Reducing PVC in Facilities With Vulnerable Populations

Date: Nov 01 2011 | **Policy Number:** 20119
Key Words: Pvc, Environmental Health, Cancer, Chemicals, Asthma, Toxicology, Toxic Chemical Exposure

The American Public Health Association (APHA) has established prior policy regarding children's environmental health and healthy schools,[1] chlorinated chemicals,[2] persistent organic pollutants,[3] chemicals policy,[4] prevention of dioxin generated by health care facilities through use of polyvinyl chloride (PVC),[5] and reducing the rising rates of asthma in children.[6] APHA policy also provides the scientific foundation for why children are more vulnerable to harm from toxic chemical exposures throughout their development.[7]

This policy builds on the public health approaches embodied in these existing policies to prevent public health risk and disease by reducing potentially harmful exposures, especially to children in this case, by avoiding exposure to flexible PVC. PVC is a synthetic thermoplastic polymer[8] that is used in a wide range of products. Nearly 15 billion pounds are produced annually in the United States.[9] PVC can exist in either of 2 distinct forms: as a rigid polymer of considerable hardness or as a polymer made flexible through the addition of plasticizers.[10] Both forms are widely used in homes, schools, nursing homes, public housing, and other facilities.The major rigid forms are piping and fittings.[10] The soft or flexible polymer is commonly found in flooring, carpeting, roofing, wall coverings, toys, and medical supplies including tubing and intravenous (IV) bags, as well as in office supplies such as computers and other electronic devices, 3-ring binders, paper clips, food wrap, lunch boxes, backpacks, and rain gear.[10, 11] This resolution focuses primarily on additives released from flexible or "soft" PVC products.

PVC Additives
Despite PVC's ubiquity in the marketplace, the public remains largely unaware of the public health and environmental risks posed by PVC at all stages of its life cycle (from production to disposal). Consumer products made from PVC—especially flexible PVC products—are not pure materials. Chemicals are added to change its properties to meet different product characteristics; these chemicals remain unchanged within the polymer matrix.[12–15] These additives can make up as much as 40% to 60% of a product,[10] but they have toxic characteristics[16] and are gradually released,[12,16,17] posing risks to infants, children, and other vulnerable populations. In addition, young children behave in ways that will increase their exposure to additives from flexible PVC products, including putting plastic products in their mouths and spending a lot of time on the floor and ground, where they can ingest chemical residues from toys, containers, dirt, and dust.[18]

Common PVC additives include plasticizers such as phthalates, which are used to soften PVC, and stabilizers such as lead, cadmium, and organotins.[12–15]Manufacturing flexible PVC requires the use of plasticizers, over 85% of which are phthalates.[10,19] Therefore, the use of phthalates in flexible PVC products cannot be separated from the use of flexible PVC.[20] Testing has identified phthalates in the air[21–23] and dust[24] of facilities using flexible PVC products. In recent studies by the Centers for Disease Control and Prevention (CDC), phthalates have been found in 97% of people tested in the United States, including newborn infants.[25,26] The highest levels were in children aged 6 to 11 years and in women of reproductive age.[25]

Phthalates and asthma. A number of studies have found associations between phthalates emitted from PVC consumer products and an increased risk of asthma and allergies, especially in children.[27–33] APHA Policy Statement 200012 has previously recognized that childhood asthma is an important predictor of asthma over a lifetime and that "children are known to be more exposed and susceptible to a number of environmental factors known to be associated with asthma."[6] Phthalates may play such a role by affecting asthma rates among vulnerable populations using facilities that have flexible PVC products.

Phthalates and reproductive toxicity. A number of studies have reviewed the adverse health effects associated with exposure to phthalates.[34–36] Numerous studies, including an expert panel of the US National Toxicology Program,[37] have found that phthalates are linked to a variety of reproductive problems.[23,34,38–41] Other adverse health effects include altered liver[42] and kidney function[43] and respiratory problems in children.[44,45] The weight of the evidence favors concern and preventive action, but the data are still coming in and more studies are needed, especially in humans, to define the range of these effects.

Metal additives. Metal additives are used in flexible PVC products to prevent degradation from heat during processing and from exposure to ultraviolet light during the useful life of a product.[12–15,46] They include lead, cadmium, zinc, and the organotins. These metals leach out of PVC products.[47–54] Lead is a known cause of neurodevelopmental problems.[55] Cadmium causes cancer and kidney damage.[56] Organotin stabilizers, which were introduced to replace lead and cadmium, also leach from PVC products[48–50] and can affect the central nervous system, skin, liver, immune system, and reproductive system.[57–62]

Broad Concerns About PVC

In addition to direct exposures that threaten children and other vulnerable populations, the public is also at risk from exposure to toxic chemicals released by PVC during other periods of its life cycle—that is, during production and disposal. PVC products are ranked among the most hazardous of plastic materials.[20] They are made from vinyl chloride monomer at facilities that release vinyl chloride, ethylene chloride, and dioxins, a highly toxic group of chemicals.[10,12–15] Vinyl chloride damages the liver and central nervous system[63] and is considered a human carcinogen.[64,65]

Environmental justice. The chemical plants where PVC is manufactured are often located in or near low-income neighborhoods and communities of color. Mossville, LA is a historic African American community surrounded by 5 PVC production plants that release dioxins in their air emissions and wastewater discharges.[66] Testing by the Agency for Toxic Substances and Disease Registry in Mossville found fish, vegetables, and fruit contaminated with dioxin.[67] Some Mossville residents had levels of dioxins in their blood more than 3 times the national average.[68] Residents reportedly were 2 to 3 times more likely to suffer a variety of adverse health problems, including respiratory and nervous system disorders.[69] The impact on the communities near facilities that produce PVC is a major environmental justice concern.

