

CHEMICALS OF CONCERN

Uses and health + environmental impacts of key hazardous chemicals

We have listed some hazardous chemicals below by impact (PBTs, carcinogens, etc.) and others by the function they provide (toxic flame retardant, solvents, pesticides etc.). The reason for this is that many functional products may contain or impact multiple body systems - for example, flame retardants can contain carcinogens, mutagens, and endocrine disruptors. Because of this it's often easier and more straightforward to restrict or address a chemical class (PFAS) or functional group (solvents) rather than individual chemicals that fall within those classes or functional groups.

Hazardous Chemicals by Impact

Persistent, Bioaccumulative, and Toxic Substances (PBTs)

PBTs are very persistent, which means they don't break down easily in nature. Instead, they build up in the environment over time to levels that contaminate food and water sources. Worse still, these substances are bioaccumulative - meaning they increase in concentration in organisms as they move up the food chain. These chemicals can cause, and continue causing, harm to health and the environment over decades, and far beyond the site of their release. Avoiding the purchase, use, and release of PBTs, especially where alternative substances are available, can prevent similar decades-long contamination consequences from choices that we make today. Familiar examples of PBTs are

Well-known PBTs are DDT (Dichloro-diphenyl-trichloroethane), a pesticide which has endocrine disrupting effects (see below), and PCBs (polychlorinated biphenyls), used in cooling fluids for electrical equipment and machinery, and probable carcinogens. Both were banned for use in the United States and other jurisdictions in the 1970s. Yet despite being out of production and restricted from use for over 40 years, both DDT and PCBs are still present in the environment.

PBTs still in use currently include:

- **Mercury**, a PBT that is still in use in products and industrial processes, and is released from coal burning, can cause permanent damage to cognitive processing, memory, attention, language, fine motor skills, and visual-spatial skills in infants exposed in utero. Mercury can contaminate waterways in

residues from cleaning products that include chlorine bleach created through the mercury cell process. Mercury often accumulates in wild fish to dangerous levels, and thus can disproportionately impact poor communities whose members catch and eat fish as a cheap source of protein.

- **Poly- and perfluoroalkyl substances (PFAS)** PFAS are a highly visible class of PBTs found in food packaging, stain-resistant furniture, non-stick cookware, outdoor clothing, aerospace, and medical and automotive applications, to name a few. PFAS can leach from food packaging into food and are present in household dust (probably because they shed from treated furniture, other home textiles and carpeting). Industrial releases and the use of firefighting foam containing PFAS has contaminated drinking water sources across the U.S. PFAS are persistent in the environment and remain in the water and soil for long durations, eventually accumulating in plants and animals. Some bioaccumulate, resulting in a buildup of these hazardous chemicals connected to cancer, hormone disruption, liver and kidney toxicity, harm to the immune system, and reproductive and developmental toxicity. Nearly every U.S. resident has PFAS in their body – broad population sampling has discovered these chemicals in blood, breast milk, umbilical cord blood, amniotic fluid, placenta, and other tissues.

Carcinogens

Carcinogens cause cancer. The list of carcinogens is extremely long. California's Safe Drinking Water and Toxic Enforcement Act of 1986 (Prop 65) updates and maintains a list of chemicals known to California to cause cancer or reproductive toxicity. Currently there are over 1000 chemicals on the list. A few commonly used substances are listed below:

