PVC in Buildings: Hazards and Alternatives

Polyvinyl chloride, commonly known as "**PVC**" or "**vinyl**," is one of the most common synthetic materials. PVC is a versatile resin and appears in thousands of different formulations and configurations. Over 14 billion pounds of PVC are currently produced per year in North America[1]. Approximately 75% of all PVC manufactured is used in construction materials.

PVC: Environmental health disaster

PVC is the worst plastic from an environmental health perspective, posing major hazards in its manufacture, product life and disposal.

Toxic Manufacturing Byproducts: Dioxin (the most potent carcinogen known), ethylene dichloride and vinyl chloride are unavoidably created in the production of PVC and can cause severe health problems, including:

- **Cancer**
- **Endocrine disruption**
- **Endometriosis**
- **Neurological damage**
- **Birth defects & impaired child development**
- **Reproductive and immune system damage**[2]

In the US, PVC is manufactured predominantly near low-income communities in Texas and Louisiana. The toxic impact of pollution from these factories on these communities has made them a focus of the environmental justice movement.

Global impact: Dioxin's impact doesn't stop there. As a persistent bioaccumulative toxin (PBT), it does not breakdown rapidly and travels around the globe, accumulating in fat tissue and concentrating as it goes up the food chain. Dioxins from Louisiana manufacturing plants migrate on the winds and concentrate in Great Lakes fish. Dioxins are even found in hazardous concentrations in the tissues of whales and polar bears and in Inuit mother's breast milk[3].

The dioxin exposure of the average American already poses a calculated risk of cancer of greater than 1 in 1,000 - thousands of times greater than the usual standard for acceptable risk. Most poignantly, dioxins concentrate in breast milk to the point that human infants now receive high doses, orders of magnitude greater than those of the average adult[4].

Terrorist risks: A 2002 Rand report for the U.S. Air Force identified chlorine gas storage and transport facilities as among the top chemical targets for a terrorist attack and cited examples of a number of such threats and attacks already carried out around the world. As a prime feedstock for PVC, chlorine makes the PVC manufacturing plants and the trains that supply them highly vulnerable. A simple terrorist attack could release a toxic cloud that would spread for miles, potentially endangering millions of lives[5].

The best security is to switch to safer materials that don't require chlorine. PVC production is the biggest single use of chlorine and so reduction in its use represents the largest single step we can take to reduce the risk of chlorine disasters, accidental or intentional.

Lethal additives: PVC is useless without the addition of a plethora of toxic chemical stabilizers - such as lead, cadmium and organotins – to keep it from breaking down rapidly and phthalate plasticizers to make it flexible. These leach, flake or outgas from PVC over time raising risks that include asthma, lead poisoning and cancer[6].

Deadly Fire Hazard: PVC poses a great risk building fires, as it releases deadly gases long before it ignites, such as hydrogen chloride which turns to hydrochloric acid when inhaled. As it burns, whether accidentally or in waste incineration, it releases yet more toxic dioxins[7]. PVC burning in landfill fires may now be the single largest source of dioxin releases to the environment.[8]

Can't be readily recycled: The multitudes of additives required to make PVC useful make large scale post-consumer recycling nearly impossible for most products and interfere with the recycling of other plastics. Of an estimated 7 billion pounds of PVC thrown away in the US, only 18 million – barely one quarter of 1% - is recycled[9]. The Association of Post Consumer Plastics Recyclers declared efforts to recycle PVC a failure and labeled it a contaminant in 1998[10].

[1] American Plastics Council 2002
[2] Schreiber 2003, Thornton 2002
[3] NACEC 2001
[4] Schettler 2000
[5] Karasik 2002
[6] Thornton 2002, Schreiber 2003, Bornehag 2004
[7] Theisen, etal. 1989, OEHHA 1999, Thornton 2002,Schreiber 2003
[8] Lent 2005
[9] Kaufman 2004, Principia 1999
[10] APR 1998

PVC in construction materials

While the many problems associated with PVC throughout its lifecycle far outweigh the benefits, the construction industry has been unaware of its true cost and long considered it a cheap convenient material. Piping, vinyl siding, and vinyl flooring are the largest and most familiar uses of PVC. Roof membranes have been a growing area. It is also used in electrical wire insulation, conduit, junction boxes, wall coverings, carpet backing, window and door frames, shades and blinds, shower curtains, furniture, flues, gutters, down spouts, waterstops, weatherstrip, flashing, moldings and elsewhere. Fortunately, for each of these uses, there exist a wide range of cost effective alternative materials that pose less of a health hazard to workers and the public at large.

Alternative options

- ❑ **Piping** Cast iron, steel, concrete vitrified clay, copper and plastics such as HDPE (high density polyethylene).
- ❑ **Siding** Fiber-cement board, stucco, recycled or reclaimed or FSC (Forest Stewardship Council) certified sustainably harvested wood, OSB (oriented strand board), brick, polypropylene.
- ❑ **Roofing Membranes** TPO (thermoplastic polyolefin), EPDM (ethylene propylene diene monomer), FPO flexible polyolefin alloy), NBP (nitrile butadiene polymer), low-slope metal roofing.
- ❑ **Flooring & Carpet** Linoleum, bamboo, ceramic tile, carpeting with natural fiber backing or polyolefins, reclaimed or FSC certified sustainably harvested wood, cork, rubber, concrete, nonchlorinated plastic polymers
- ❑ **Wall Coverings & Furniture** Natural fibers (such as wood and wool), polyethylene, polyester and paint.
- ❑ **Electrical Insulation and Sheathing** Halogen free, XLP and XLPE (thermoset crosslinked polyethylene) & LLDPE (linear low-density polyethylene)
- ❑ **Windows & Doors** Recycled, reclaimed or FSC certified sustainably harvested wood, fiberglass, aluminum.

Join the move away from PVC

Architectural firms, governments and major corporations all over the world are dropping PVC. A wide range of major corporations including Microsoft, HP, Shaw, WalMart, Firestone, Nike, Mattel, Lego, Johnson & Johnson, GM, VW and Honda have begun the switch to alternative materials[11]. San Francisco and New York State have banned PVC pipe. An increasing number of major projects, from the Kaiser Permanente hospital system and U.S. EPA headquarters in Washington, DC to the 2000 Olympic village in Sydney, Australia, have vastly reduced or completely eliminated use of PVC[12]. More government agencies are eliminating it from wiring, flooring and other applications, including the US Navy, Air Force and NASA[13].

Replacing PVC in your projects is easier than you may think. A number of resource guides are available to help you find green construction materials. But beware: some construction materials labeled "green" actually contain recycled PVC/vinyl and frequently require virgin PVC mixed with the recycled. The Healthy Building Network web site (below) provides lots of guidance for this and other healthy building issues.

For more information:

- **Healthy Building Network**: Charts of PVC free building materials and more on the hazards of PVC, including a review of the science. **www.healthybuilding.net**
- **Environmental Building News**: Article discussing issues around a phase out of PVC **www.buildinggreen.com/features/pvc/pvc.html**
- **Health Care Without Harm and Center for Health & Environmental Justice:** Information on related efforts to eliminate PVC and other dioxin sources **www.noharm.org** **www.chej.org**

References:

APR (Association of Post Consumer Plastic Recyclers). 1998 APR takes a stand on PVC. Press release. Washington, DC April 14.

American Plastics Council, Resin Review 2002, Arlington, VA.

Bornehag, CG, et al. "Allergic symptoms and asthma among children are associated with phthalates in dust from their homes: a nested case-control study," Environmental Health Perspectives. 15 July 2004

CHEJ "Microsoft Completes Phase Out of PVC" Center for Health, Environment & Justice, News Release Dec 12, 2005.

EBN, Hospital, Heal Thyself:Greening the Design and Construction of Healthcare Facilities, Environmental Building News, Brattleboro VT June 2005

EPA (U.S. Environmental Protection Agency, Green Building Design Initiative, Washington, DC, 1998.

Karasik, Theodore, Toxic Warfare, Rand Corp, Santa Monica, CA 2002.

Kaufman (2004) S.M., N. Goldstein, K. Millrath and N.J. Themelis. "The State of Garbage in America: 14th AnnualNationwide Survey of Solid Waste Management in the United States." BioCycle: 31-41, Jan 2004.

LEGO Company, 2002 Annual Report.

Lent, Tom, Comments to the USGBC TSAC on the PVC Draft Report dated December 17, 2004, Feb 2005

Mattel, "Mattel Commits to the Elimination of Phthalates..." press release, 1998, http://www.shareholder.com/mattel/News/19980923-54258.cfm .

Microsoft, "'Microsoft Phases Out PVC From Its Packaging", Microsoft PressPass, Redmond, WA. Dec. 7, 2005

NACEC (North American Commission on Environmental Cooperation), Tracking Dioxins, 2001.

Nike, Nike Statement On Decision to Phase-out PVC – press release, Aug1998

OEHHA(CA Office of Environmental Health Assessment) Acute Toxicity Summary: Hydrogen Chloride March 1999

Principia Partners, Post Industrial and Post Consumer Vinyl Reclam, report to the Chlor Vinyl steering group of the Vinyl Institute , July 1999.

Schettler, Ted and Stein, J., In Harm's Way: Toxic Threats to Child Development, Greater Boston Physicians for Social Responsibility, Cambridge 2000.

Schreiber, Judith affidavit before the Supreme Court of the State of New York in the matter of the Resilient Floor Covering Institute vs. New York State Department of Environmental Conservation, 2003

Theisen J., W. Funkcke, E. Balfanz,and J Konig. 1989 Determination of PCDFs & PCDDs in fire accidents and laboratory combustion tests involving PVC-containing materials. Chemospihere, 19:423-428.

Thornton, Joe, PhD. Environmental Impacts of Polyvinyl Chloride Building Materials, Healthy Building Network, Washington, DC 2002.

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[11] Microsoft 2005, Nike 1998, Mattel 1998, LEGO 2002, Thornton 2002, CHEJ 2005

[12] EPA 1998, EBN 2005

[13] Thornton 2002