

Pick your Poison - Emerging Contaminants

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News Worthy Headlines?

1. Lead in Drinking Water (Flint, MI)
2. BPA in Plastic Bottles/Liners
3. Plastic Contamination in the Environment
4. Fracking Contamination of Drinking Water
5. Monsanto Roundup is Everywhere
6. Summer Beach Closures for Bacterial Contamination
7. Antibiotic resistant Everything?
8. Pipeline spills/concern
9. Sperm counts of Western men plummeting due to Environmental Factors

Emerging Environmental Contaminants

- Arsenic
- Bisphenol A (BPAs)
- 1,4-Dioxane
- 1-Dioxin-Furan
- Polycyclic Aromatic Hydrocarbons or Polynuclear Aromatic Hydrocarbons (PAHs)
- Micro-beads
- Lead (drinking water, ground water, and soil)
- Glyphosate (herbicide aka weed killer)
- Fracking Drinking Water Contamination

General Outline for Each Contaminant

- Brief background of the Contaminant
- How does it contaminate the environment?
- How and why do we even care that it is a contaminant?
- How is it typically cleaned up from the environment?
- What are the potential business opportunities?



Arsenic

- Chemical Element (As) with atomic number 33
- Occurs in many minerals but also pure elemental crystal
- Primary Uses
 - Alloys of lead in Car batteries
 - Ammunition
 - Historical Pesticides (even today)
- Naturally Occurring in Soil
- Humans regularly exposed to small amounts in air, water, and food



Arsenic Contamination

- Why hot now?
 - Redevelopment of former Industrial Sites
 - Regulatory levels often can be below EPA Limits and are within naturally occurring levels in soil
 - Historical Orchards and Redevelopment into Residential
 - Cleanup methods
 - Metals are difficult to cleanup but are not very mobile



Arsenic Cleanup

- Generally Cleanup involves disposing of the soil
- Groundwater cleanup can be difficult but plume generally not very mobile
- Hazardous levels of Arsenic are very costly and difficult to clean-up
- Sediment of Stormwater Management Facilities often have high levels of metals



Arsenic Business Opportunities

- Understanding naturally occurring arsenic levels of local soils
- Understanding local, State, and Federal cleanup standards and requirements
- More prevalent in the environment than many of us think
- Public perspective of Arsenic contamination and dealing with repercussions
- Helping client to minimize cost of cleanup for new or redevelopment of a project

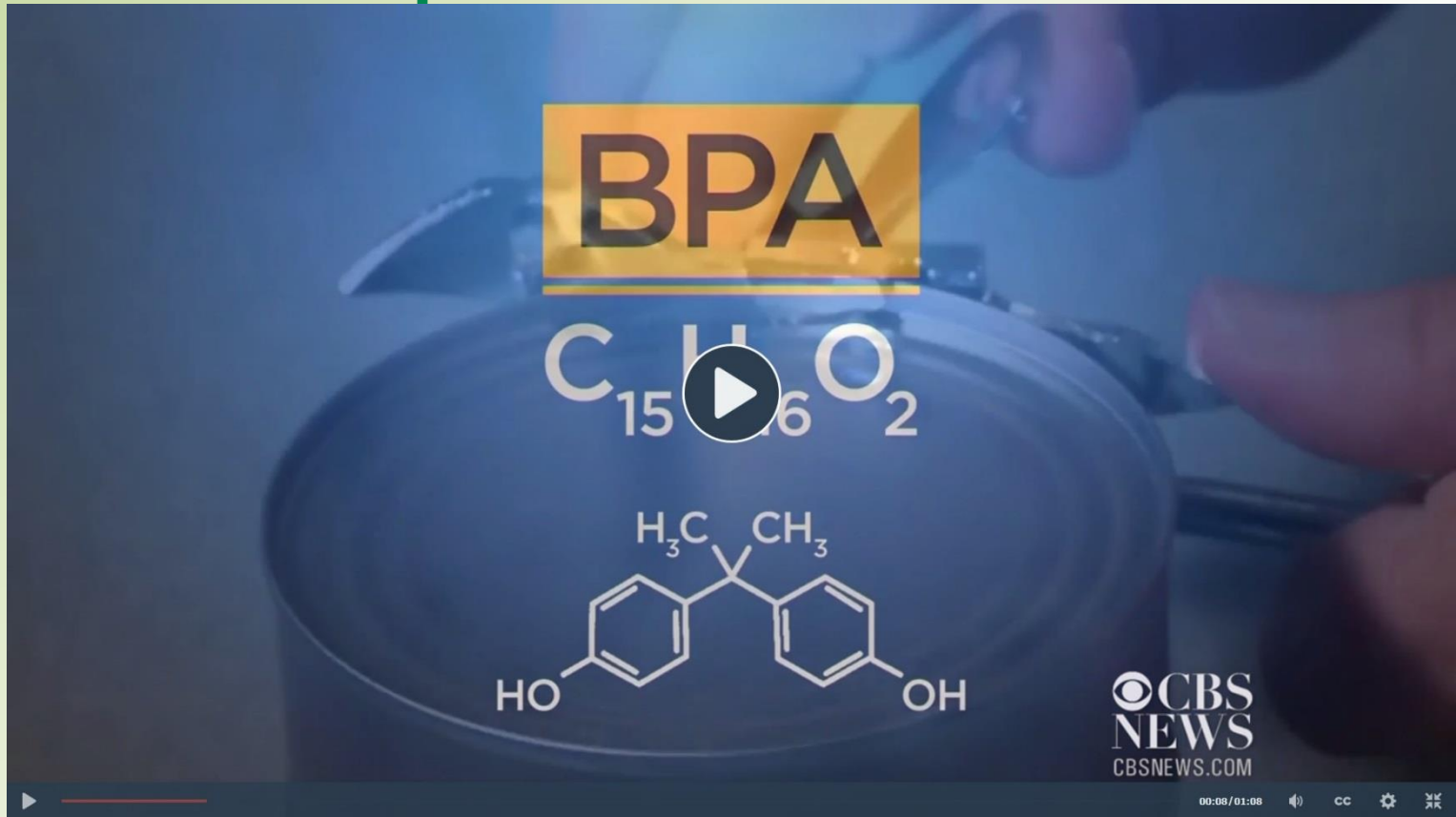
Bisphenol A (BPAs)

- **Bisphenol A (BPA)** is an organic synthetic compound with the chemical formula $(\text{CH}_3)_2\text{C}(\text{C}_6\text{H}_4\text{OH})_2$
- Colorless solid that is soluble in organic solvents, but poorly soluble in water. It has been in commercial use since 1957.
- BPA is employed to make certain plastics and epoxy resins.
- BPA-based plastic is clear and tough, and is made into a variety of common consumer goods, such as water bottles, sports equipment, CDs, and DVDs.
- Epoxy resins containing BPA are used to line water pipes, inside of many food and beverage cans, and thermal paper such as that used in sales receipts.

BPA Contamination

- BPA is a xenoestrogen, exhibiting estrogen-mimicking, hormone-like properties that raise concern about its suitability in some consumer products and food containers.
- The U.S. Food and Drug Administration (FDA) has ended its authorization of the use of BPA in baby bottles and infant formula packaging, based on market
- The FDA states "BPA is safe at the current levels occurring in foods" based on extensive research, including two more studies issued by the agency in early 2014.^[5] The European Food Safety Authority (EFSA) reviewed new scientific information on BPA in 2008, 2009, 2010, 2011 and 2015: EFSA's experts concluded on each occasion that they could not identify any new evidence which would lead them to revise their opinion that the known level of exposure to BPA is safe; however, the EFSA does recognize some uncertainties, and will continue to investigate them.^[6]
- **WHERE DOES THAT PUT CONSUMERS?**

BPA Still present in Our Foods



src="https://www.cbsnews.com/embed/video/bpa-chemical-still-found-in-some-canned-foods/" id="cbsNewsVideo" frameborder="0" width="100%" height="100%"></iframe>

BPA Cleanup & Business Opportunities

- BPAs may eventually be banned
- What about BPAs already in our bodies and the environment?
- Current best course of action is not using but is this practical?
- May never get out of the environment

1,4-Dioxane

- Man-made Solvent/Stabilizer
- 2% to 8% in 1,1,1-TCA
 - ✓ Metal inhibitor
 - Acid acceptor
- Up to 1% in TCE – possible
- Colorless flammable liquid
- Dissolves Fully in Water
- Poor sorption properties

Where is 1,4-Dioxane?

- Industrial wastes - Solvent Use
 - Pharmaceutical purifying agent
 - Medical waste - Scintillation cocktails, filter production,...
 - Aircraft deicing products
 - Municipal Wastewater – not treating 1,4-dioxane
-
- Shampoo – up to 300,000 ppb
 - Dishwashing Soap – up to 65,000 ppb
 - Baby Lotion – up to 11,000 ppb
 - Hair Lotion – up to 108,000 ppb
 - Bath Foam – up to 41,000 ppb
 - Food Additives – up to 10,000 ppb
 - Cosmetics – in 46% based on 2008 survey
 - FDA is “watching it” but no regulatory restrictions



1,4-Dioxane Cleanup

- Chemical Lab testing methods
- No Federal MCL – EPA tap water RSL of 0.67 ppb
- Only 9 states have cleanup levels with varying levels of ppb
- Very mobile in soils and ground water
- In-situ Treatment techniques

1,4-Dioxane Business Opps

- Knowing it is present and understanding how it can be cleaned up
- Understanding if the State that your project is located has a clean-up standard (only 9 states)
- Educating regulators and your clients



Polycyclic Aromatic Hydrocarbons (PAHs)

- Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals
- Formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat.
- PAHs are usually found as a mixture containing two or more of these compounds, such as soot.
- Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

How do PAHs Contaminate?

- PAHs enter the air mostly as releases from volcanoes, forest fires, burning coal, and automobile exhaust.
- PAHs can occur in air attached to dust particles.
- Some PAH particles can readily evaporate into the air from soil or surface waters.
- PAHs can break down by reacting with sunlight and other chemicals in the air, over a period of days to weeks.
- PAHs enter water through discharges from industrial and wastewater treatment plants.
- Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers.
- Microorganisms can break down PAHs in soil or water after a period of weeks to months.
- In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.
- PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.

Why Test for These Contaminants (PAHs)?

- Required by EPA, State, or local regulatory agency
- Have informed client
- Trying to find a problem
 - Due Diligence (reduce buying cost)
 - Going to find some levels of contamination

Why clean up PAH contamination?

PAH's have been deemed carcinogenic and teratogenic.

Found in human liver tissue and fatty tissues

Hyperaccumulation of toxins such as PAH can occur in plants grown in contaminated soils, increasing the risk of the people eating the produce.



PAHs Cleanup/Levels

- Removal of Contaminated soil and groundwater from the site
- OSHA has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m³).
- The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m³ averaged over an 8-hour exposure period.
- NIOSH recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m³ for a 10-hour workday, within a 40-hour workweek. There are other limits for work place exposure for things that contain PAHs, such as coal, coal tar, and mineral oil.

PAHs Biz Opportunities

- PAHs are everywhere so balancing cleanup with leave alone
- Observed in soil and groundwater with limit Federal, State regulations for all 100 PAH contaminants
- Understanding their presence and potential clean-up opportunities can allow you to educate your clients
- Always going to be present in the environment - what action level?

Dioxins and Dioxin-like Compounds (DLCs) (i.e. 1-Dioxin Furan)

- Dioxins and dioxin-like compounds (DLCs) are compounds that are highly toxic environmental persistent organic pollutants (POPs).
- Mostly by-products of various industrial processes - or, in case of dioxin-like PCBs and PBBs.
- 75 Polychlorinated dibenzo-p-dioxins (PCDDs) congeners, or simply dioxins - **the most dangerous being 2,3,7,8-Tetrachlorodibenzodioxin (TCDD)**
- Furans, or Polychlorinated dibenzofurans (PCDFs). PCDFs are derivatives of dibenzofuran. There are 135 isomers, ten have dioxin-like properties.
- **Dioxin may refer to 1,4-Dioxin proper**, the basic chemical unit of the more complex dioxins. This simple compound is not persistent and has no PCDD-like toxicity.

Where do Dioxins come from?

- PCB-compounds, always containing low concentrations of dioxin-like PCBs and PCDFs. They have entered the environment through **accidents such as fires or leaks from transformers or heat exchangers, or from PCB-containing products in landfills or during incineration**
- Waste incineration emits them

Why do we care about Dioxins?

- Environmental persistence and bioaccumulation
 - Accumulate in animal and human fat
 - Biomagnification in top predators
- Both in America and in Europe, many waterfowl have high concentrations of dioxins
- Very slow elimination in humans and animals because of low water solubility
- Biological half-lives of several years for all dioxins. That of TCDD is estimated to be 7 to 8 years, and for other PCDD/Fs from 1.4 to 13 years

How do we cleanup dioxins?

- If soil contamination, remove from project location.
 - Not all env. remediation facilities accept
 - Concentrations need to be low enough to avoid Haz. Levels
- Milk, dairy products and meat have been by far the most important sources so limit?
- Limit exposure to herbicides.



Business Opportunities

- Understanding the historical nature of a project site
- Potential for dioxins to be present
- Educating our clients over the potential contamination
- Always going to be present in the environment - what action level?

Microbeads?

- What are microbeads?
 - Any solid plastic particle less than 5mm in size
- Why are they used?
 - Intended to be exfoliates or cleaners
- Where are they used?
 - Typically in toothpastes and facial cleansers
- Why should I be concerned?
 - You drink water, right?
 - You eat seafood?
 - Do you want to ingest plastic?

