Oil and Gas
Fracturing, Drilling and Production Chemicals, Waste and Environmental Impacts

December 3rd 2013

David A. Calvert, Ph.D
President / CEO Eco Compounds
Director Environmental Health and Safety
True Oil Enterprises
Discussion

EPA Exemption of Oil and Gas Waste

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Use of Greener Chemicals
EPA EXEMPTION
OIL AND GAS WASTE
The **Resource Conservation and Recovery Act** (RCRA), enacted in 1976, is the principal federal law in the United States governing the disposal of solid waste and hazardous waste.

RCRA, Subtitle D, places Oil and Gas waste in the same category as household hazardous waste and coffee grounds.
Non-Hazardous Oil and Gas Drilling and Production Waste

Wastes generated by the exploration, development, and production of crude oil and natural gas are “exempt” by Federal law from being regulated as hazardous waste per RCRA Subtitle C.
The Solid Waste Disposal Act of 1980 prohibits EPA from regulating drilling fluids, produced water and other waste associated with the exploration, development or production of crude oil or natural gas as RCRA Subtitle C (hazardous waste.)

Therefore, oil and gas wastes are referred to as “non-hazardous” and must regulated at the state level.

The exemption for oil and gas exploration and production waste is codified at 40 C.F.R. 261.4 (b)(5).
Environmental Protection Agency
Exempt Oil and Gas Waste Categories

Large Volume Waste

Produced Waters
Drilling Fluids
Drilling Cuttings

Associated Waste

Completion Fluids
Production Pit / Storage Tank Sludges
Produced Oily Sands and Solids
Washout Water and Sludge from Tank Cleaning
A simple rule

A simple rule of thumb can be used to determine if an E&P waste is exempt from RCRA Subtitle C regulations:

1. Has the waste come from down-hole, i.e., was it brought to the surface during oil and gas E&P operations?

2. Has the waste otherwise been generated by contact with the oil and gas production stream during the removal of produced water or other contaminants from the product?
Just because oil and gas wastes are exempt from being regulated as hazardous waste, does not mean that the waste does not pose a hazard to workers and community members living in close proximity to the drilling, production and waste handling sites.
SOURCES OF ENVIRONMENTAL CONTAMINATION
Air Contamination

Oil & Gas Environmental Conference
Sources of Environmental Contamination
Ground water, surface water, soil, sediments and air are impacted by:

**Fracturing** which can create pathways that can allow migration into other non-target formations.

**Leaks and spills** which can occur from injection wells, flow lines, pipelines, pits, tanks, chemical storage containers, drums and trucks.

**Road spreading and land spreading** can introduce contaminants into the environment.

**Discharges** into surface water resources of waste water not meeting permit limits.
June 25, 2009 - Louisiana

Hydraulic fracturing was occurring at a well site in the Haynesville Shale and production fluids ran off site.

40 beef cows with calves were grazing in the pasture next to the drill rig. The pasture fence was 150’ from the drill rig.

19 cattle died after ingesting white, milky fluid in rainwater puddles in the pasture.
The cattle were foaming at the mouth, billowing and had bleeding tongues prior to their deaths.

The same white milky fluid was present in puddles on the rig site.

During the hydraulic fracturing process yellow-green fumes were being released into the air and deposited on the ground around the drill rig and in the pasture.

Examples such as this stimulate the need for Eco-Friendly alternatives to the current chemicals used in the industry today.
We have responsibility to:
Ensure protection of ground water and surface water resources and prevent contamination of soil and water resources.

Develop regulations for fracturing and re-fracturing.

Have Buffer zone, set back and exclusion zones for well sites, compressors and tank batteries from water bodies, water wells, homes, businesses, buildings, schools, and park.

Develop efficient and effective Eco-Friendly compounds to substitute for the current toxic or hazardous chemicals.
WATER VOLUMES

So how much waste are we talking about?
Large quantities of water usage and waste water production during drilling and fracturing process.

The use of large quantities of surface and groundwater can deplete and degrade shallow drinking water aquifers and surface water resources.

Shale fracturing requires
  1.2 million gallons of water for each Vertical well

  3.5 million gallons of water for each Horizontal well
CHEMICALS IN WASTE
Each million gallons of hydraulic fracturing fluid contains @ 40,000 pounds of chemicals.

Thus a vertical well would have 48,000 pounds (approximately 6000 gallons) of chemicals in the fracturing fluid.

A horizontal well would have 140,000 pounds of chemicals (approximately 17,500 gallons).

20 to 30% of hydraulic fracturing flow back waste water remains underground. The flow back water contains large quantities of the chemicals used in the fracturing process.
The fluids necessary for the fracturing process is described as flow-back water and is contaminated with the fracturing chemicals and fluids. Fracturing fluids consist of:

- Surfactants
- friction reducing chemicals
- biocides
- scale inhibitors
- propping agents
Gas Process Waste

In natural gas production the wastewater generated is known as produced water and is contaminated with:

- volatile organic chemicals
- toxic heavy metals
- sulfur containing compounds
- NORM - Radioactive Radium 226 and 228
- salt water minerals

The toxic heavy metals consist of arsenic, barium, cadmium, chromium, lead, mercury, and vanadium which are known, possible and probable human cancer causing agents.
The volatile organic chemicals consist of:

- Benzene - a known human cancer causing agent and other organic chemicals

Possible and probable human cancer causing agents and mutagens.

