Chemical Classes of Concern:

5. Selected Solvents

What Are Solvents and How Are They Used?
Solvents are used to dissolve materials. Carrier solvents disperse and transfer other substances. For example, pigments and resins in a carrier solvent form a paint that can be spread. Carrier solvents evaporate off, leaving the other materials behind. Solvents can also be used to dissolve materials to remove them, for example, cleaning and degreasing solvents dissolve grease and remove it from a metal part or textile. Solvents are also used to allow mixing of different constituents, for example, to allow a chemical reaction to take place.[1]

Solvents are used in many consumer products, including: paints, coatings, inks, adhesives, nail polishes and removers, paint strippers and cleaning and degreasing products. They are also used extensively in manufacturing and occupational settings.[2]

Which Are the Most Common Types of Solvents?

The most common solvents are water and organic (carbon-based) solvents, including hydrocarbons, oxygenated hydrocarbons, and halogenated hydrocarbon solvents.

- Water is the safest solvent, but can't be used easily for some applications because not all substances dissolve easily in water and because water evaporates more slowly than organic solvents.

- Aliphatic hydrocarbon solvents, including petroleum distillates and hexane, are straight-chain or branched hydrocarbons, and dissolve many resins, oils and other chemicals. Aromatic hydrocarbon solvents, including benzene, toluene and xylene, have a benzene ring chemical structure and dissolve many resins, adhesives, inks and other chemicals. Hydrocarbon solvents are often flammable and neurotoxic.[3,4]

- Halogenated organic solvents, are hydrocarbons which have halogens (typically chlorine, sometimes bromine) bonded to them. Common halogenated solvents include perchloroethylene, methylene chloride (or dichloromethane), trichloroethylene and n-propyl bromide; they are primarily used in industrial parts cleaning applications, paint stripping and garment dry cleaning. They also dissolve many resins and oils. They are not flammable, but do have human health concerns, including neurotoxicity[4] and carcinogenicity.[3]

- Other solvents that may be less toxic include those based on citrus or plant oils (e.g., d-limonene), oxygenated hydrocarbon solvents (e.g., acetates, glycol ethers, ketones and alcohols), n-methyl pyrrolidone (NMP), and siloxanes (e.g., D5).

Why Are They A Concern?
Organic solvents are a concern to consumers and workers because they can cause adverse health effects and they evaporate easily, so users are exposed to them via inhalation. Acute, short-term exposure to large amounts of solvents can cause severe, life threatening, health effects. Chronic, long-term exposure to smaller amounts can also cause negative health effects. Common adverse health effects of exposure to some organic solvents include neurotoxicity, liver and kidney damage, carcinogenicity, and reproductive toxicity.[3,4]

Do We Need Solvents?

Solvents perform an essential function in some consumer products. For many products and applications, less harmful solvents or non-solvent based processes can be used in lieu of the solvents that are known to cause negative health effects:[5]

- Paints, coatings and adhesives, and clean-up/thinning products:[6] The availability and performance characteristics of water-based products have increased over the years for nearly all of these product categories.

- Paint strippers: In lieu of solvents, mechanical removal methods are available for stripping paint, but they may cause respiratory issues. Alternatives to methylene chloride-based strippers are available, including n-methyl pyrrolidone (NMP), which also has toxicity concerns[7], dibasic esters, and citrus-based products.

- Garment cleaning - Many consumers take garments to a dry cleaner, where they are cleaned in perchloroethylene. Some residual percholoroethylene remains in the clothes and evaporates inside the consumer's home. Alternative dry cleaning solvents include hydrocarbons, D5 siloxane, and dibutoxymethane (Solvon K4). Professional wet cleaning has been shown to be effective for cleaning "dry-clean only" garments, and is the safest alternative for workers, consumers and the environment.[8,9]

[1]American Chemistry Council, Solvents Industry Group. "Solvents Explained" accessed 8Oct2013 at: http://solvents.americanchemistry.com/Solvents-Explained

[2] Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health (NIOSH). Overview for Organic Solvents, including Criteria Documents for many solvents used in the workplace. Criteria Documents are not new, but have good basic health and safety information. Accessed at: http://www.cdc.gov/niosh/topics/organsolv/

[3] Cone, J.E. and Packard, K., "Health Hazards of Solvents" presentation and resources by Association of Occupational and Environmental Clinics (AOEC), accessed at http://aoec.org/resources.htm .

[4] Spencer, P.S.; Schaumburg, H.H. Organic solvent neutotoxicity: facts and research needs. *Scand J Work Environ Health*, 1985, *53-60.*

[5]Toxics Use Reduction Institute, "Cleaner Solutions Database." Database of 20 years of industrial and janitorial cleaning and paint removal lab testing in TURI's Cleaning Lab. Accessed 8OCT2013 at: http://www.cleanersolutions.org/

[6] Wolf, K. and Morris, M. Low-VOC, Low Toxicity Alternatives for Consumer Product Cleanup and Thinning Solvents, Institute for Research and Technical Assistance, Prepared for Cal/EPA's Department of Toxic Substances Control, March 2007.

[7] Wu, I.; Lin, J.; Cheng, E. Acute poisoning with the neonicotinoid insecticide imidacloprid in N-Methyl Pyrrolidone. *Clinical Toxicol*, 2001, *617-621.*

[8] Toxics Use Reduction Institute, "Assessment of Alternatives to Perchloroethylene for the Dry Cleaning Industry" June 2012. Accessed 8OCT2013 at: http://www.turi.org/Our_Work/Business/Small_Businesses/Dry_Cleaning

[9] California Air Resources Board, "Dry Cleaning Notice 2009-1: Alternatives Solvents Used for Dry Cleaning Operations" Accessed 8OCT2013 at http://www.arb.ca.gov/toxics/dryclean/pub.htm#fact