Micro-beads - Drinking Water Contaminant?

- Wastewater Treatment Plants Limited Removal
 - Micro-beads
 - Small plastic beads
 - Contamination of our water ways
 - No effort by US to ban these
 - Wildlife ingest
 - Next “Mold is Gold” or Asbestos size problem?



Small bits of plastic used in **body washes, exfoliators, toothpastes,** and other **cleansing products**



Can potentially cause **problems** for the **food chain** and our **food supply**

Isn't filtered out by water treatments because of its size, so it **ends up in rivers, lakes, and oceans**

The **plastic** is then consumed by marine life, which **harms** them



PRODUCTS WITH **MICRO BEADS**



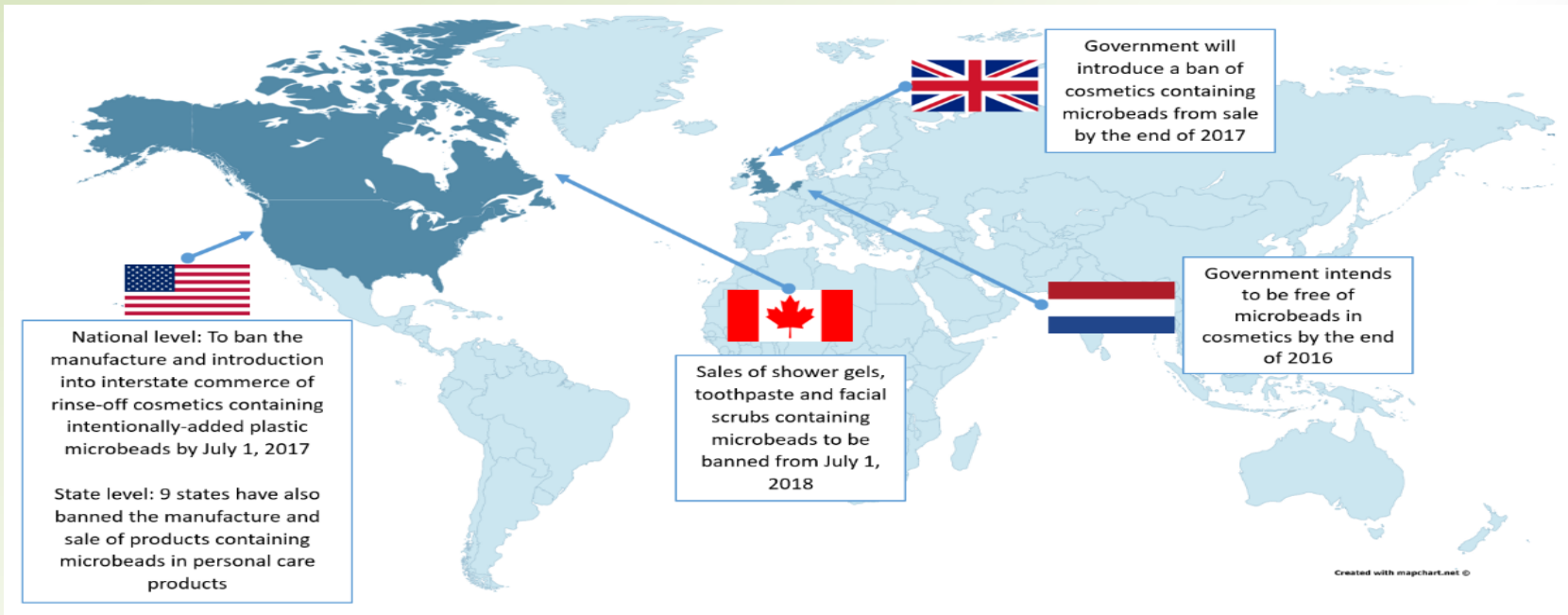
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What is being done?

- Don't buy products with Microbeads
- US banned the production of microbeads from personal care products and cosmetics starting in July 2017
- Numerous states and already have bans
- International issue



Micro-bead Business Opportunities

- Understanding the historical nature of a project site
- Microbeads are present everywhere
- Educating our clients over the potential contamination
- Always going to be present in the environment - what action level?
- Is there any action that we can do?

Conclusions

- Numerous Emerging Contaminants discussed but many more not discussed
- Constantly changing Environmental Contaminants
- Regulations barely keep up with health concerns and list of potential contaminants
- Removal of soil and in-situ or pump and treat groundwater treatment most common methods

Questions?

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