- Toluene
- Ethyl Benzene
- Xylene
WASTE MANAGEMENT
Prudent waste management decisions, even for nonhazardous waste, should be based on the inherent nature of the waste. Not all waste management options are appropriate for every waste. Operators should be familiar with STATE and FEDERAL regulations governing the management of hazardous and non-hazardous wastes.

Management options consist of:

- Source Reduction
- Recycle / Reuse
- Treatment
- Land Disposal
Source Reduction
Avoiding waste generation, generating the least volume, or generating the least toxic waste possible.

• Material elimination
• Inventory control and management
• Material substitution (Greener Chemicals)
• Process modification
• Improved housekeeping
• Return of unused material to supplier
Recycling/Reuse

Reclaiming useful constituents of a waste material or removing contaminants from a waste so that it can be reused. Also may involve the use of a waste as a substitute product for a commercial product.

- Reuse
- Reprocess
- Reclaim
- Use as fuel
- Underground injection for enhanced recovery
- Road spreading
Treatment

Any method, technique, or process that changes the physical, chemical, or biological character of a waste. (Note that treatment does not necessarily prevent the creation of pollutants.)

- Filtration
- Chemical treatment
- Biological treatment
- Thermal treatment
- Extraction
- Chemical stabilization
- Incineration
- Landfarming
Disposal

*ExxonMobil Development Company conducted the first subsurface injection of drill cuttings in Colorado an effort to reduce the environmental footprint of drilling operations. The operator demonstrated injection as a technically feasible option for drilling waste disposal during full-field development.*

The discharge, deposition, injection, dumping, spilling, leaking, or placing of any waste into or on land, water, or air. Examples are:

- National Pollutant Discharge Elimination System (NPDES) discharge
- Solidification
- Burial
- Underground injection for disposal
DISPOSAL OPTIONS

FRACTURING WASTE WATER AND PRODUCTION WASTE WATER
Disposal Options

Injection into Disposal Wells - the water is wasted and no longer available for use

Wastewater Treatment Facilities that discharge the treated wastewater into surface water bodies - strict monitoring and compliance measures are needed to insure the protection of surface water bodies.

Emerging Technologies such as Thermal Evaporation and Brine Concentrator Technologies - air emissions from the Thermal Evaporation system is an area of concern.
“Never under any circumstances take a sleeping pill and a laxative on the same night”
THE USE OF GREENER CHEMICALS IN OIL AND GAS EXTRACTION
The industry has been using specialty chemical additives in fracturing fluids for more than 40 years. The risk associated with their use in the actual fracturing process is typically minimal.

Greater concern is transporting the chemicals to the site and possible ground spillage.

The recent direction is to develop and manufacturer surfactants and fluids that have little or no impact on the environments. The terms Eco-friendly, Natural, Environmentally friendly are widely used to describe these chemicals.
June 19, 2013 — Oil industry leaders met at the Green Chemistry & Engineering conference to discuss the current state of hydraulic fracturing and to begin exploring ways to produce greener and more sustainable chemicals for use in the process.

Eco-Friendly safer chemical additives are the preferred option, for if they were to spill, would cause less environmental damage than the ones that have been used in the past.

Significant strides have been made, and there are more strides to develop alternatives to the current toxic hazardous chemicals.
Going Green remains a grey area for many E&P drillers and operators. They have an increased demand to find environmentally friendly alternatives to meet their sustainability programs thereby reducing toxic wastes.

The challenge for the chemical industry is to formulate Eco-friendly surfactants, anti scaling agents etc. that balance between “Natural” and “Effective”. Most companies will use “Green” products if they offer the same or improved performance.

Second to performance is the risk of negatively affecting the dynamics of the formations ability to produce. Which influences the oil companies decisions.
The Challenge

• There is often times a misconception that safer, greener or environmentaly friendly products are less effective than their caustic and hazardous counterparts.

• The challenge is educating the decision makers to review the science behind the effectiveness.
Avoid EPA Fines

EPA Compliant
RCRA Compliant
Environmentally Friendly
Summary

• While E&P waste has been identified as non-hazardous we have a responsibility to ensure the health and safety of the sites, crews and environment.

• Become aware of State and local laws as it relates to E&P waste management

• Every effort should be made to develop a waste disposal management plan specific to your needs.

• Educate yourselves on the alternatives to greener chemistries in the Oil and Gas industries to decrease the toxic footprint.
OSHA Oil and Gas eTools

Ground Water Protection Agency
http://www.gwpc.org/

US Energy Information Administration
http://www.eia.gov/

American Petroleum Institute
Waste Management in Exploration and Production
(Feburary 1997). API E5 (2nd ed.)

RESOURCES
Thank You

Have a Safe and Happy Holiday Season
Non Exempt RCRA in CA.

- Acute oral toxicity – $LD_{50}$ is less than 50 mg/kg.
- Acute dermal toxicity – $LD_{50}$ is less than 43 mg/kg.
- Acute inhalation toxicity – The $LC_{50}$ is less than 100 ppm.
- Carcinogenicity – Single or combined concentration equal to or exceeds 0.1 percent (1000 ppm).
- Experience or testing – Like hazardous waste criteria, these wastes are shown through experience or testing to pose an extreme hazard.
- Water reactivity – When contacted by water, the waste reacts violently, generating extreme heat, burning, exploding or having some other rapid reaction.
- Persistent and bioaccumulative toxic substances: