

**USGBC TSAC PVC Draft Report dated December 17, 2004 (released 12/22/04)**  
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Submit to [tsac@committees.usgbc.org](mailto:tsac@committees.usgbc.org), any time before midnight on February 15, 2005.

**Comments submitted by:**

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These comments are submitted because we believe that green buildings should be environmentally healthy buildings that avoid the use of materials that pose unreasonable and avoidable risks to public health and environment. We have reviewed the U.S. Green Building Council's LEED Technical and Scientific Advisory Committee (TSAC) report entitled "*Assessment of Technical Basis for a PVC-Related Materials Credit in LEED.*" We are deeply disappointed in the accuracy of some of the scientific information and the overall quality of the scientific analysis in this report. We are concerned that this report will encourage the continued use of polyvinyl chloride (PVC) at a time when many companies have recognized the health and environmental risks that PVC poses and have made the decision to move away from using it.

The Center for Health, Environment, and Justice (CHEJ) has closely followed the U.S. Environmental Protection Agency's (USEPA) reassessment of the health effects of dioxin and dioxin-like substances for over 10 years. A significant portion of this work has focused on the role of PVC in the generation of dioxin and dioxin-like substances. We recent completed a report that evaluated the public health and environmental impacts of PVC that primarily focused on what happens at the end of the useful life of PVC materials such as piping, siding, flooring, or windows, when these materials are discarded. This report, entitled "*Bad News Comes in 3's - The Poison Plastic, Health Hazards and the Looming Waste Crisis,*" documents a wide range of severe and long lasting health and environmental hazards directly attributed to the production, use and disposal of PVC products. A copy of our report is attached to these comments. Many of the comments included below are discussed in more detail in our report.

Our main concern with the TSAC Report is that it does not adequately evaluate the public health and environmental risks posed when the useful life of a PVC product ends. When burned, whether in an incinerator, backyard burn barrel or during an accidental building or vehicle fire, PVC plastic forms dioxins, a highly toxic group of chemicals that build up in the food chain. Dioxins are known to cause cancer, reproductive, developmental and immune problems. Landfilling PVC also poses significant public health and environmental risks due to leaching of toxic additives into groundwater, dioxin-forming landfills fires, and toxic emissions in landfill gases.

The TSAC Report also fails to adequately assess the contribution of PVC to dioxin air emissions nationwide. The evidence linking PVC to dioxin air emissions is clearly documented in numerous publications including the USEPA Inventory of Sources of Dioxin in the U.S. These concerns are expressed in more detail below.

For these and other reasons, we feel that the TSAC Report does not accurately reflect the current consensus of scientific knowledge of the public health and environmental impacts of PVC. We are concerned that the TSAC Report as written will undermine our efforts and those of other organizations to move priority toxic chemicals out of use. We urge the U.S. Green Building Council to stand with the growing movement of organizations, consumers, and companies who have recognized the lifecycle hazards created by PVC.

Although we have other concerns about the TSAC Report, the thrust of these comments will focus on the committee's failure to adequately evaluate the public health and environmental risks posed when PVC materials are disposed of and the failure to adequately assess the contribution of PVC to dioxin air emissions nationwide.

- 1) The Life Cycle Assessment (LCA) and Risk Assessment (RA) models used in the TSCA Report do NOT include a factor to address the environmental and public health risks that result when PVC is disposed of at the end of its useful life as a consumer product (see LCA Framework pp. 22-to 27; RA, pp. 27-31; and Exposure Assessment, pp 32- 37). There is also no discussion of the broad environmental and public health risks of PVC in Section 3.3.1 Overview regarding risk assessment estimates (p. 53-58).

