# Public Health and the Proposed Pit Rule

**Ben Thomas, Ph.D.**

**Presented to the Oil Conservation Commission**
**May 2012**

## OVERVIEW OF TESTIMONY

- Hazard vs. Risk
- What is in the pits
- Risk evaluation of detected constituents
- Constituents of Concern
- Proposed amendments to Pit Rule
- Conclusions

Thank you for the opportunity to speak before the Oil Conservation Commission. My name is Ben Thomas. As has been stated, I am an expert in the fields of pathology, toxicology, and Risk-Based Decision Making (RBDM). I have been retained by the New Mexico Oil and Gas Association to evaluate its proposed amendments to OCD's Pit Rule with regard to the potential health and environmental risks posed by the constituents found in the various oil and gas pits.

## Hazard vs. Risk

In order understand my message today, it is important that we all have a common appreciation of the technical distinction between the terms "hazard" and "risk". While many people consider these to be synonyms, they are not.

BEFORE THE OIL CONSERVATION COMMISION
CASE NO. 14784 NMOGA EXHIBIT 12
OFFERED BY BEN THOMAS, Ph.D.
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"Hazard" is technically defined as a potential adverse effect. It is a yes-or-no designation, assigned without qualification. For example, statement that "Tylenol is a liver toxicant" is a designation of toxicological hazard.

"Risk" is defined as the probability that the adverse effect (or hazard) will occur. For example, "risk" requires that a receptor (e.g., a person or an environmental receptor) be exposed to the toxicant at a defined level. Thus, a person who swallows 15 Tylenol tablets at once is at higher risk of developing toxic liver injury than if he swallowed one tablet. The risk of Tylenol-related liver toxicity is zero in someone who doesn't ingest any Tylenol.

It is "risk", not "hazard", that is important in developing regulatory policy – that is, a regulatory agency must consider whether it is reasonable to believe that a receptor (i.e., human, animal, or plant) might be exposed to a high enough level of a toxicant that an adverse effect is of concern? If the answer is "yes", regulatory criteria are warranted. If the answer is "no", establishing regulatory criteria becomes a waste of everyone's time and efforts.

# What is in the Oil & Gas Pits?

## A. The Industry Sampling Program (2006)

To confirm and characterize what chemicals are in Drilling/Reserve Pits, the industry conducted a detailed sampling and analysis of pit contents. Because of differences in geology and operating practices, the Industry chose...

- Three drilling/reserve pits in NW New Mexico (San Juan Basin; generally gas production at depths of 600–9000 ft below ground surface), and
- Three pits in SE New Mexico (Lea County in the Permian Basin; generally oil production at 7000+ ft).

An independent third party collected samples of the solids contents of temporary pits (after fluids removed; just prior to closure). The samples were analyzed for a full range of constituents using standard EPA methods for metals, volatile and semivolatile organic compounds, anions, cations, TPH, PCBs, radium isotopes, and other analytes. Where the EPA methods allowed, a TCLP leachate of each sample was prepared and analyzed (selected metals and volatile organics).

Twelve samples of pit contents were collected at depth by auger at 11 locations in each pit...11 samples + 1 duplicate from each pit.
Laboratory results were subjected to an independent quality assurance audit, then evaluated by my staff.
Any constituents having at least one of the 12 samples exhibiting a concentration above the detection limit (including estimated concentrations) was included in the analysis of each pit

## 1. What was found? – Total Petroleum Hydrocarbon

TPH was evaluated by EPA Method 8015, which separates petroleum hydrocarbons into gasoline-range (GRO) and diesel-range (DRO) fractions. Most of the hydrocarbons in both the northwest and southeast pits were in the DRO-size fraction.

- SE NM average Total TPH (GRO+DRO) was 7700 mg/kg
- NW NM average Total TPH (GRO+DRO) was 1800 mg/kg
- OCD's criterion is 2500 mg/kg.

## 2. What was found? – Chloride

The average concentrations of Chloride anion were found to be:

- SE NM was 126,000 mg/kg
- NW NM was 3,900 mg/kg

## 3. What was found? – Arsenic

Arsenic is not a component of commercial drilling muds, and its presence is likely due to natural subsurface minerals being brought up during drilling.

- Average NW was 4.1 mg/kg
- Average SE was 2.3 mg/kg
- NMED's Tier 1 Residential Soil Screening Level = 3.9 mg/kg (version 4)
- Arsenic levels in TCLP leachates were not detectable, indicating that the natural arsenic-containing minerals will not dissolve in water, are not environmentally mobile, and are not bioavailable.

CONCLUSION: Arsenic exists in New Mexico drilling/recycle pits in a chemical form that does not pose health or environmental risks.

## 4. What was found? – Barium

Barium (in the form of barium sulfate) is a common component of drilling muds.

- Average SE was 1763 mg/kg
- Average NW was 10,000 mg/kg
- NMED SSL of 5450 mg/kg
- Barium levels in the TCLP leachates were low (estimated to be less than 3% of total; and were less than the WQCC 3103 criterion of 1 mg/L).
- Low water solubility indicates that barium in the pits is not environmentally mobile, and is not bioavailable.

CONCLUSION: Barium is in a form that is generally not soluble in water, and therefore does not pose a health or environmental risk.

## 5. What was found? – Benzene

Benzene is a natural constituent of petroleum (GRO fraction) and natural gas liquids, and is not considered to be a component of water-based drilling mud formulations. It is a recognized carcinogen.

- Average SE NM was 8.17 mg/kg
- Average NW NM was 0.12 mg/kg
- NMED SSL is 10.3 mg/kg

> Note: All soil samples exhibiting benzene concentrations above SSL were from Pit LC-1 (in SE NM) and these analytical samples were highly diluted (1000X vs. the usual 5-100X). High dilution ratios magnify analytical variability, and greatly complicate interpretation of such data.

