic Overexposure can adversely affect liver, eyes, lungs brain and nervous system. **Probable human carcinogen.**

Decomposition: **Highly toxic gases may be generated by thermal decomposition or combustion.** Vapors may form explosive mixture with air. Decomposition may create hazardous amounts of carbon dioxide and carbon monoxide.

Disposal: According to RCRA Hazardous Waste Code D001 (ignitable waste).

NOTE 2. Methanol

Methanol is released to the environment during industrial uses and naturally from volcanic gases, vegetation, and microbes. Exposure may occur from ambient air and during the use of solvents. Acute (short-term) or chronic (long-term) exposure of humans to methanol by inhalation or ingestion may result in blurred vision, headache, dizziness, and nausea. No information is available on the reproductive, developmental, or carcinogenic effects of methanol in humans. **Birth defects have been observed in the offspring of rats and mice exposed to methanol by inhalation.** EPA has not classified methanol with respect to carcinogenicity.

<http://www.epa.gov/ttn/atw/hlthef/methanol.html>

NOTE 3. Propargyl alcohol

Flammable, potentially explosive. The substance may be toxic to blood, kidneys, liver, brain, cardiovascular system, upper respiratory tract, skin, central nervous system.

Repeated or prolonged exposure to the substance can produce target organs damage. Prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation, respiratory tract irritation leading to frequent attacks of bronchial infection, general deterioration of health by an accumulation in one or many organs.

http://www.sciencelab.com/xMSDS-Propargyl_Alcohol-9924728

3. CORROSION INHIBITOR A261

Composition: **Aromatic ketones**, Aliphatic alcohol polyglycol ether, **Methanol**, Aliphatic acid, **Prop-2-yn-1-ol**, **Aromatic hydrocarbon**, **Formaldehyde**, **Propan-2-ol**

Precautions: **Highly Flammable. Corrosive.** Eye contact may cause permanent damage or blindness, Skin contact may cause tissue damage and cause illness. Inhalation may cause illness. Ingestion causes severe pain, burns, swelling, may cause illness. Probable human carcinogen. **Toxic to aquatic organisms.**

Decomposition: When heated or burned creates oxides of carbon and sulfur, harmful organic chemical fumes.

Disposal: By injection or other acceptable method in accordance with local regulations.

NOTE 4. Aromatic ketones

Several ketones and aldehydes have been classified as known or likely carcinogens. Aldehydes and ketones are widely used industrial chemicals both as solvents and as chemical intermediates (ingredients for other chemicals). Most can be classified as volatile organic compounds meaning that their vapors may be easily inhaled or ignited.

<http://www.ilpi.com/msds/ref/ketone.html>

NOTE 5. Prop-2-yn-1-ol

Because dermal lethality data in rabbits indicate that prop-2-yn-1-ol is readily absorbed through the skin, a skin notation is recommended.

<http://toxnet.nlm.nih.gov/cgi-bin/sis/search/r?dbs+hsdb:@term+@rn+@rel+107-19-7>

NOTE 6. Formaldehyde

Studies have shown that even low levels of formaldehyde can have health effects. Low levels of exposure can irritate the eyes, nose and throat, cause skin problems, serious breathing problems and can increase risk of certain kinds of cancer. **OSHA regulates formaldehyde as a cancer-causing substance.** (NYCOSH)

http://www.nycosh.org/workplace_hazards/formal.html

NOTE 7. Propan-2-ol

Causes respiratory tract, eye and skin irritation. contains material which causes damage to the following organs: respiratory tract, skin, central nervous system, eye, lens or cornea. Flammable liquid and vapor. **Vapor may cause flash fire.** (MSDS) http://nanosafeguard.com/images/msds/Marine_Sealing_Component2_msds.pdf

NOTE 8. Aromatic hydrocarbons

U.S. Public Health Service statement "How can polycyclic aromatic hydrocarbons [PAHs] affect my health?"-- PAHs can be harmful to your health under some circumstances. Several of the **PAHs . . . have caused tumors in laboratory animals when they breathed these substances in the air, when they ate them, or when they had long periods of skin contact with them.** Studies of people show that individuals exposed by breathing or skin contact for long periods to mixtures that contain PAHs and other compounds can also develop cancer. **Mice fed high levels of benzo[a]pyrene during pregnancy had difficulty reproducing and so did their offspring.** <http://www.atsdr.cdc.gov/toxprofiles/tp69.pdf>

4. FAW-5

Composition: **2-butoxyethanol, Methanol, Ethyl alcohol, Aqueous ammonia**

Precautions: **Combustible hazard.** May be absorbed through skin in toxic amounts. **Inhalation may cause collapse, unconsciousness, even death.** Ingestion may cause blindness, mental confusion, stupor. Chronic overexposure may damage liver, kidneys, eyes, lungs and central nervous system. **May be teratogenic and fetotoxic.**

Thermal decomposition or combustion may produce carbon monoxide, carbon dioxide.