- **Formaldehyde.** Formaldehyde is used in, and released from, furnishings and cabinets made of composite wood, building materials (carpets, plywood, paints, and adhesives), wrinkle-resistant clothing, household cleaners, cosmetics, glues, and tobacco smoke. Formaldehyde is a carcinogen and has been identified as a cause of leukemia and nose and throat cancer. Formaldehyde in indoor environments can trigger allergic responses, asthma, and nose, eyes and throat irritation.
- **Benzene.** Benzene is a colorless liquid that is present in crude oil and petroleum. It is an industrial chemical and mostly used as a building block, or intermediate, to manufacture chemicals such as dyes and pigments, with more complex structures. Workers in industries such as rubber, chemicals, paint, and petroleum may be exposed to much higher levels of benzene than people in other lines of work. More than half of all benzene production is processed into ethylbenzene, a precursor to styrene, which is used to make polymers and plastics such as polystyrene, a common food packaging and packaging material. Acute exposure to benzene affects the central nervous system, and exposure occurs through inhalation or absorption through the skin or digestive tract. Chronic exposure to benzene primarily occurs from working in industrial settings using benzene, but can also occur from using everyday products, and is linked to leukemia and other blood disorders.
- **Chromium VI (hexavalent chromium or "Hex chrome")** is one of the valence states of the metal chromium. Industrial processes that involve chromium can result in worker exposure to toxic hexavalent chromium. A major source of worker exposure to Cr(VI) occurs during welding on stainless steel and other alloy steels containing chromium metal. Cr(VI) compounds may also be used as pigments in dyes, paints, inks, and plastics, and as an anticorrosive agent added to paints, primers, and other surface coatings. Adverse health effects associated with Cr(VI) exposure include occupational asthma, eye, nose, skin and respiratory irritation, kidney and liver damage, pulmonary congestion and edema, upper abdominal pain, and respiratory cancer.
- **Styrene** is a monomer with a vinyl group that allows it to polymerize into products such as polystyrene, acrylonitrile butadiene styrene (ABS), rubber, and latex. These materials are used in rubber, plastic, insulation, fiberglass, pipes, food containers, and carpet backing. Workers are exposed to styrene via eye and skin ingestion and inhalation. The EPA has described styrene to be "a suspected toxin to the gastrointestinal tract, kidney, and respiratory system, among others".

- **Vinyl chloride** is the monomer that PVC or “vinyl” plastics are derived from. It is produced in massive quantities in the U.S. and China, and can also be formed in the environment when soil organisms break down chlorinated solvents. When released, vinyl chloride can enter the air and drinking water sources, and so it is commonly found near landfills. Because it is volatile, primary exposure is via inhalation, and mostly to workers, factory-adjacent fence-line communities, and communities that reside near landfills, rather than to end users. Acute exposure to vinyl chloride causes dizziness, nausea, visual disturbances, and headache. High levels of exposure cause cardiac arrhythmias, and even fatal respiratory failure. Vinyl chloride is a mutagen and a human carcinogen that causes brain and lung tumors, liver cancer, and malignant lymphatic tumors.

Mutagens

A mutagen is a physical or chemical agent that permanently changes genetic material, usually DNA, in an organism and thus increases the frequency of mutations above the natural background level. Many mutations can cause cancer, and are therefore characterized as carcinogens, although not all are linked to cancer.

- **Sodium chromate** is used as a corrosion inhibitor in the petroleum industry and as a dyeing auxiliary in the textile industry. Sodium chromate is carcinogenic, corrosive and exposure may produce severe eye damage or blindness. Human exposure further encompasses impaired fertility, heritable genetic damage, and harm to unborn children.
- **Acrylamide** is a chemical that is used to manufacture many polymers, particularly polyacrylamide, which is then used as a thickening agent. Acrylamide can also arise from some cooked foods. Acrylamide is considered a potential occupational carcinogen by U.S. government agencies and classified as a Group 2A carcinogen by the International Agency for Research on Cancer (IARC). Acrylamide is absorbed by the skin and distributed throughout the body; the highest levels are found in the blood, non-exposed skin, kidneys, liver, testes, and spleen. Acrylamide has also been found to have neurotoxic effects in humans and animal studies show neurotoxic effects as well as mutations in sperm.
- Some **Polycyclic Aromatic Hydrocarbons (PAHs)** including anthracene are mutagens. PAHs are a class of chemicals that occur naturally in coal, crude oil, and gasoline, and are produced when coal, oil, gas, wood, garbage, and tobacco are burned. PAHs are also a component of coal tar and are used to make certain dyes.

Endocrine disrupting chemicals (EDCs)

Endocrine Disrupting Chemicals are chemicals that interfere with and mimic hormones in humans and other animals. EDCs are used to perform many different functions in products and processes. The endocrine (hormone) system controls metabolism and reproduction and other aspects of human growth. When the system is disturbed, it can cause a wide range of health disorders including cancers, type 2 diabetes, infertility, cognitive disorders (ADHD), childhood obesity, asthma, and more. Pregnant women and young children are particularly vulnerable to exposure to EDCs, given the importance of the endocrine system during key points of human development. There are many different EDCs – for example ChemSec, a Swedish NGO lists 32 EDCs on its Substitute it Now (SIN) list due to their endocrine activity.