- Benzene was found in all LC-1 leachate samples at concentrations above the WQCC 3103 criterion (0.01 mg/L).

## 6. What was found? – Halogenated Compounds

Several unusual halogenated compounds were reported by the laboratory at detectable levels. Subsequent lab discussions confirmed that these were "QC surrogates" purposely added to the sample to evaluate analytical recoveries:

2,3,4-TRIFLUOROTOLUENE -- Method 8015 (TPH)
o-TERPHENYL -- Method 8015 (TPH)
DECACHLOROBIPHENYL -- Method 8082 (PEST/PCB)
TETRACHLORO-m-XYLENE -- Method 8082 (PEST/PCB)
4-BROMOFLUOROBENZENE -- Method 8260 (VOC)
DIBROMOFLUOROMETHANE -- Method 8260 (VOC)
2-FLUOROBIPHENYL -- Method 8270 (SVOC)
2-FLUOROPHENOL -- Method 8270 (SVOC)
2,4,6-TRIBROMOPHENOL -- Method 8270 (SVOC)

### 7. What was found? -- Other Compounds

- The average soil concentrations of other detected Metal, VOC, SVOC, PCB analytes were below available NMED SSLs or SSL surrogate criteria.
- The average leachate concentrations of all other analytes were below available WQCC 3103 criteria or drinking water surrogate criteria.

CONCLUSION: Other compounds detected do not to pose significant risk to public health and the environment.

## B. The OCD Sampling Program (2007)

From May 22 to June 1, 2007, OCD staff collected aqueous and non-aqueous samples from 21 drilling/reserve pits, 2 production pits, and 2 closed-loop tanks, including blind duplicate samples, to answer the questions raised during the pit rulemaking outreach meetings.

- Twelve samples were taken from the northwest and 25 samples were taken from the southeast.
- It appears that OCD collected samples of solids from the surface at the four corners of each pit and mixed them to create a composite sample for analysis.
- OCD also collected water samples, suggesting that the fluids in some pits had not yet been removed for closure.
- The samples were analyzed for volatile organic compounds (VOCs), semi-volatile compounds (SVOCs), gasoline-range and diesel-range organics (GRO+DRO), polycyclic aromatic hydrocarbons (PAHs), total extractable petroleum hydrocarbons (TPH), total metals, and general chemistry cations and anions.
- The OCD data generally mirror the results of the Industry survey.

## C. Industry & OCD Findings

There may be several hundred chemicals present in the E&P wastes contained in various oil & gas pits. Most of these chemicals pose no recognized risk to health, environment, or natural resources, and are not measured by standard EPA methods. In addition, the analytical data from the Industry and OCD samplings of representative pits indicate that relatively few of these chemicals are present in a form or concentration to be of possible regulatory concern if an accidental release occurs:

- Total Petroleum Hydrocarbon – A variable mix of hydrocarbons (consistent with petroleum) were seen at relatively low concentrations by both the Industry and OCD programs. These hydrocarbons were analyzed by a method that essentially combines them according to molecular size -- that is, it groups them into those compounds that distill in the gasoline-range (GRO = 120-400°F) or in the diesel-range (DRO = 350-750°F) fractions. The GRO fraction contains compounds that are slightly water-soluble (especially the single-ring aromatics), and these could become environmentally mobile if a release were to occur. Because of the low concentrations in the pits, the hazard of regulatory concern would primarily be the ability of petroleum hydrocarbons to affect the odor and taste of water.

- Chloride Anion ($Cl^-$) – Chloride (in the form of sodium chloride and other mineral salts) is commonly found in the geological formations that contain oil and natural gas. It is not surprising, therefore, to find high levels ($100{,}000^+$ mg/L) of chloride anion in some E&P pits. These salts are soluble in water, and would be environmentally mobile if a release occurred. Chloride anion is not considered to be toxic to man and animals. However, chloride anion can adversely affect the growth of many

species of plants. Dissolved chloride salts can adversely affect the taste and pot ability of water.

- Benzene – Benzene is a component of the GRO fraction of petroleum. It is one of the more soluble constituents (saturation = 1850 mg/L in fresh water), and is considered to be one of the more toxic components of petroleum. Benzene is a bone marrow poison, and is a carcinogen. Although it is present in the pits at low concentration, it is listed here because many regulatory agencies, by policy, consider any exposure to a carcinogen to be unacceptable.

# Conclusions

Based on the data from the Industry and OCD's sampling programs, it seems clear that only a few of the constituents found in oil & gas pits may be of regulatory concern (TPH, chloride, and benzene).

These constituents pose no risk to public health and the environment if pits are closed by the procedures proposed by the Industry. If an environmental release were to occur, the primary hazards of concern would be odor and taste impacts on water sources.

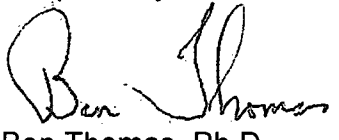
Based on my evaluation of the risk issues, I believe that the proposed Industry approach provides benefits similar to the current OCD policy, but at less cost:

- Small onsite pit closures (small mass of toxicant) present less overall risk to water than large concentrated landfills (large mass of toxicant).
- If liners are intact, both onsite pit closure and landfills are equally protective.
- If liners fail, onsite pit closures are more protective than large landfills
- Direct exposure risks (e.g., residential and construction) are *de minimis* for onsite pit closure.

- Other cumulative risks are minimized (e.g., lives, injuries, emissions, etc.).

Thank you for the opportunity to testify here today. I would be pleased to answer any questions you may have.

Respectfully Submitted,



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# ATTACHMENTS TO REPORT

A Corrected Summary Table (comparison to NMED SSLs version 4; deletion of halogenated surrogate compounds)