Disposal: **According to RCRA* Hazardous Waste Code D001 (ignitable waste).** [*RCRA -- Resource Conservation Recovery Act]

NOTE 9. 2-butoxyethanol

(CCOHS) Emergency overview: **Combustible liquid and vapor. Very toxic. Fatal if inhaled.** Harmful if absorbed through the skin. Central nervous system depressant. Causes severe eye and skin irritation. <http://www.atsdr.cdc.gov/toxprofiles/phs118.html>

NOTE 10. Aqueous ammonia

Corrosive alkaline solution. Causes burns to any area of contact. Harmful if swallowed, inhaled or absorbed through skin. **Inhalation may be fatal** as a result of spasm inflammation and edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema. **May be absorbed through the skin with possible systemic effects. Eye Contact can cause temporary or permanent blindness.** Prolonged or repeated skin exposure may cause dermatitis. Prolonged or repeated exposure may cause eye, liver, kidney, or lung damage. **Health Rating: 4 - extreme (poison) Contact Rating: 3 - severe (corrosive)** <http://www.jtbaker.com/msds/englishhtml/A5472.htm>

[Methanol -- See Note 2.]

5. FDP-S819-05

Composition: **Sodium perborate tetrahydrate**

Precautions: Skin disorders, lung disorders, eye ailments; prolonged exposure may cause gastrointestinal effects and muscular dysfunction.

Accidental release: **Prevent from entering sewers or, waterways or low areas.**

Disposal: In accordance with local, state, federal regulations.

NOTE 11. Sodium perborate tetrahydrate

(MSDS English) Harmful if swallowed, inhaled or absorbed through skin. causes irritation to skin, eyes and respiratory tract. Health Rating: 3 - Severe Contact Rating: 3 - Severe MSDS #S4634 <http://www.jtbaker.com/msds/englishhtml/S4634.htm>

Inhalation: May be caustic to nasal and lung tissues. Ingestion: **May cause convulsions, collapse, coma, and death.** Skin Contact: Absorption of large amounts may cause symptoms similar to those of ingestion. Eye Contact may cause corrosion.

6. FE-1A

Composition: Acetic Acid; Acetic anhydride

Precautions: Contact with skin or eyes causes severe burns. **Inhalation causes severe respiratory irritation.** Ingestion causes burns to mouth, throat and stomach. **Prolonged exposure may cause erosion of the teeth.**

Decomposition products: **Toxic gases and vapors** (such as carbon dioxide, carbon monoxide, various hydrocarbons, and acid aerosols) may be released when acetic anhydride is heated or decomposes.

Accidental spills: **Prevent from entering sewers, waterways, or low areas.**

Disposal: In accordance with federal, state and local regulations.
<http://www.osha.gov/SLTC/healthguidelines/aceticanhydride/recognition.html>

7. FLOMAX 50 MSDS

Composition: Secondary alcohol, proprietary, proprietary.

Precautions: **Extremely flammable & Explosion hazard**

Can cause permanent eye damage if not removed promptly. Ingestion harmful.

Disposal Method: Recycle if possible, otherwise use licensed disposal contractor.

8. FLOMAX 50 UWS -- Same as #7.

9. GAS PERM 1000

Composition: **Isopropanol**

Precautions: **Highly flammable.** Inhalation or ingestion may cause central nervous system depression, unconsciousness. May be absorbed through the skin. May cause severe eye ailments. Overexposure may affect liver and kidneys.

Decomposition: **In fire may produce toxic gases.**

Disposal: In accordance with federal, state, and local regulations.
<http://www.techni-tool.com/content/resources/MSDS/754CH122.pdf>

NOTE 12. Isopropanol: Inhalation can cause ulceration of the respiratory tract with bronchitis, pneumonia, palpitations, dental erosion, cyanosis, asphyxiation, gastric hemorrhage, and death. **Absorption through skin can cause similar effects to inhalation.** Ingestion can cause stomach and esophageal perforation, circulatory collapse leading to renal, liver, or heart failure. **Ecological Information:** No information found. **Vapors hazardous in drains, sewers, low level enclosures or wells.** MSDS Feb. 21, 1998 <http://www.labchem.net/msds/75222.pdf>

Decomposition Products: Carbon Monoxide, Carbon dioxide, possibly HF, other organic compounds. **Spill Procedures: Avoid inhalation, touching, ignition sources. Contain spill from entering waterways.** Disposal: according to RCRA Hazardous Waste Code D001 (ignitable waste).

10. HAI-OS ACID INHIBITOR

Composition: **Methanol, Propargyl alcohol**

Precautions: **Highly flammable.** May be absorbed through skin. May cause eye damage. Inhalation may cause chemical pneumonia, depress central nervous system, cause unconsciousness. **Ingestion may cause blindness or death.** Prolonged exposure may damage eyes, blood, liver, kidneys, nervous system, spleen. **Acute fish toxicity, may cause long-term adverse effects in aquatic environment.**

Accidental Release: Prevent for entering sewers, waterways, low areas.

Disposal: In accordance with federal, state, and local regulations.

[Methanol, Propargyl alcohol, see Notes 2 and 3.]

11. HC-2

Composition: Sodium chloride, Inner salt of alkyl amines

Precautions: May cause severe eye irritation, corneal damage

Accidental Release: **Prevent for entering sewers, waterways, low areas.**

Disposal: In accordance with federal, state, and local regulations.

12. HYDROCHLORIC ACID 15% DTC-Canada

Precautions: May burn skin, eyes, respiratory system.

Disposal Method: Injection or other acceptable method according to local regulations.

13. HYDROCHLORIC ACID 15% H15 STC-USA -- Same as #12

14. HYDROCHLORIC ACID [30 - 60%]

Precautions: May burn skin, eyes, respiratory system.

Accidental Release: **Prevent from entering sewers, waterways, low areas.**

Disposal Method: In accordance with federal, state, and local regulations.

15. INFLO-102

Composition: **Methanol, 2-butoxyethanol, Isopropanol**

Precautions: **Highly Flammable. Skin absorption may cause systemic poisoning;** vapors irritate eyes. Inhalation may cause respiratory irritation, unconsciousness. Prolonged concentrated exposure can cause unconsciousness and death; **ingestion of 100-200 mls can be fatal.**

Decomposition Products: Carbon Monoxide, Carbon dioxide, possibly HF, other organic compounds.

Spill Procedures: **Avoid inhalation, touching, ignition sources. Contain spill from entering waterways.**

Disposal: According to RCRA Hazardous Waste Code D001 (ignitable waste).

[Methanol, 2-butoxyethanol, Isopropanol, see notes 2, 9 and 12.]

16. MULTIFUNCTIONAL SURFACTANT F105

Composition: Polyethoxylated alkanol, **2butoxyethanol, Butan-1-ol**

Precautions: **Highly combustible.** Hazardous to skin, eyes; inhalation can cause CNS-depression, narcosis. Ingestion may cause defects to central nervous system.

Accidental release: **Keep out of sewage and waterways. Toxic to aquatic organisms.**

Disposal Method: Injection or other acceptable method in accordance with local regulations.

NOTE 13. Butan-1-ol (CAS# 71-36-3)

Flammable liquid and vapor. May cause adverse reproductive effects based upon animal studies. May be harmful if absorbed through the skin. Ecological Information: Data not yet available.

Decomposition products: toxic fumes of carbon monoxide, carbon dioxide. **Butanol should not bind strongly to soil and so is expected to leach into groundwater.**

Disposal: **RCRA U-Series:** waste number U031 (Ignitable waste).

<http://avogadro.chem.iastate.edu/MSDS/1-butanol.htm>

[2butoxyethanol -- see Note 9.]

17. NITROGEN REFRIGERATED LIQUID

Composition: Formula N₂ -- CAS: 7727-37-9 (Nitrogen (acetaldehyde))

Precautions: May cause tissue freezing. Inhalation may affect mental and physical capacities. **Prolonged inhalation may lead to convulsions, coma and death.**

Accidental Release: Evacuate all personnel from affected area.

Disposal: Do not attempt to dispose of residual waste. Return in shipping container.

18. SANDWEDGE WF

Composition: **Methanol, Isopropanol**

Precautions: **Highly Flammable.** May be absorbed through skin. May damage eye tissue. Inhalation may cause respiratory irritation, unconsciousness. **Ingestion may cause convulsions, blindness, death.** Prolonged exposure may damage eyes, liver, kidneys, blood, heart, nervous system, spleen.

Accidental Release: **Prevent from entering sewers, waterways, low areas.**

Disposal: In accordance with federal, state, and local regulations.

[Methanol and Isopropanol -- see Notes 2 and 12.]