This is a major omission. How can a "life-cycle assessment" be complete when it ignores the environmental and public health impacts of a major component of a material's life-cycle, when it is discarded? PVC waste is primarily disposed of either by burning it in an incinerator or backyard burn barrel, or by placing it in a landfill. When PVC is burned in a municipal or medical waste incinerator, dioxins and other toxic gases are formed, and heavy metals which are present in the waste are released into the air and residual ash. Dioxins are also released when residents in rural areas dispose of

their trash by burning it in small furnaces or barrels behind their homes. It is the chlorine in PVC that facilitates the formation of dioxins and other chlorinated organic compounds that are subsequently released into the environment (1).

Waste incinerators are a major source of dioxins released to the air and land. Municipal solid waste incinerators are considered the largest source of dioxin emissions in air (2). The most recent inventory of dioxin sources in the U.S. estimated that municipal and medical waste incinerators together account for 55% of all dioxin releases to air (40% and 15%, respectively) (2). Dioxin air emissions have since declined as many incinerators have closed or added pollution controls to meet new standards (3, 4). Much of the dioxins formed from incinerators are released to the land through landfilling of incinerator ash.

An estimated 250,000 tons of PVC were burned in trash incinerators in the U.S. in 2002 (5). PVC waste contributes substantially to the chlorine content of the waste and to the formation of dioxins in trash incinerator emissions. Estimates of how much PVC waste contributes to the chlorine content in waste streams vary from 35 to 66% (6, 7). Other minor chlorine sources include food waste and paper. Another source estimates that, on average, about 50 to 67% of the chlorine input in an incinerator can be attributed to PVC (8). However, as much as 80% of the organically bound chlorine, which is thought to be more conducive to dioxin formation than inorganic chlorine, may be from PVC (9).

In addition to dioxins, PVC waste contributes to the formation of hydrochloric acid (HCl) in the flue gases of incinerators. This gas must be neutralized and removed by scrubbers because it damages the air pollution control equipment and requires additional maintenance. In addition, the metal stabilizers in PVC (lead and cadmium) do not break down during incineration but are released either as hazardous air emissions or remain in the ash and cinders (7). Older PVC products that used cadmium as a metal stabilizer will contribute cadmium when burned (7). Consequently, burning PVC waste will increase the operating cost of the incinerator (6).

Waste incineration has been linked to a number of serious health problems in plant workers, as well as in surrounding communities. Many of these troubles implicate PVC as the root source of contamination. For instance, workers in incinerator plants have increased levels of chlorinated phenols and lead in their body tissues, which may result from PVC, as well as mercury and arsenic (10). The USEPA has reported that metals emissions in incinerators rise when the chlorine content of the waste rises. In one study, metals were up to seven times higher when the chlorine content of the waste was increased from 0 to 8.3% (11). Elevated chlorine content levels also impair the efficiency of the scrubber to remove metals from stack gases (11). Incinerator operators are not the only exposed group. Populations living near incinerators are particularly vulnerable to elevated levels of dioxins and heavy metals in tissue and blood, as well as to respiratory ailments and cancers (10). Elevated levels of congenital abnormalities have also been observed in newborns in areas in the immediate vicinity of incineration plants (12).

Even distant populations are at risk, as toxic air releases settle on crops and these crops are transported to other areas and/or eaten by livestock which, in turn, are consumed by people (13, 14). A study by Barry Commoner and researchers at Queens College in New York found Inuit Native peoples living in the northern reaches of Canada, miles from any sources of dioxin, had high levels of dioxin in their bodies (15). These researchers also found dioxins released from incinerators and other dioxin sources hundreds of miles away in the U.S. and lower Canada were transported by wind currents to the far reaches of the globe.

Landfilling is the most common disposal option for PVC and thus is a significant part of the disposal stage of the PVC life cycle. The majority of PVC that is discarded as waste ends up in a landfill. However, landfills do not solve the PVC disposal dilemma. They eventually leak, routinely emit toxic gases and occasionally catch on fire.

According to the USEPA, about 1.42 million tons of PVC was present in U.S. municipal solid waste in 2001 (16). This represents less than one percent of the 163 million tons of municipal solid waste disposed of in landfills and incinerators. (This total does not include an additional 49 millions tons of municipal discards that were recycled or composted and contained negligible amounts of PVC.)

