

# An Evaluation of the Chemtronics Superfund Site

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# What's there?

- During the operation of Chemtronics Inc. a large number of chemicals passed through the site.
- For the most part these chemicals have been capped or neutralized.
- Contaminants that remain on site are currently undergoing treatment to prevent spread, and ultimately, to be removed.
- Currently, contaminants remain contained within the site.

# Topics

- Risk Assessment Practices
- BZ
- CS and RDX
- Chlorinated Solvents
  - Chemistry
  - Air Stripping
- Perchlorates
- Remediation with Vegetable Oil

# Reference

- Parts Per Billion (ppb) – One part in a billion or approximately 1 tablespoon of sugar in Lake Tomahawk
- Half Life – The time it takes for half of a substance to break down
- Precipitation – Formation of a solid within a solution or other solid
- Volatile – The tendency of a substance to vaporize
- Migration – Movement of a substance from the point of origin

# Risk Assessment

Megan Brooks-Planck

# Risk Assessment

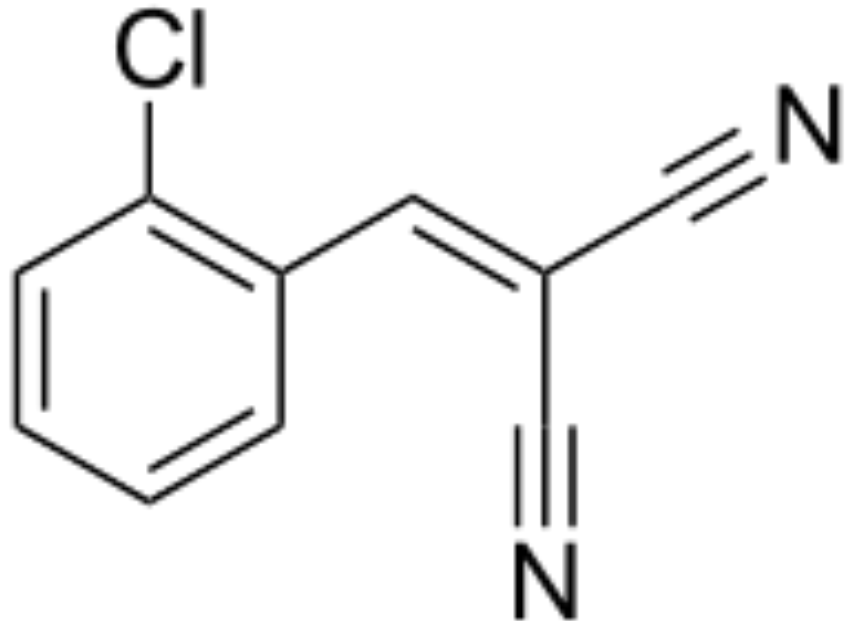
- The EPA determines risk using a four step process.
  - Hazard Identification
  - Dose-Response Assessment
  - Exposure Assessment
  - Risk Characterization

# CS and RDX

Eden May

# What is CS?

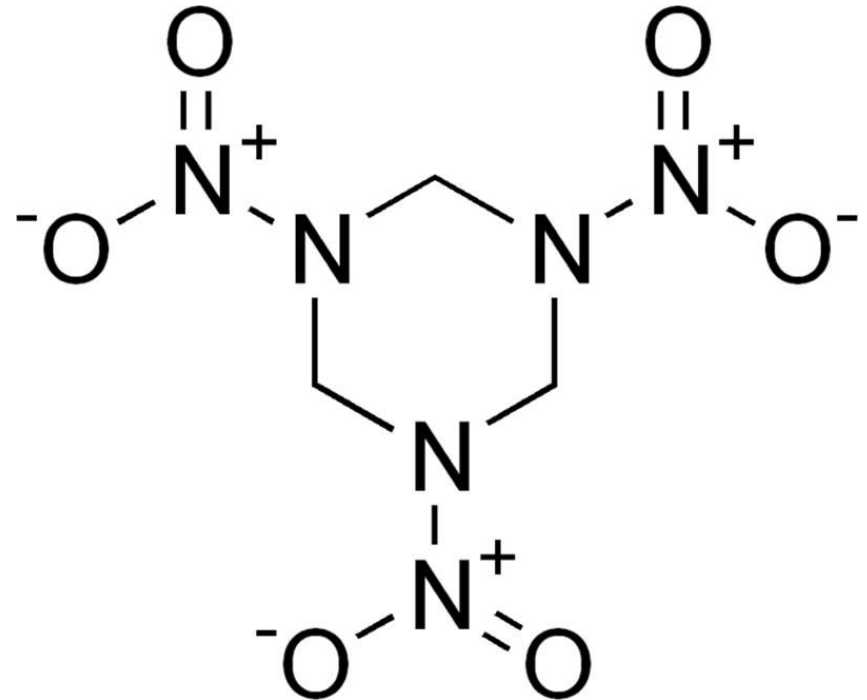
- “Tear gas”
- Non-lethal, used as an aerosol
- Can damage lungs, heart and liver
- Present in soil at some sites
- Decomposes quickly in water
- Half life is 41 minutes





# What is RDX?

- Produced as an explosive
- Can cause nausea, vomiting, confusion and amnesia
- EPA human health standard 103 micrograms/liter
- 220 micrograms/liter in one well



# RDX Degradation and Remediation:

- In situ – anaerobic conditions - reduction
- Cannot be attributed to single biological or chemical process
- Similar explosives may also be removed by reductive processes
- Conclusions
  - Microbial and chemical processes play important roles in reducing RDX in the aquifer
  - Reduction time took ~10 days for abiotic transformation
  - Electron donors enhance rate
  - *Rhodoferrax* spp. bacteria critical to in situ reduction in anoxic conditions

**BZ**

Michael Buttrick

# What is BZ?

- 3-Quinuclidinyl benzilate
- Potent hallucinogen
- Tested and produced during 1960's and 70's
- Designed to be distributed as aerosol
- Never saw official use
- Exposure Limit
  - ID<sub>50</sub> (incapacitating dosage):  
0.00616 mg (direct i.v.)

# Degradation of BZ

- No BZ detected in recent years
- Small amounts of Benzilic Acid decomposition product are present  
(less than 2 parts per million)
- Any BZ not removed during initial clean-up has turned to Benzilic acid
- Storage barrels of BZ were removed 25 years ago
- If any BZ was missed, its decomposition rate would indicate that less than .0000000005% remains

# Current Levels of BZ

Preliminary Soil Concentration (1988):

Benzilic Acid: 56.9mg/kg of soil

BZ: 17.1mg/kg of soil

Chemtronics Site Data (2007):

Benzilic Acid:

Soil Concentration: 9.3mg/kg of soil

Groundwater Concentration: 1.4mg/L water

BZ:

Soil: Not Detected

Groundwater: Not Detected

# Chlorinated Solvents

Meng Yuan Li

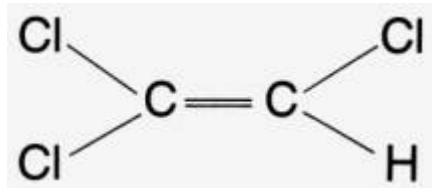
# What are Chlorinated Solvents?

- Metal degreasing agents
- Are present at highest concentrations on site
- Found at high levels in some wells, not in other wells
- Common industrial pollutant
- Carcinogenic to humans exposed at work
  - Kidney, liver cancer
  - Non-Hodgkin lymphoma
- Neurobehavioral deficits
  - Long-term exposure to low concentration of TCE
- Evidence only from long term high level exposure