19. TEMPORARY CLAY STABILIZER L64

Composition: **Tetramethylammonium chloride**

Precautions: Contact harmful to skin and eyes. Avoid inhaling. **Ingestion may cause death.**

Decomposition: **Heating or burning will release harmful carbon/nitrogen oxides, ammonia and organic chemical fumes.**

Disposal: Injection or other acceptable method in accordance with local regulations.

http://www.sciencelab.com/xMSDS-Tetramethylammonium_chloride-9925214

20. MAGNACIDE 575

Composition: phosphonium, tetrakis(hydroxymethyl)-,sulfate

Precautions: **Toxic to aquatic organisms, may cause adverse effects in the aquatic environment.** (MSDS Japan)

http://www.nippon-chem.com/msds/msds_thps.pdf]

21. SCALHEHIB 100

Composition: **Ethylene Glycol**

Precautions: **Flammable and combustible.** Absorbed through skin. **Mutagenic for mammalian somatic cells.** May cause damage to the following organs: kidneys, liver, central nervous system.

Decomposition: Explosive decomposition may occur if combined with strong acids or strong bases and subjected to elevated temperatures. This product may release **Formaldehyde**

Disposal: **Prevent entry into sewers, basements or confined areas.** Waste must be disposed of in accordance with federal, state and local environmental control regulations. http://www.sciencelab.com/xMSDS-Ethylene_glycol-9927167

22. ACTIVATOR 78-ACTW

Composition: **C12-14 Secondary alcohol, Ethoxylated; Methanol**

Precautions: **Liquid or vapor may cause a flash fire or ignite explosively. Ingestion may cause blindness.** Inhalation can irritate lungs, cause central nervous system depression. May be absorbed through skin. Ecological information not determined.

Disposal: Recover free liquid. Absorb residue and dispose according to local, state and federal requirements. Empty container. Since empty containers retain waste residue, follow warnings even after container is empty. **DO NOT drill, grind, puncture or weld on or nearby.**

Decomposition: **Hazardous oxides of carbon.** This produce may release **Formaldehyde.**

NOTE 14. C12-14 Secondary alcohol, Ethoxylated

May cause severe burns.

Spills: **Avoid uncontrolled releases of this material.** Where spills are possible a comprehensive spill response plan should be developed and implemented.

Disposal: All recovered material should be packaged, labeled, transported, and disposed or reclaimed in conformance with applicable laws and regulations and in conformance with good engineering practices. **Avoid landfilling of liquids.**

<http://www.anatrace.com/msds/APO138.pdf>

[Methanol, Formaldehyde, Ethoxylated alcohol -- see Notes 2 and 6, 14.]

23. BORATE CROSSLINKER J532 (CAS: 1303-96-4)

Composition: **Aliphatic alcohol; Sodium tetraborate decahydrate.**

Precautions: **MSDS: "Caution! The toxicological properties of this material have not been fully investigated." Mutagenic effect observed in insect studies. Reproductive toxicity on laboratory animals.**

Disposal: By injection or other acceptable method in accordance with local regulations.

NOTE 15: Sodium tetraborate decahydrate. May impair fertility. May cause harm to the unborn child. Ingestion: Human fatalities reported from acute poisoning. Chronic exposure may cause reproductive disorders and teratogenic effects.

Decomposition: **Hazardous oxides of boron.**

http://research.amnh.org/molecular/histology_lab_msdms/histology_msdms/sodium_tetraborate_decahydrate.pdf

NOTE 16: ALIPHATIC ALCOHOL

Precautions: **Flammable. May cause flash fire.** Harmful if inhaled or swallowed. May be absorbed through the skin.

Disposal: **Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.**

http://vpracingfuels.com/PDF/MSDS_LC6_Sep08.pdf

24. FERROTROL 300L

Composition: Citric Acid

Precautions: Irritant to eyes, skin, mucous membranes and respiratory system. Acute fish toxicity; pH will decrease in water close to the discharge and can have local effects on water living organisms.

(English MSDS, manufactured by BP Drilling Chemicals)

<http://logichem.netpower.no/datasheet.aspx?ild=31628&iDepld=5523>

Spills: Prevent from entering sewers or waterways.

Disposal: In accordance with federal and local regulations.

25. BC-140

Composition: Monoethanolamine, Ethylene glycol, Boric acid

Precautions: Corrosive. May cause eye ailments; skin, liver and kidney disorders. Ingestion may be harmful to heart, kidney, brain. Prolonged or repeated exposure may cause embryo or fetus toxicity. Ecological information not determined.

Decomposition: Toxic fumes. Carbon monoxide and carbon dioxide.

Disposal: In accordance with federal, state and local regulations.

26. ALDACIDE G

Composition: Glutaraldehyde

Precautions: Harmful if inhaled. May be absorbed through skin. May cause permanent eye damage. Aspiration into lungs may cause chemical pneumonia, which can be fatal. May be highly toxic to aquatic life. (MSDS Sheet, July 5, 2006).

Decomposition: Carbon monoxide and carbon dioxide.

Disposal: In accordance with federal and local regulations.

27. FE-5A

Composition: Thioglycolic acid

Precautions: May cause severe skin and respiratory burns. May be absorbed through skin. Ingestion may cause severe burns, dyspnea and coma.

Spills: Prevent from entering sewers, waterways or low areas.

Decomposition: May produce Hydrogen sulfide. Oxides or sulfur. Carbon monoxide and carbon dioxide.

Disposal: In accordance with federal and local regulations.

28. LP-65

Composition: Ammonium chloride

Precautions: Causes irritation to skin, eyes and respiratory tract. Harmful if swallowed or inhaled. Ecological information not determined.

Spills: Prevent from entering sewers, waterways or low areas.

Decomposition: Hydrogen chloride. Oxides of nitrogen. Ammonia. Carbon monoxide and carbon dioxide.

Disposal: In accordance with federal, state and local regulations.

29. LGC-35 CBM

Composition: Paraffinic solvent; Polysaccharide

Precautions: Combustible. Inhalation may cause respiratory irritation or chemical pneumonia, which can be fatal. Ingestion may be fatal. Chronic exposure may be carcinogenic. Ecological information not determined.

Decomposition: Carbon monoxide and carbon dioxide.

Disposal: In accordance with federal and local regulations.

30. FR-46

Composition: Ammonium bisulfate

Precautions: Corrosive. Chronic effect may cause damage to lungs, mucous membranes. Extremely hazardous in case of skin contact or ingestion.

Hazardous in case of eye contact or inhalation. Ecological information not determined.

http://www.sciencelab.com/xMSDS-Ammonium_bisulfate-9922913

Spills: Prevent from entering sewers, waterways or low areas.

Decomposition: Carbon monoxide and carbon dioxide, Oxides of nitrogen

Disposal: In accordance with federal and local regulations.

31. BE-3S

Composition: 2-Monobromo-3-nitrilopropionamide; 2,2Dibromo-3-nitrilopropionamide

Precautions: Flammable. Causes severe respiratory irritation Vapors cyanogen bromide (see Note 1) and dibromoacetylnitrile may form ion the drum head space. Causes severe skin and eye irritation. May be toxic to aquatic life.

Spills: Prevent from entering sewers, waterways or low areas.

Decomposition: Oxides of nitrogen, Bromide; Hydrogen bromide; Methyl and ethyl bromide; Cyanogen bromide; Hydrogen cyanide; Carbon monoxide and carbon dioxide.

Disposal: In accordance with federal and local regulations.

32. BE-6

Composition: 2-Bromo-2nitro 1,3-propanediol

Precautions: May cause serious eye damage, may be harmful to skin or if ingested. Possible carcinogen. Very toxic to aquatic organisms. Avoid release to environment. (Halliburton MSDS Jan. 5, 2006)

Spills: Prevent from entering sewers, waterways or low areas.

Decomposition: Oxides of nitrogen; Bromine; Hydrogen bromide; Carbon monoxide and carbon dioxide.

Disposal: In accordance with federal and local regulations.

33. CLASTA XP

Contains: Polyepichlorohydrin trimethylamine quaternized

Precautions: Flammable. May cause severe skin and respiratory irritation, severe eye irritation. Ecological information not determined.

Spills: Prevent from entering sewers, waterways, or low areas.

Decomposition: Oxides of oxygen. Carbon monoxide and carbon dioxide.

Disposal: In accordance with federal and local regulations.

34. FDP-S798

Composition: Sodium perborate tetrahydrate

Precautions: May cause severe eye irritation, skin and respiratory irritation. Harmful if swallowed.

Incompatible materials: Avoid contact with water, organic matter, all flammables. Acute fish toxicity.

Spills: Prevent from entering sewers, waterways or low areas.

Disposal: In accordance with federal and local regulations.

OVERVIEW ANALYSIS OF 34 HIGHLY HAZARDOUS PRODUCTS

WATER ISSUES

Products known to be toxic to aquatic environment: (21): Nos. 1, 3, 5, 6, 10, 11, 14, 15, 16, 18, 20, 21, 24, 26, 27, 28, 30, 31, 32, 33, 34.

Products whose toxicity to aquatic environment is yet to be determined: (11): Nos. 2, 4, 9, 12, 13, 19, 22, 25, 29, 30, 33.

AIR ISSUES

Chemicals dangerous to breathe (24): Nos. 1, 2, 3, 4, 5, 6, 7, 8, 10, 14, 15, 16, 19, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32.

Chemicals whose decomposition may release toxicity into the air (20): Nos. 1, 2, 3, 4, 6, 9, 15, 16, 19, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32, 33.

Chemicals highly flammable or explosive (13): 1, 2, 3, 4, 9, 10, 15, 16, 18, 21, 22, 29, 31.