PVC disposal. When PVC materials are burned, the metals present as additives are released. In addition, dioxins are formed.[70] APHA Policy Statement 9607 previously recognized that dioxins are formed by the disposal of chlorinated compounds, such as PVC.[5] One of the dioxins formed, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), is a potent cancer-causing agent classified as a human carcinogen.[71,72] TCDD and other dioxins cause adverse effects in the reproductive, developmental, immune, and endocrine systems in both animals and humans.[73]

APHA Policy Statement 9304 previously recognized that chlorine-containing compounds such as PVC "pose public health risks involving the workplace, consumer products, and the general environment" and that the elimination of these compounds from "certain manufacturing processes, products, and uses may be the most cost-effective and health protective way to reduce health and environmental exposures to chlorinated organic compounds."[2] The International Joint Commission, a treaty body established by the United States and Canada, similarly recommended that the governments, "in consultation with industry and other affected interests, develop timetables to sunset the use of chlorine and chlorine-containing compounds as industrial feedstocks."[74]

Alternatives to PVC

Primary prevention of exposure to these toxic additives could be easily accomplished by replacing flexible PVC with safer readily available products and materials. For example, vinyl flooring can be replaced by linoleum; vinyl roofing by thermoplastic polyolefin (TPO); PVC medical tubing by materials including silicone, polyurethane, and rubber; and vinyl IV bags by materials including nylon, ethylene vinyl acetate, polyethylene, and other plastics.[75] Researchers at Tufts University found that the initial cost of PVC flooring may be cheaper than other alternatives, but over the life of a product, PVC costs more because of the increased cleaning costs needed to maintain the flooring. The total cost over 20 years was estimated at $1048 for Armstrong solid vinyl flooring, compared with $805 for Armstrong linoleum.[75] Similarly, for a single-ply, 45-mm commercial roof application, the cost of materials and labor was $3.70 per square foot for PVC compared with $3.50 per square foot for TPO.[75] These researchers found that alternatives providing equal or better performance are available for almost every use of PVC; some are cost-competitive, while others cost slightly more.[75–77] Furthermore, replacing PVC with safer alternatives will likely not result in job loss, according to one analysis.[77]

The public health risks posed by PVC's additives during its life cycle have been recognized by a growing body of organizations. Major corporations in the electronics industry are phasing out PVC in favor of readily available safer and cost-effective alternatives.[78] Hospitals and health care providers have pledged to reduce or phase out PVC and bis(2-ethylhexyl)phthalate (DEHP).[79] Several governmental bodies around the United States and the world have enacted policies to reduce the purchase of products like PVC.[75] The US Green Building Council's LEED program provides incentives to avoid building materials such as PVC that release persistent bioaccumulative toxins (PBTs) and contain phthalates.[80,81] In addition, PVC ranked low in several studies of sustainability metrics, including life cycle impacts and green design principles.[82,83]

While plastics, including PVC, may offer considerable benefits,[84] our current approaches to production, use, and disposal are not sustainable and present concerns for public health and the environment.[85] A precautionary approach, such as described in APHA Policy Statement 200011[7] and by the President's Cancer Panel,[86] can reduce exposures to this avoidable public health and environmental risk.

Further, removal of PVC products from schools would be a step in accomplishing APHA Policy Statement 200010, which recognized that "every child and school employee should have a right to an environmentally safe and healthy school," that parents and school staff have a right to know about environmental health hazards and threats in the school environment, and that schools should follow "pollution prevention principles for infrastructure siting, construction, maintenance, and other practices that reduce or eliminate children's exposures that affect health, learning, or behavior."[1]

In light of the widespread hazards to children and other vulnerable populations due primarily to the release of additives from flexible PVC products and at every stage of its life cycle, and of PVC's pervasiveness in schools, day care centers, medical care facilities, nursing homes, public housing, facilities for special needs and the disabled, and other facilities with vulnerable populations, the American Public Health Association—

1. Urges local, state, and federal governments to educate administrators, purchasing staff, employees, parents, and caregivers about PVC hazards and safer alternatives in schools, day care centers, medical care facilities, nursing homes, public housing, facilities for special needs and the disabled, and other facilities with vulnerable populations;

2. Urges state and federal governments to consider requiring the labeling of PVC used in products, and consider requiring product manufacturers that sell PVC products to schools, day care centers, medical care facilities, nursing homes, public housing, facilities for special needs and the disabled, and other facilities with vulnerable populations to notify purchasers of the amount of PVC and the specific chemical name of additives used in individual products. This information should be made available online in a searchable database;

3. Urges state and federal governments to consider providing financial incentives for schools, day care centers, medical care facilities, nursing homes, public housing, facilities for special needs and the disabled, and other facilities with vulnerable populations for the development, purchase, and use of safer alternatives to PVC in schools;

4. Urges local, state, and federal governments and decisionmakers to consider phasing out the use and purchase of flexible PVC in building materials, consumer products, and office supplies in schools, day care centers, medical care facilities, nursing homes, public housing, facilities for special needs and the disabled, and other facilities with vulnerable populations when cost-effective alternatives are available;

5. Urges state and federal governments, in enacting such phaseouts, to consider policies that alleviate short-term economic impacts on the PVC production workforce, and also to consider economic benefits to workers in industries making safer alternatives; and

6. Urges the National Institute of Allergy and Infectious Diseases (NIAID) and other federal agencies to research the link between asthma and other health impacts and exposure to phthalates and other additives released from PVC products.

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