Chemical Classes 4-6

4. Bisphenols and Phthalates
5. Solvents
6. Metals

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Quick overview and updates

- Chemicals and structure(s)
- basic function/use
- key hazards and concerns
- Necessary-ness and safer alternatives
- policy, regulatory, market activities
Bisphenols & Phthalate Esters

- Plastics, resins, chemicals

HOC6H4CH3\(\text{O} \quad \text{O} \quad \text{O} \quad \text{O} \quad \text{O} \quad \text{O}
\)

- e.g., BPA

HOC6H4SO\(\text{O} \quad \text{O} \quad \text{O} \quad \text{O} \quad \text{O} \quad \text{O}
\)

- e.g., BPS

Ortho-phthalate ester

HOC6H4\text{O} \quad \text{O} \quad \text{O} \quad \text{O} \quad \text{O} \quad \text{O}

- e.g., DEHP
Bisphenols

- **Uses:**
  - Feedstock for polycarbonate and epoxy resins
  - Developer on thermal paper
BISPHENOLS

Human health concerns:

- High production-volume: constant exposure
- Known endocrine disruptors, concern with low dose exposure
- Reproductive and developmental toxins
- Particular impact on children’s health

BPA Policy updates:

- EU SVHC (Dec 2016)
- EU use restricted in thermal paper after 2020
- EPA DfE alternatives assessment for thermal paper (2014)
- California Prop 65 list
- Numerous manufacturer and retailer commitments to phase out BPA in children’s products and food packaging
Bisphenols - alternatives

- Non-polycarbonate resins:
  - E.g., Triton copolyester, glass

- Can linings:
  - Acrylic, polyester, oleoresin, glass jars

- Receipts:
  - Optional and e-receipts, phenol-free thermal paper
Phthalate Esters

- Plasticizers in plastics
- Solvents and emollients in personal care products and cosmetics

DEP – diethyl phthalate
BBP
DINP
DPHP

Commercial products are mixtures, with various chain lengths and configurations
CLASS 4: PHTHALATES
USED AS PLASTICIZERS, OTHER

Global Plasticizer Consumption (2014)
total = 8 million tonnes

- Ortho Phthalates 70%
- Terephthalates 12%
- Epoxies 7%
- Aliphatics 4%
- Trimellitates 2%

95% of plasticizers are used to make flexible PVC
Endocrine disruptors
• Effects at very low concentrations
• Permanent effects from prenatal and early childhood exposure
  • Neurodevelopmental deficits
  • Behavioral abnormalities
• Effects expressed in multiple generations

“Phthalate exposure is widespread in the US population”
-- Centers for Disease Control and Prevention (CDC)

P. Grandjean and P.J. Landrigan, Lancet Neurol 2014
National Report on Human Exposures to Environmental Chemicals (CDC 2014)
Policy update

• Massachusetts evaluated the class of phthalate esters. For Ortho-PEs:
  – Reproductive health effects across ortho-PEs, variable potency
  – Commercial products are mixtures; not feasible to categorize by carbon chain length
  – New products continue to come on the market with similar constituents and different CAS no.
  – Additive health effects
5. Solvents – basic functions

• Dissolve or disperse materials
• Carrier solvents
• Cleaning and stripping
• Mixing medium
Hydrocarbon Solvents

- **Aliphatic** organic solvents
  - Petroleum distillates, mineral spirits, hexane

- **Aromatic** organic solvents
  - Toluene, xylene, benzene

- Paints, coatings, thinners
- adhesives, printing inks
Oxygenated Solvents

- **Examples:**
  - ethyl acetate
  - Acetone
  - glycol ethers
  - alcohols

- Nail polish and polish remover

- Janitorial cleaners, personal care products
Chlorinated and other halogenated Solvents

- Methylene chloride (dichloromethane)
- Perchloroethylene (perc)
- Trichloroethylene (TCE),
- N propyl bromide (nPB),
- trans-dichloroethylene,
- Hydrofluoroethers (HFEs)

- Paint strippers
- Dry cleaning
- Degreasing

Credit: Making it mine blogspot
Volatile Methyl Siloxanes: cyclosiloxanes

- Examples:
  - D5 cyclic siloxane
  - D4 and D5 cyclic siloxanes (cyclomethicone, cyclosiloxanes)

- Dry Cleaning

- cosmetics, hair conditioners, personal care products
Human Health and Other Concerns

*Broad, diverse category with various concerns*

**Human Health**

- **Neurotoxicity** – most organic solvents
- **Carcinogenicity** – Chlorinated/brominated
- **Liver and kidney toxicity** - many organic solvents
- **Reproductive toxicity** - e.g., ethylene glycol ethers, N methyl pyrrolidone (NMP)
- **Contact dermatitis, defatting of skin** – many organic solvents

**Other concerns**

- **VOCs, flammability, groundwater contamination**
US Policy Update - Solvents

EPA proposing to ban TCE under TSCA in:
- Degreasing, Spot Cleaning and Arts & Crafts Use
- Commercial vapor degreasing (comment period ends May 19, 2017)

EPA proposing to ban methylene chloride, and possibly NMP in:
- Consumer and most commercial paint strippers (currently not in furniture refinishing) (comment period ends May 19, 2017)

7 Of first 10 chemicals to evaluate under TSCA are solvents:
- nPB, carbon tetrachloride, methylene chloride, NMP, TCE, perc, 1,4-dioxane
Policy Update
halogenated hydrocarbons

Massachusetts TURA SAB getting a little tired of the “whack-a-mole” approach....

• TURA Science Advisory Board recommended listing of C1-C4 halogenated hydrocarbon category, not otherwise listed on TURA list of toxic or hazardous substances.

California

• Methylene chloride – CA DTSC Safer Consumer Products priority product
  – paint strippers containing DCM
Policy Update - siloxanes

- Siloxanes – D4 (octamethylcyclotetrasiloxane) and D5 (Decamethylcyclopentasiloxane)
  - EU: pending decision
    - Wash-off personal care products in the EU shall not contain more than 0.1% of D4, nor more than 0.1% of D5
  - EU: published notice of intention April 2017
    - Leave-on personal care products in the EU
Safer alternative: Water

Nature’s original solvent
Certain metals and their compounds:

- Chromium
- Cobalt
- Nickel
- Cadmium
- Mercury
- Arsenic
- Tin
- Antimony
- Lead
Metals - Uses

- Alloys and corrosion resistant coatings
- Conductors, electronics
- Pigments in paints and dyes
- Additives in plastics
- Biocides
CERTAIN METALS - HAZARDS

- Can display toxicity at very low doses
- Specific hazards depend on exposure route, compound, and oxidation state:
  - Cancer, reproductive toxicity, neurotoxicity
  - Sb: heart and lung problems (if inhaled)
  - As: skin and lung cancer, anemia, vascular disease
  - Cd: lung problems, kidney failure
  - Cr +6: kidney damage and lung cancer
  - Co (at high doses): lung and heart problems, dermatitis
  - Pb: neurotoxicity, blindness, hearing loss, lower IQ
  - Hg: memory loss, tremors, numbness
  - Ni: cancer
  - organotin: neurotoxicity, liver, kidney and skin toxicity
CERTAIN METALS – Safer Alternatives

• Safer alternatives exist for:
  – lead in paint, plastics, water pipe and fixtures
  – mercury in mascara, dental fillings
  – Organotin anti-foulant coatings
  – Cadmium or lead in jewelry

• For essential uses, need responsible mining, worker protection and recycling practices.

• On-going research in
  – non-hex chrome sealants, primers, and coatings
  – Anti-fouling biomimicry coatings, etc.
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