NOTE ON DISPOSAL --- Of these 34 toxic/hazardous products, the MSDS sheets only call for 4 of them (Nos. 2, 4, 15, 17) to be disposed of in any special way. The other 30 may be disposed of "according to federal, state, and local regulations," despite the limitations of localities to understand or have facilities to deal with many of these substances, and despite the numerous dangers that many of these substances could pose for local public waters.

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PART II ANALYSIS OF GAS DRILLING SHEETS FOR MARCELLUS SHALE WELLS IN YATES, SCHUYLER, STEUBEN, BROOME AND CORTLAND COUNTIES

For the five counties requested, DEC provided Drilling Sheets for 14 gas drilling operations in the Marcellus Shale formation. Of the 14, only 12 were hydraulically fractured, and only one of those 12 was "slickwater" fractured.

In this analysis, all hydraulically fractured wells are analyzed for: 1) Amount of fresh water used; 2) Water source; 3) Additives used; 4) Amount of return fluid; 5) Percentage of return fluid; 6) Method of disposal; 7) Time of drilling operation from site construction to site reclamation.

In addition, several notes have been added for chemical products used that were not included on DEC's supplied list. (The numbering of these products continues from the list in Part I.)

1. **HOUSEL 2** (EOG Resources) drilled but never stimulated

2. **SCHIAVONE 2** (EOG Resources)

Fresh water used: 34,062 gal. Water Source: Watkins Glen

Additives: Ferrotrol 300L(2 gal.); Claytreat 3C (136 gal.); Magnacide 575 (2 gal.); Inflo102 (40 gal.); FRW 14 (19 gal.); CL-14 (1 gal.)

[For Ferrotrol 300L, Magnacide 575, Inflo 102, CL-14, see Nos. 24, 20, 15 and 2.]

3. **WGI 10** (EOG Resources)

Fresh water used: 111,720 gal. Water Source: Big Flats

Additives: Magnacide 575 -- 6 gal.; FRW -14 -- 54 gal.

[For Magnacide 575, see No. 20.]

4. **WGI 11** (EOG Resources)

Fresh water used: 10,920 gal. Water Source: Watkins Glen

Additives: Ferrotrol 300L, 2 gal.; FRW-14 -- 12 gal.; Inflo-2, 8 gal.; FAW-5, 35 gal.; CL-14, 1 gal.

[For Ferrotrol 300L, Inflo-2, FAW-5, CL-14, see Nos., 24, 15, 4 and 2.]

Return Fluids: Shrivone -- Contained in tank; WGI 10 -- Contained in tank; WGI 11 -- Not fractured with water, but a nitrogen foam. Return fluids were contained in tank.

Disposal: Shrivone, WGI 10, WGI 11 --- all return fluids temporarily stored in empty Frac tanks. "Water haulers used to take return fluids to disposal locations. Such disposal locations include: Bath Treatment Plant; Valley Joint Sewer Plant - Athens, PA; City of Auburn Water Pollution Control Plant."

Time from site construction to reclamation: Shrivone -- 45 days; Housel 2 -- 18 days; WGI 10 -- 60 days; WGI 11 -- 52 days.

5. **BEAGELL 2-B** (Chesapeake Energy -- date of sheet August 15, 2008)

Fresh water used: 263,000 gal. Source: Susquehanna River

Additives: Held by drillers as proprietary information. (MSDS sheets supplied to DEC but not included in FOIL response).

From supplied chemical code numbers, the following were among the products used: HCL 15% (1,000 gal.); Corrosion Inhibitor A261 (1 gal.); Clay Stabilizer L084 (335 gal.); Surfactant F105 (323 gal.); Scale Inhibitor L065 (155 gal.). Friction Reducer J313 (122 gal.); Hexion AcTivator 78 ACTW.

[For Corrosion inhibitor A261, Surfactant F105, Scale Inhibitor L065, Hexion AcTivator 78 ACTW, see Nos. 3, 16, 21, 22.]

Return Fluids: 116,550 gal. Disposal: POTW, Athens, PA

Percentage of water returned -- 44%

Time from site construction to reclamation: 63 days

6. **BUTKOWSKY 1-B** (Chesapeake Energy)

Fresh water used: 263,340 gallons Source: Susquehanna River

Additives: Held by drillers as proprietary information. (MSDS sheets supplied to DEC but not included in FOIL response).

From supplied chemical code numbers, the following were among the products used: HLC 15% (5,000 gal.); Surfactant F108 (3 gal.); Surfactant F105 (450 gal.); Clay Stabilizer L084 (326 gal.); Corrosion Inhibitor A261 -- (6 gal.); Borate Crosslinker J532 (411 gal.); Hexion AcTivator 78 ACTW (138 gal.)

