Toxic Chemicals in Products and Building Materials Purchased by New York Schools and Government Agencies

Opportunities for Purchasers to Prevent Pollution by Specifying and Promoting Safer Products

Responsible school and government procurement policies can protect building occupants, students and staff and prevent them from being exposed to hazardous chemicals of concern in products and building materials. Environmentally preferable purchasing programs can also play an important role in shifting the market and promoting safer products. This fact sheet summarizes the environmental health hazards of polyvinyl chloride (PVC) and PVC associated chemicals, such as dioxins, phthalates and vinyl chloride, and halogenated flame retardants. These chemicals of concern are commonly found in products and building materials purchased by New York schools and government agencies.

Polyvinyl Chloride (PVC) Plastic Products and Building Materials

Polyvinyl chloride (PVC or vinyl) is plastic widely used in products and building materials purchased by government agencies and schools in New York City, New York State and across the nation. PVC is considered to be a hazardous plastic as its lifecycle uses and/or releases hazardous chemicals of concern including vinyl chloride, ethylene dichloride, chlorine gas, dioxins and furans, PCBs, phthalates, mercury, lead, cadmium and organotins. PVC production, use, combustion and disposal result in potential exposure of production workers, residents living near production facilities, and the general public to chemicals from PVC that are associated with adverse effects on health.

The production of PVC leads to the use and release of hazardous chemicals, including chlorine gas, mercury, and cancer-causing vinyl chloride monomer and ethylene dichloride. Communities surrounding U.S. vinyl chloride chemical facilities, half of which are in Louisiana, suffer from serious toxic chemical pollution of their groundwater, surface waters and air. Some communities adjacent to PVC chemical plants have been relocated or demolished due to PVC groundwater contamination problems. PVC plastic also requires large amounts of toxic additives to make it flexible, stable and/or usable. These additives are released during the use and disposal of PVC products, resulting in human exposures to phthalates, lead, cadmium and other toxic...
chemicals. PVC occupational exposure is a risk factor for systemic sclerosis (scleroderma), a diffuse connective tissue disease characterized by changes in the skin, blood vessels, skeletal muscles, and internal organs according to the National Library of Medicine, 2002. Studies on testicular cancer and occupational exposures found an increase in the risk for seminoma (testicular cancer). PVC flooring and other PVC products contribute to poorer indoor air quality as PVC products can off gas chemicals called volatile organic compounds (VOCs). A study by the California Air Resources Board found forty chemicals, some of which are toxic, off-gassing from PVC flooring. Another study found PVC flooring can emit chemicals for a period of at least nine months, indicating a persistent risk of toxic exposure.

**Phthalates in PVC Plastic Products and Building Materials**

Phthalates are chemicals used to soften or plasticize PVC products such as flooring, which can be released from PVC into the air inside buildings and schools. The phthalates cling to dust and can then be breathed in by children and other building occupants. Over 90% of all phthalates are used in PVC products including many found in buildings and schools. Some phthalates such as DEHP have been linked to reproductive problems including shorter pregnancy duration and premature breast development in girls and sperm damage and impaired reproductive development in boys. Some studies have also found a correlation between phthalates and obesity, a growing problem for children in America. According to the NY Attorney General’s Office, “Phthalates are of concern because exposure to them may affect development and reproduction, and increase the risk of infertility, testicular damage, reduced sperm count and suppressed ovulation (NTP, 2000; Health Care Without Harm, 2002, pages 1-3). Phthalates have also been implicated in the pathogenesis of asthma and respiratory disease (Oie et al., 1997; Jaakkola et al., 2000).” Phthalates are highest in children ages 6 to 11, and in women. In 2008, President Bush signed legislation banning phthalates such as DEHP in children’s toys. While phthalates have been banned from PVC toys, they are widespread in PVC products used in schools and other buildings.

The US Environmental Protection Agency (EPA) has identified phthalates as chemicals of concern and developed a “chemicals action plan” to regulate them since, “EPA is concerned about phthalates because of their toxicity and the evidence of pervasive human and environmental exposure to these chemicals… Adverse effects on the development of the reproductive system in male laboratory animals are the most sensitive health outcomes from phthalate exposure… Recent scientific attention has focused on whether the cumulative effect of several phthalates may multiply the reproductive effects in the organism exposed… Phthalate exposures are a potential concern for children’s health. In animal studies, exposure to phthalates during fetal development results in adverse effects on the male reproductive system… Given the well-characterized health effects of phthalate exposure in animals in conjunction with the demonstrated widespread phthalate exposure in children, EPA believes that the cumulative health risks of phthalates should be assessed to determine what actions are warranted to insure protection of children’s health from this group of chemicals.”