The USEPA estimated that about 1.12 million tons of PVC was dumped in landfills in 2001 (16). Using another source of data on municipal waste generation for 2002, the amount of PVC dumped in landfills was estimated at 2.04 million tons (5), nearly twice the USEPA amount. This latter estimate assumes the same percent PVC content in the municipal solid waste stream as reported by the USEPA. The estimated number of active landfills in the U.S. where PVC could end up ranges from 1,767 (5) to 3,200 (17).

The amount of PVC waste going to landfills is expected to increase substantially over the next 20 years. A study in Europe found the amount of PVC waste generated in the 15 European Union countries will increase from 3.6 million tons per year in 2000 to 4.7 million tons in 2010 and to 6.4 million tons per year by 2020 (18, 19). This is an increase of more than 75% over 20 years. This is because most PVC products were put into commercial use during the 1970's and their useful service life is ending. Components in cars, construction materials, and electrical, household and industrial goods typically last from 5 to 15 years (18). Building materials such as pipes, flooring, and siding may last for decades before being replaced (18). As production of these PVC materials has been on going for more than 30 years, the PVC waste that is entering the waste stream today is a reflection of the products put in use years ago. An estimated 150 million tons of PVC will require disposal worldwide in the coming years (20).

PVC is also found in construction and demolition (C&D) waste generated from the construction, renovation, repair and

demolition of structures such as residential and commercial buildings, roads, and bridges (21). Franklin Associates estimated that 136 million tons of building-related C&D debris was generated in 1996 (22). The percentage of PVC in C&D waste is hard to estimate. One report specifically identified and estimated the percent of vinyl siding and PVC pipes in C&D waste to be 0.63% for the two materials combined (22). Other types of PVC plastic waste were not considered. In 2002, forty-two states reported that 1,931 landfills were dedicated for disposal of C&D waste (5). Many if not most of these landfills are unlined, offering groundwater supplies even less protection from contaminants that may leach from PVC and other C&D waste components.

There are significant dangers associated with the dumping of PVC in landfills. Although there appears to be little degradation of the PVC polymer (19, 23), the additives present in PVC products are not chemically bound to the PVC and they will seep out into the environment over time (6, 23). This is especially true of flexible PVC products. In the case of the rigid PVC products, stabilizers are generally thought to be encapsulated in the matrix of the PVC polymer and thus migration is expected to be less than what occurs with the plasticizers (18, 19, 23).

- 2) The Life Cycle Assessment (LCA) and Risk Assessment (RA) models used in the TSCA Report do NOT assess the public health and environmental impact of the toxic additives used in the manufacture of PVC products. These additives include stabilizers (lead, cadmium, antimony, organotin, and zinc), plasticizers (diethyl hexylphthalate (DEHP), Diisononylphthalate (DINP), Diisodecylphthalate (DIDP), and fillers that are mixed in with, but are not chemically bound to the PVC.

The most important of these chemical additives are the plasticizers known as phthalates and metal stabilizers. Plasticizers are added to PVC to “soften” the plastic and make it pliable for certain applications. About 90% of all phthalates consumed in the U.S. (and about 98% in England) are used in PVC products (8, 24). These plasticizers can make up a large portion, in some cases up to 60% by weight, of the vinyl product (25). Because these additives are not chemically bound to the PVC, they will leach out over time (8).

Studies have shown plasticizers such as DEHP and DINP have migrated out of PVC containers used to store food (25, 26); IV bags used to hold blood (27, 28); toys (29, 30); and numerous other products, exposing people to toxic additives (31, 32, 33).