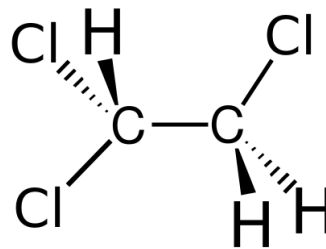


# What are Chlorinated Solvents?

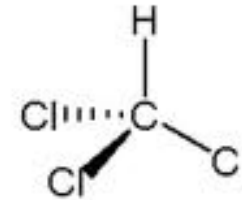
TCE Trichlorethylene



TCA Trichloroethane



Chloroform



## EPA drinking water limits

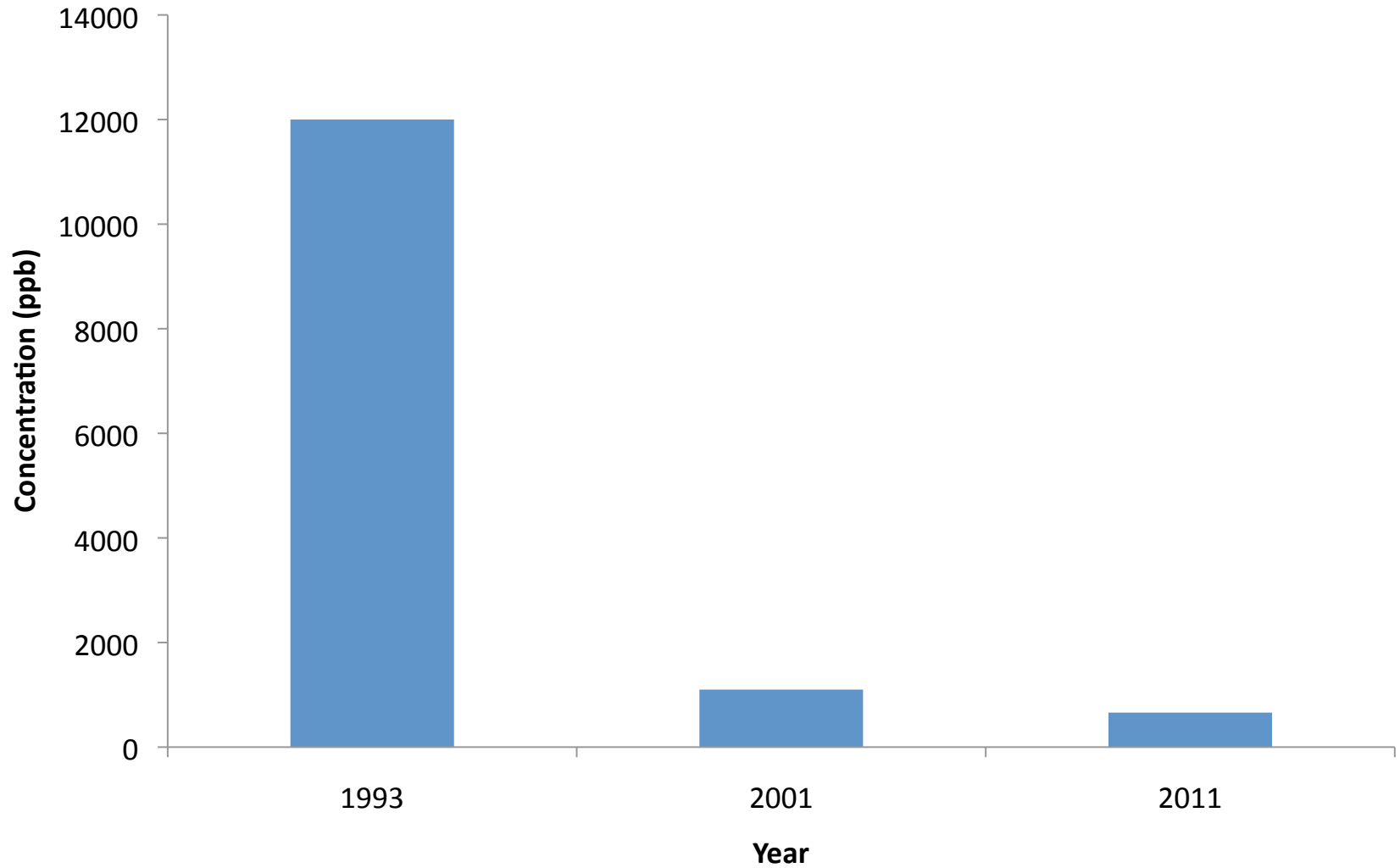
5 micrograms/liter

200 micrograms/liter

70 micrograms/liter

All found in groundwater at levels exceeding EPA limits in some wells

### TCE in One Back Valley Shallow Well



EPA standard for TCE = 5ppb

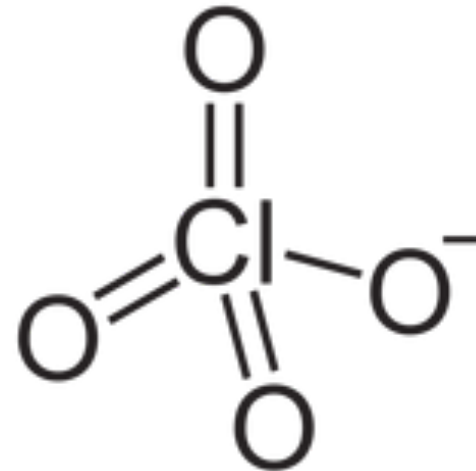
# Perchlorates

Elizabeth Bonnell

# What is perchlorate?

## Source:

- Fireworks
- Warfare
- Some chemical processes
- Can form naturally



## Chemtronic Site Sources

- Explosives

# Health effects of perchlorate

- Competes with iodide in the thyroid gland
  - Only at high perchlorate levels
  - Some concern for pregnant women
- Not likely to cause cancer