[Same as #5 Beagell 2B.]

Return Fluids: 94,164 gal. Disposal: POTW, Athens, PA

Percentage of water returned -- 36%

Time from site construction to reclamation: 63 days

7. MCDANIELS 1A (Eastern American Energy -- Feb-Mar 2008)

Fresh water used: 2 frackings -- approx. 200,000 gal. (total)

Water Source: Glen Brook (a creek near the site)

Additives (Feb. fracking): HC-2 (27 gal.); Gas Perm 1000 (28 gal.); Aldacide G ((3 gal.); LP-65 (1 gal.); HAI-OS (1 gal.); FE-5A (1 gal.); SandWedge WF (3 gal.); HCL(30 gal.); FE-1A (50 gal.)

[For Gas Perm 1000, Hai-OS, SandWedge WF, HCL, see Nos. 9, 10, 18, 12.]

Additives (Mar. fracking): FR-46 (131 gal.); Gas Perm 1000 (131 gal.) LGC-35 CBM (131 gal.); BC-140 (48 gal.); Aldacide G (3 gal.); LP-65 (28 gal.); HC-2 (28 gal.); SandWedge WF (185)); Hai-OS (1 gal.); HCl (30 gal.); FE-1A (50 gal.)

[For Gas Perm 100, HC-2, SandWedge WF, Hai-OS, FE-1A, see Nos. 9, 11, 18, 10, 6.]

Return Fluids: 131,985 gal.

Percentage of water returned: 66%

Disposal: Valley Joint Sewer Plant -- Athens, PA

Time table: Site Construction Feb. 24, 2008 -- Fluid Disposal April 26, 2008 -- Site Reclamation still ongoing as of August 29, 2008 -- Total so far 6 months . . .

8. FROST 2 -1 (Nitrified)

NOTE: Frost 2 was fracked twice, the first time "Nitrified" in April 2006, the second time "Slickwater fractured" in July 2006 (the only instance of "Slickwater Fracturing" in the drilling sheets received from our DEC FOIL request).

Fresh water used: 35,406 gal. Source: Local water source

NOTE: Nine residences were within 1,000 feet of the wellbore. Fortuna tested the water for these nine residences before drilling, but not after.

Additives: HC-2 (94 gal.); LGC-35 CBM (130 gal.); BC-140 (30 gal.); ClaSta XP (2 gal.); Hai-OS (1 gal.); HCL (75 gal.); FE-1A (5 gal.); BE-3S (6 lbs.); GBW-30 (20 lbs.).

[For HC-2, LGC-35 CVBM, BC-140, Hai-OS, HCL, FE-1A, BE-3S, see Nos. 11, 29, 25, 10, 12, 6, 31, 33.]

Recovered Frac Fluid: 7,686 gal.

Percent of Frac fluid recovered: 22%.

Time from site construction to reclamation -- 80 days.

9. FROST 2 - 2 (Slickwater Fractured)

Fresh water used: 640,550 gal. Water source: Catatonk Creek, Tioga County

Additives: FRP-121 (3,300 lbs.); Flomax 50 (551 gal.); Unicide 2000 (209 gal.); ScaleHib 100 (55 gal.)

[For ScaleHib 100, see No. 21.]

Return Fluids: 285,264

Percentage of Frac fluid recovered: 44.5%

Disposal: PA Brine Treatment Plant, Franklin, PA

Radioactivity testing was done at wellsite: Normal reading were recorded.

Time from site construction to reclamation: 108 days.

10. WEBSTER T1 "Nitrified Frac" (Fortuna)

Fresh water used: 68,700 Source -- unknown local source

Additives: FDP-S819 (80 gal.); FR-48 (50 gal.); ClaSta XP (2 gal.); HAI-OS (1 gal.); HCL (975 gal.); FE-2A (5 gal.); FE-1A (5 gal.); BE-6 (10 lbs.); FDP-S798 (33 lbs.).

[For FDP-S819, ClaStaXP, Hai-OS, HCL, FE-2A ((same CAS# 77-92-9 as Ferrotrol), FE 1-A, BE-6, FDP-S798, see Nos. 5,19, 10, 12, 24, 6, 32, 34.)

Returned frac fluid: 25,200 gal.

Percentage of frac fluid returned: 37%

Disposal: Valley Joint Sewer Plant, Sayre, PA

Time from site construction to reclamation: 77 days

11. WEBSTER T1 "Slickwater Fracture" -- [permitted but not yet drilled]

Amt. of Fresh water permitted -- 646,000 gal. Source: Catatunk Creek, Tioga Co.