The federal agency also cited that national CDC biomonitoring data demonstrates that children have the highest exposures to phthalates of all groups monitored, and other data indicate in utero exposures to phthalates.

**Dioxins Released During Production and Disposal of PVC**

Dioxins are some of the most toxic chemicals ever studied by the federal Environmental Protection Agency (EPA) and have been targeted for international phase-out by over 170 nations around the world. Dioxins are a class of chemicals unintentionally created from the manufacture and incineration of chlorinated products such as
PVC. Dioxin is a potent cancer-causing agent and is considered to be a “known human carcinogen” by the World Health Organization’s International Agency for Research on Cancer and the U.S. Department of Health and Human Services’ National Toxicology Program. According to the EPA, the levels of dioxin-like compounds found in the general population may cause a lifetime cancer risk as high as one in 1,000. This is 1,000 times higher than the generally “acceptable” risk level of one in a million. Dioxin also causes a wide range of non-cancer effects including reproductive, developmental, immunological, and endocrine effects in both animals and humans. The New York Academy of Sciences conducted a study to identify and quantify the flow of dioxin into the New York and New Jersey Harbor and their report extensively discussed the relationship between PVC combustion and dioxin. The report found, “the steep rise in the use of PVC in all aspects of building and construction enhances the potential to release dioxins if the PVC materials are incinerated or burned.” The Academy estimated that there are up to 36,000 tons of PVC waste burned in the NY/NJ harbor watershed every year, contributing to the formation of dioxin.

Vinyl Chloride & Other PVC Chemicals of Concern

Vinyl chloride monomer is the basic building block of PVC. Ninety eight percent of vinyl chloride monomer is used to produce PVC and various PVC copolymers. Since vinyl chloride is a volatile gas, most vinyl chloride released to the environment is eventually transported to the atmosphere; lesser amounts are transported to groundwater. Vinyl chloride has been detected in the ambient air in the vicinity of vinyl chloride and PVC manufacturing plants and hazardous waste sites. Vinyl chloride is classified as a known human carcinogen by the U.S. Department of Health and Human Services NTP and several other federal and international agencies. Studies of workers who have breathed vinyl chloride over many years showed an increased risk of liver, brain, lung cancer, and some cancers of the blood have also been observed in workers. Other acute effects after high level exposure include irritation of the eyes and respiratory tract, loss of consciousness, lung and kidney irritation, and inhibition of blood clotting in humans. Chronic non-cancer health effects include liver damage, and “vinyl chloride disease” which is characterized by Raynaud’s phenomenon (fingers numbness) and changes in the bones at the end of the fingers, joint and muscle pain, and scleroderma-like skin changes. Reproductive and developmental effects include case reports of male sexual dysfunction, increased incidence of birth defects in children of exposed women, increased incidence of miscarriages in wives of occupationally exposed men, as well as testicular damage and decreased male fertility in exposed rats. There are other PVC associated chemicals of concern, including ethylene dichloride, volatile organic chemicals (VOCs) which off-gas from PVC and become airborne contaminants to interior spaces in occupied buildings, exposing people to VOC emissions, including tetrahydrofuran and cyclohexanone. In addition, PVC products may contain other hazardous additives of concern such as lead, cadmium, organotins and others.
Halogenated Flame Retardants in Products