# Current Levels

- 2500 micrograms/liter in one Chemtronics well
- 6 micrograms/liter maximum permissible level in California
- Not travelling to off-site wells

# What are they doing to clean it up?

- No previous methods at Chemtronics
- Possible Methods:
  - Anaerobic Degradation now being tested
    - Seems promising
  - Treatment through physical processes not likely now

# Bioremediation: Emulsified Vegetable Oil

Davis Jones



# What does reduction mean?

- Reduction is the gain of electrons
- If something gains electrons (is reduced) something else has to lose the electrons (is oxidized)
- Some bacteria can speed up the reaction
- Vegetable oil is a possible source of electrons leading to reduction of pollutants

# General Remediation

- July 2012 – Enhanced In situ Bioremediation (EISB) using food grade vegetable oil (EVO) approved by the EPA
  - Contractor
- Four sites tested in Front Valley
- Current activity: FSCT – Feasibility Screening/  
Candidate Testing
  - Microcosm testing – Bacterial strains
  - Shallow well test

# General Remediation

- EVO provides underground emulsion to stimulate BOZ – biologically active zone
- BOZ stimulates bacterial growth
- Acts as electron donor to reduce chlorinated solvents

reduce = gaining an electron

# Contaminants Treated

## Chemicals of Potential Concern

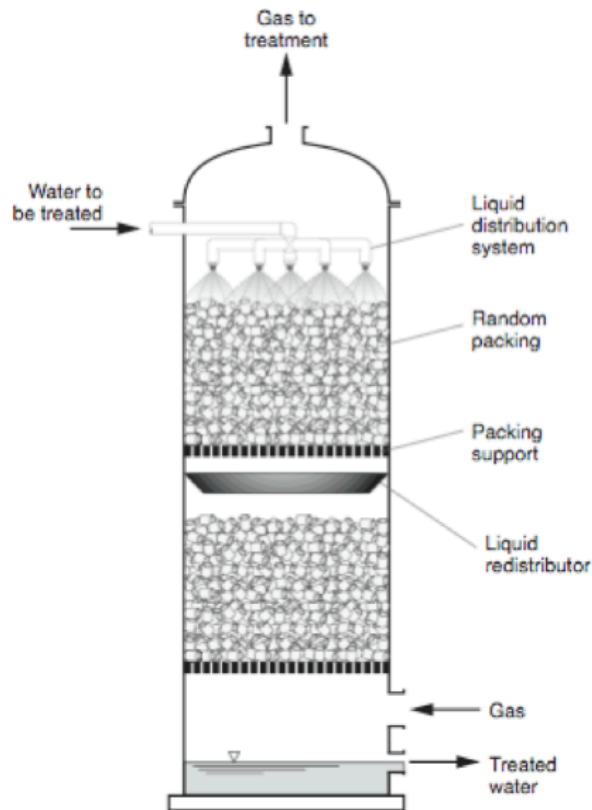
- VOC –volatile organic compounds (TCE, PCE, 1-2-DCA, CF )
- Nitroaromatics (RDX, HMX, 2,4,6- TNT)
- Perchlorate

Bioremediation can be effective for all three categories

# Other Types of Remediation

Rebecca Johnson & Stephanie Williams

# Remediation: Air Stripping



Schematic of a Packed Tower Air Stripper (Crittenden et al., 2005)

- Contaminated water enters at the top of the column as air enters at the bottom
- Packing provides increased surface area
- chlorinated solvents enter the gas phase
- Treated water exits through the bottom of the column, solvents are off gassed

# Reaction in air

- Light can cause removal of chlorinated solvents in air
- TCE breaks down into  $\text{CO}_2$  and  $\text{HCl}$
- The half life of TCE is 3.5 days
- After two weeks, TCE is essentially gone from air

# Other Methods for removal of solvents

- Natural attenuation
  - “Let nature take care of it” (bioremediation, dilution, etc)
- Zero-Valence Iron
  - Metal-water interface
  - Corrosion of iron
- Bioremediation
  - Bacteria remove Cl and replace with H
  - Final product is harmless
  - Currently being tested on-site