12. CALABRO T1 (Fortuna)

Fresh water used: 20,244 gal. Source: unknown local source

Additives: HC-2 (56 gal.); LGC-35 CBM (71 gal.); BC-140 (3 gal.); ClaSta XP (2 gal.); HAI-OS (1 gal.); HCL (75 gal.); FE-1A (5 gal.); BE-3S (6 lbs.); GBW-30 (5 lbs.).

[For HC-2, LGC-35 CBM, BC-140, CLaSta XP, HAI-OS, HCL, FE-1A, BE-3S, see Nos. 11, 29, 25, 33, 10, 6, 31.]

Recovered frac fluids: 8,232

Percentage of frac fluids returned: 41%

Disposal: Valley Joint Sewer Plant, Sayre PA.

Time from site construction to reclamation: 80 days.

13. CALABRO T2

Fresh water used: 15,078 gal. Source: unknown local source

Additives: same as Calabro T1 (approx. same amts.)

Recovered frac fluids: 4,326

Percentage of frac fluids recovered: 29%

Disposal: Valley Joint Sewer Plant, Sayre PA.

Time from site construction to reclamation: 79 days.

14. DRUMM G2 (Fortuna)

Fresh water used: 34,860 gal. Source: unknown local source

Additives: same as Calabro T1 & Calabro T2 (approx. same amts.)

Recovered frac fluids: 17,766

Percentage of frac fluids recovered: 51%

Disposal: Valley Joint Sewer Plant, Sayre PA.

Time from site construction to reclamation: 65 days.

PART III -- SUMMARY & QUESTIONS

SUMMARY

Drilling sheets on 14 wells were received. 12 of the 14 were stimulated (11 were "Nitrified," one, Frost 2-2, was "slickwater fractured.").

Average amount of fresh water used for the 11 non-slickwater wells: 93,163 gal.
(Range: 15,078 gal. - 263,340 gal.)

Amount of fresh water used for "slickwater" fractured well: 640,550 gal.
(690% increase over non-slickwater wells)

Average amount of frac water returned (from 9 wells providing that information): 41%.

Number of different toxic chemical products used: 34.

Number of products (in MSDS) hazardous to aquatic environments: 21.

Number of products (in MSDS) whose aquatic toxicity is undetermined: 11.

Average time from site construction to site reclamation: 75.

QUESTIONS (by no means meant as an exhaustive list)

- 1. QUESTION:** How is it that Multifunctional Surfactant F-15 [No. 16] can be disposed of via "Injection or other acceptable method in accordance with local regulations" when one of its ingredients, butan-1-ol entails the caution: "Avoid runoff into storm sewers and ditches which lead to waterways. Butanol should not bind strongly to soil and so is expected to leach into groundwater . . . RCRA U-Series:: waste number U031 (Ignitable waste)"?
- 2. QUESTION:** (similar to Q. 1) Why is it that FE-105 and Gas Perm 1000 can be disposed of "according to federal, state and local regulations," when both contain Isopropanol (See Note 12), which is separately required to be disposed of according to RCRA Hazardous Waste Code D001 (ignitable waste)?
- 3. QUESTION:** How adequately can the local and regional treatment plants remove the toxicity (and brine) from millions of gallons of frack fluid before returning it benignly to local water supplies?
- 4. QUESTION:** If only 41% of fracking fluid is recovered, what happens to the other 59%? Is it contained? Flowing loosely underground? Seeping out?
- 5. QUESTION:** Given the strong suspicion of a connection between gas drilling in the Texas Barnett Shale and seismic activity [See work of Dr. Chris Hayward, geophysics research projects director at SMU], what surety can there be that contained fluids will remain contained and not eventually infect area aquifers and waterways?
- 6. QUESTION:** As to the recovered fracking fluids---given that, according to MSDSs, 30 of the 34 toxic products in this report may be disposed of "according to local regulations," what uniformity is there among "local regulations" that would give confidence that those 30 products will be adequately treated before being released back into public waters?
- 7. QUESTION:** Given that, of the 13 hydrofracked wells in this report, 11 of them disposed of their returned fracking fluids in Pennsylvania, who is responsible for proper oversight of these toxic materials? The localities of Athens, Franklin and Sayre PA? The lead agency NYS DEC? PA DEP? EPA---despite exemption of hydraulic fracturing from EPA oversight, is this not interstate commerce? Susquehanna River Basin Commission? Who is responsible for making sure that these water treatment facilities are capable of treating all the chemicals contained in fracking fluids, as well as the brine and other contaminants in the return waters? Who is responsible for their quality control?

8. QUESTION: For the 11 products whose aquatic toxicity has yet to be determined, should the determination not be made before they are disposed to water treatment plants for ultimate return into the aquatic environment?

This report was prepared by Steve Coffman, a member of the Committee To Preserve The Finger Lakes -- August 4, 2009.