Halogenated Flame Retardants (HFRs) are a family of chemicals added to materials to improve their resistance to heat and flames, including Polybrominated diphenyl ethers (PBDEs) and chlorinated tris. HFRs, such as PBDEs, are found in furniture, computers, televisions and many other products and they migrate into the home environment exposing people. Studies by the Center for Disease Control and Prevention found over 90 percent of Americans have HFRs in their bodies, with PBDEs having the highest concentrations. Many HFRs persist in the environment, build up in our bodies, and are toxic. The Stockholm Convention on Persistent Organic Pollutants (POPs), a binding treaty among 172 countries worldwide, has banned 21 chemicals over environmental and public health concerns; all of them are halogenated and two are flame retardants. EPA is also concerned that some PBDE congeners are persistent, bioaccumulative, and toxic to both humans and the environment. They have been studied for ecotoxicity in mammals, birds, fish, and invertebrates. PBDEs are not chemically bound to plastics, foam, fabrics, or other products in which they are used, making them more likely to leach out of these products. EPA has designated PBDE’s as a family of chemicals that may present an unreasonable risk of injury to health or the environment and has developed a “chemical action plan.” Part of the action plan included the phase out of some of the most widely used flame retardant chemicals (penta and octa-BDE in 2004 and deca-BDE in 2013). Exposure to PBDEs in the womb has been associated with decreased IQ, attention deficits, and poor motor development in children, and emerging studies have linked flame retardants such as PBDEs and chlorinated tris to reproductive problems. Chlorinated tris, one of the most highly used flame retardants, causes mutations in DNA which may lead to cancer. Animal studies of PBDEs have found negative effects on the thyroid gland, immune system and the liver, and may cause neurobehavioral alterations. Rats and mice that ate food with decabromodiphenyl ether (one type of PBDE) throughout their lives developed liver tumors. Based on this evidence, the EPA has classified decabromodiphenyl ether as a possible human carcinogen.

Children More At Risk from Toxic Chemicals

Children are not “little adults” as their developing brains and bodies, as well as their metabolism and behaviors make them uniquely vulnerable to harm from toxic chemicals such as phthalates, dioxin, and flame retardants. Exposure begins in the womb through the mother’s exposures to chemicals. Infants may ingest chemicals through breast milk, formula and contact with their environment. Rapid brain development in the fetus, infants and young children make them more susceptible to harm from chemicals that may impair brain function and development. For their weight, children eat, drink and breathe more than adults—so pound for pound they take in a greater quantity of contaminants. Children put things in their mouths and spend a lot of time on...
the ground, so they may ingest chemicals from toys, dirt and dust. Increasingly, children are being found to be hyperactive and slow to learn. In recent years, a number of chronic illnesses that are linked to chemical exposure have been on the rise. The number of children in special education programs with learning disabilities increased 191% from 1977 to 1994.\textsuperscript{xxvi} Asthma is a leading reason for school absenteeism and the number one chronic childhood illness.\textsuperscript{xxvii} Eight thousand American children are diagnosed each year with cancer\textsuperscript{xxviii}, and the incidence of cancer in children jumped 26% between 1975 and 1998.\textsuperscript{xxix} The incidence of testicular cancer in young men has increased by 60%.\textsuperscript{xxx} Chemicals such as dioxins and phthalates have been linked with many of these diseases.\textsuperscript{xxxi} Studies have also found that chemicals are trespassing into our bodies. Today babies are being born pre-polluted with potentially harmful levels of phthalates\textsuperscript{xxi} and dioxins.\textsuperscript{xxii} Phthalates have been found in indoor air and dust, and in human urine, blood and breast milk.\textsuperscript{xxii} A study of 2,500 individuals found metabolites of at least one phthalate in 97 percent of those tested.\textsuperscript{xxiii} Dioxins build up in our bodies over our lifetime and can remain there for many years. The levels of dioxins in our bodies are at or near the levels known to cause harm.\textsuperscript{xxv}

Cancer, Reproductive Problems, Asthma and Learning Disabilities Linked to Chemical Exposures

Chronic illnesses linked to chemical exposure are also on the rise among adults. Breast cancer is the second most common cancer in women, and is on the rise. Incidence rates in the United States increased by more than 40 percent between 1973 and 1998. A woman’s lifetime risk of breast cancer is now one in eight.\textsuperscript{xxvi} According to the Breast Cancer Fund, “no more than 10 percent of breast cancers are genetic, and science points to toxic chemicals and radiation as factors in the sharp rise of breast cancer incidence.”\textsuperscript{xxv} A number of chemicals used and released by the PVC lifecycle have been found to cause or may be linked with breast cancer, including vinyl chloride, dioxins and phthalates. Vinyl chloride and dioxins are classified as known human carcinogens by the federal NTP and IARC. Certain phthalates, including DEHP, have been found to significantly increase cell proliferation in MCF-7 breast cancer cells and this DEHP inhibited the anti-tumor action of tamoxifen in MCF-7 breast cancer cells.\textsuperscript{xxxvi} Dioxins are known endocrine disruptors. A study of women exposed to dioxins during a chemical plant explosion found a tenfold increase in TCDD levels associated with more than twice the risk of breast cancer.\textsuperscript{xxxi}

Across the country, reproductive health problems are on the rise. Women up to age 34 have reported an increasing number of fertility problems over the last decades. Average sperm count appears to be steadily declining, and there are rising rates of male genital birth defects such as hypospadias, a condition in which the urethra does not develop properly.\textsuperscript{xxvii} Scientists are finding that chemical exposure can cause these disorders, such as endocrine disrupting phthalates and dioxins.\textsuperscript{xxxi} These chemicals interfere with the body’s natural hormones and can scramble messages that natural hormones transfer between cells. Exposure to phthalates have been linked to shorter pregnancy duration\textsuperscript{i}, premature breast development in females\textsuperscript{iii}, early onset of puberty\textsuperscript{iv}, sperm damage\textsuperscript{v}, and impaired reproductive development in boys.\textsuperscript{vi} Exposure to dioxin can cause or is linked to birth defects\textsuperscript{vii}, decreased fertility\textsuperscript{viii}, and decreased sperm counts.\textsuperscript{ix} Studies have found birth defects in the offspring of Vietnam veterans exposed to Agent Orange dioxins.\textsuperscript{xxv}

Asthma is a serious respiratory disease that affects 7 million American children and 16 million adults.\textsuperscript{xxvi} An average of one out of every 13 school-age children has asthma. Asthma is a leading cause of school absenteeism: 14.7 million school days are missed each year due to asthma.\textsuperscript{xxv} A number of studies have found a correlation between
phthalates emitted from PVC building products, such as flooring, and asthma. A study among hospital personnel found asthma symptoms were more common in the buildings with phthalate degradation in PVC flooring. A study of office workers found they were diagnosed with adult-onset asthma at a rate of about 9 times higher than expected, and identified PVC flooring as the source of chemicals, such as 2-ethyl-1-hexanol, in the air.

The incidence of learning and developmental disabilities affects about one in six children in the U.S. Many factors, such as heredity, social environment, nutrition and chemical contaminants, contribute to brain development in complex ways. Chemical contaminants have historically been the least researched and are the most preventable. Research shows that the developing fetus and children are particularly vulnerable to environmental exposures. According to the American Association on Intellectual and Developmental Disabilities, “students with disabilities are a special ‘at risk’ population for the harmful effects of exposures to environmental hazards at school.” PVC associated chemicals, including dioxins, lead, and mercury, have been linked with or shown to cause learning and developmental disabilities.

---

For information on safer alternatives to PVC products, please visit CHEJ’s website at http://chej.org/campaigns/pvc-free-products and for safer alternatives to HFR products, visit the Alliance for Toxic-free Fire Safety’s website at www.toxicfreefiresafety.org

For more information, please contact:
Center for Health, Environment & Justice (CHEJ)
212.964.3680 / mike@chej.org
www.chej.org/greenpurchasing
References:

1 NYS Attorney General Affidavit in the case of Resilient Floor Covering Institute and Tarkett, Inc. vs. NYS Department of Environmental Conservation, 2003.
Toxic Chemicals in Products and Building Materials Purchased by New York Schools and Government Agencies


xviii USEPA. 2003. Exposure and human health assessment for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and related compounds, part III: integrated summary and risk characterization for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds. USEPA, Office of Research and Development, NAS Review Draft, December.


xxiv U.S. Environmental Protection Agency; Polybrominated Diphenyl Ethers (PBDEs) Action Plan Summary http://www.epa.gov/oppt/existingchemicals/pubs/actionplans/pbde.html


xxvi Muir, T. and Zegarac, M. 2001. Societal costs of exposure to toxic substances: economic and health costs of four case studies that are candidates for environmental causation. Environmental Health Perspectives Supplements Volume 109, Number S6, December.


The Breast Cancer Fund. Online: [http://www.breastcancerfund.org/site/c.kwXXLDPaE/b.44850/k.189A/Prevention_What_We_Do.htm](http://www.breastcancerfund.org/site/c.kwXXLDPaE/b.44850/k.189A/Prevention_What_We_Do.htm) (2009).