A few well-studied EDC's:

- **Bisphenols A, F, and S (BPA, BPF, and BPS)** are found in some plastic food and beverage containers (polycarbonates) and the linings of cans and jar lids. BPA/BPF/BPS are associated with reproductive, immune system, and neurological problems, as well as an increased likelihood of Alzheimer's, childhood asthma, metabolic disease, type 2 diabetes, and cardiovascular disease. They exhibit estrogen-mimicking, hormone-like properties and exposure to small amounts can cause harm to people. A 2007 research review published in *Reproductive Toxicology* found that BPA in the blood of women is linked to obesity, multiple miscarriages, polycystic ovarian syndrome (PCOS), endometrial hyperplasia, and other

issues. Most exposure to BPA is via food packaging materials, where the BPA leaches out of plastic water bottles or can linings.

BPA exposure, even in extremely small doses and exposure, can disrupt the body's natural hormones and cause serious health problems. There is particular concern with BPA exposure at critical developmental stages, such as during pregnancy and at puberty. Pregnant women, children, and teens may be most at risk from exposures to BPA.

- **Phthalates.** Phthalates are a group of man-made substances that are added to plastics to make them more flexible. They are used in thousands of product types and tens of millions of products. Phthalates are associated with damage to the liver, kidneys, lungs, and reproductive system. Like BPA, they are endocrine disrupting chemicals, and research has shown close associations between exposure to phthalates at an early age and problems with brain development, ADHD and similar behavioral problems, and reduced fertility later in life. Eight phthalates are banned by the US Consumer Product Safety Commission for use in children's toys and child care articles and the European Commission has limited the use of five phthalates in food contact materials made of plastic.
- **Parabens.** Parabens are common preservatives found in health and beauty products, such as lotions, shampoo and conditioners. Common exposure routes are from ingestion, swallowing and absorption through the skin. Parabens can disrupt hormones in the body and harm fertility and reproductive organs, affect birth outcomes, and increase the risk of cancer. Some can also cause skin irritation. Because they are used in everyday products, the general population is highly likely to be exposed.

Reproductive Toxins

Reprotoxins may produce or increase an impairment of male or female reproductive functions or capacity and/or the incidence of adverse effects in progeny of those exposed. Some reprotoxins appear to produce their effects by disrupting the endocrine (hormone) system; others impact the reproductive system by different routes.

- **Carbon disulfide**, a building block chemical in the chemical industry and a solvent used in viscose rayon process has been linked to both acute and chronic forms of poisoning, with a diverse range of symptoms. It is a neurotoxin and reprotoxin and results in reduced male sex drive, male and female infertility, spontaneous abortion, growth retardation, menstrual disorders, and breast milk contamination.
- **Bisphenol A (BPA)** is an endocrine disruptor that negatively affects reproductive development. It is an estrogen mimicker (Xenoestrogen) and a likely androgen mimicker. It is used in the production of various plastic products.

Other chemicals of concern

Flame Retardants

Flame retardants are a large, diverse group of synthetic chemicals that are added to many consumer products and construction materials that are made from textiles, foam, plastics, and resins. They are used to i) inhibit materials and products from burning, and ii) to meet regulatory flammability standards. They may be added as a copolymer during polymerization, or during the molding or extrusion process, or during the finishing process, as in textiles.

Some flame retardants may cause cancer, some are endocrine disruptors, and some persist in the environment. Some are persistent organic pollutants, also known as "forever chemicals", which means that they do not break down in the environment. Most flame retardants are not chemically bound to the polymer that they are added to. That means that they can migrate out of the material or product and into the environment. Residues have been detected in humans and wildlife, with health concerns that are resulting in litigation.

Of particular concern are some halogenated compounds, some organophosphorous compounds and some compounds that contain both phosphorous and a halogen.

- **Halogenated flame retardants** include organochlorines, chlorinated paraffins, and organobromines such as decabromodiphenyl ether (decaBDE), decabromodiphenyl ethane, tetrabromobisphenol A (TBBPA), and hexabromocyclododecane (HBCD), to name a few.
- **Organophosphorous flame retardants** include triphenyl phosphate (TPP), bisphenol A diphenyl phosphate (BADP), tricresyl phosphate (TCP), and dimethyl methylphosphonate (DMMP) to name a few.
- **Mixed Flame Retardants** Some flame retardants contain both phosphorus and a halogen. This includes tris(2,3-dibromopropyl) phosphate (brominated tris) and chlorinated organophosphates such as tris(1,3-dichloro-2-propyl)phosphate (chlorinated tris or TDCPP).

Many organohalogen flame retardants have been banned or phased out, but many of their replacements have not been adequately tested and are likely to cause similar harm since their chemical structure is similar.

Polyvinyl chloride (PVC)

PVC, often known simply as vinyl, is an illustrative example of how using hazardous substances can have ongoing environmental and health repercussions. Beyond the impacts of PVC's primary constituent chemical, vinyl chloride monomer - discussed above, the issues with PVC arise largely from hazardous substances that are added to the plastic during manufacturing to contribute specific properties - including lead and some phthalates. Rigid PVC is used to make pipes, doors, and window frames, whereas flexible PVC is used to cover wiring, amongst other uses. PVC is also used in medical equipment including blood bags, where it can leach toxic chemicals directly into the bloodstream of unknowing patients.

Issues with PVC include:

- The addition of endocrine disruptors such as phthalates - plasticizers that make PVC and other plastics more flexible. When PVC is used in plumbing, imitation leather, flooring (sheet vinyl flooring and vinyl composition tile), and applications where it replaces rubber, phthalates are added to improve functionality.
- Toxic Additives. Lead and lead compounds are sometimes added to PVC pipes where they act as a stabilizer during manufacturing. Over time, lead may leach out of PVC pipes into the surrounding water supply and affect whole communities. Lead is an extremely hazardous chemical. Acute exposure results in headaches, nausea, dizziness and chronic exposure damages the kidneys, brain, red blood cells. Lead is a carcinogen and no amount is considered safe.
- Carcinogens. Vinyl chloride, the monomer in PVC, has been linked to cancer. Vinyl chloride exposure is associated with an increased risk of liver cancer (hepatic angiosarcoma), brain and lung cancers, lymphoma, and leukemia. Vinyl chloride itself is not usually present in finished products, because it is polymerized to form PVC. But workers at facilities where vinyl chloride is produced or used are exposed to vinyl chloride, primarily through inhalation. High levels of vinyl chloride are found in air around factories that produce vinyl products. If a water supply is contaminated, vinyl chloride can enter household air when the water is used for showering, cooking, or laundry.
- Dioxins. These substances are not added to PVC but result as byproducts of burning PVC, Dioxins are a group of chemically-related compounds that are persistent environmental pollutants (POPs). They are highly toxic and can cause reproductive and developmental problems, damage the immune system, interfere with hormones and also cause cancer. Dioxins can be produced when siding or plumbing burns during house fires, but mostly result when waste containing PVC is incinerated. This affects communities that reside near incinerators, or landfills if fires break out, putting vulnerable communities at risk. Considering end of life options is very important before purchasing PVC products.

Triclosan

An antimicrobial, and a pesticide, triclosan is found in many household products, including apparel, toys, kitchenware, hand sanitizers, and other personal care products. It prevents the growth of bacteria and mold and fights odor. Exposure to triclosan occurs through skin absorption and through ingestion when swallowed. When triclosan is released into the environment, additional exposure is possible through ingesting plants grown in soil treated with sewage sludge, or eating contaminated fish. Some short-term animal studies have shown that exposure to triclosan is associated with a decrease in the levels of thyroid hormones, and other research suggests that long term exposure to triclosan might prompt cancer cells (such as breast cancer) to grow, and make it easier for antibiotic-resistant bacteria to grow in people's nose or throat. Triclosan easily enters waterways in residues from personal care products, which poses a problem because it is toxic to fish. Minnesota banned triclosan in soaps and hand sanitizers in 2014, and the state of Washington has a current policy to ban triclosan in all cosmetics.

Oxybenzone

A chemical found in some sunscreens that absorbs UV-A ultraviolet rays, offering protection to users. It is also added to plastics, toys, furniture finishes, and other products to limit UV degradation. Exposure is mostly via skin absorption. Oxybenzone causes allergic skin reactions and behaves like an endocrine disruptor in many studies. Exposure may increase the risk of breast cancer and endometriosis and the National Toxicology Program found equivocal evidence of carcinogenicity in rats after observing increases in thyroid tumors and uterine hyperplasia in females with high exposure to oxybenzone