In some cases, these additives will evaporate or “off-gas” from PVC materials like flooring, wall covering or carpeting, contaminating indoor air (34, 35, 36). A study by the California Air Resources Board measured forty target

compounds off-gassing from PVC flooring. Phenol was found in the air off-gassing from all the vinyl sheets evaluated. tetrahydrofuran, cyclohexanone, toluene and n-tridecane were also found (34). Another study found the degradation of plasticizers from PVC flooring was likely responsible for an increase in adult asthma as well as eye and skin symptoms in workers. The prevalence of these symptoms decreased when the PVC flooring was removed (37). A Swedish study estimated that 42,000 tons of phthalates are released from PVC products worldwide each year (25).

Components of PVC have also been found to leach from PVC pipes. Vinyl chloride has been found to leach from PVC pipes made prior to 1977 (38). PVC pipes made prior to this time had a high residue of vinyl chloride that failed to bond when the vinyl chloride monomer was polymerized into polyvinyl chloride. In a study of unplasticized PVC pipe, vinyl chloride was detected in water after 30 days at 2.5 parts per billion (ppb), a level that exceeds the USEPA drinking water standard of 1 ppb (39). Smaller pipe size, longer line length, and warm temperatures all increase the likelihood of vinyl chloride leaching from PVC pipes. Additional studies have found organotin stabilizers also leach from PVC pipes (40, 41, 42, 43).

Phthalates have been shown to cause developmental and reproductive damage (44), altered liver (45) and kidney function (46) and have been linked to the development of respiratory problems in children (47, 48). More detailed information on the health and environmental impact of phthalates used in PVC products are available from other sources (33, 49, 50).

Metal stabilizers including lead, cadmium, zinc, antimony and the organotins will leach out of PVC products. Lead and cadmium were found to leach out of children's toys made with PVC (51). Lead migrated out of PVC window blinds (52) and into water carried in PVC pipes (25). Lead is a known cause of neurodevelopmental problems (53). Cadmium causes cancer and kidney damage (54).

Organotin stabilizers (tributyltin, tetrabutyltin, monooctyltin, dioctyltin) were introduced to replace toxic metal stabilizers like lead and cadmium, but they have also been found to leach from PVC products (32, 40). The organotins affect the central nervous system, skin, liver, immune system and reproductive system (55, 56). The diorganotins are potent developmental toxins (56, 57) and potent teratogens (56, 58). Tributyltin affects the nervous system, and has caused reproductive and developmental problems in animal studies (59, 60).

Antimony trioxide (ATO) is added to PVC used in flexible electrical cables and roofing foils to inhibit the formation and spread of flames during a fire (61, 62). For flame retardant applications, PVC accounted for 32% of the European market for antimony trioxide in 1998 (61). The antimony, which is a synergist rather than a flame retardant, acts to

enhance the flame retarding properties of chlorine in PVC. Antimony trioxide is a suspect human carcinogen when inhaled and is toxic to the lungs, heart, eyes and skin (61, 63). During fires and waste incineration, antimony dust and toxic antimony halides are released. Antimony also catalyzes the formation of dioxins and furans (61).

- 3) The Life Cycle Assessment (LCA) and Risk Assessment (RA) models used in the TSCA Report ignore the impact of PVC during accidental fires. This is one of the most important issues that need to be evaluated in an assessment of the overall life cycle impact of PVC.

In 1995, there were an estimated 574,000 structural fires and another 406,000 vehicle fires in the U.S. (2). When the PVC in buildings and vehicles burns, a variety of toxic substances are formed that pose major public health risks. The primary combustion products are hydrogen chloride gas, carbon dioxide and carbon monoxide (64). Hydrogen chloride gas is a corrosive and highly toxic gas that can burn the skin and cause severe damage to the eyes and lungs. When hydrogen chloride comes in contact with the mucous lining of the lungs, it is converted into hydrochloric acid that can cause severe and permanent respiratory damage (65).

Accidental fires that burn PVC also generate phosgene gas, benzene, toluene, xylenes, dioxins, furans and other products of incomplete combustion (65). The poor combustion conditions that are typical of these fires are ideal for the formation of dioxins and furans (66). Dioxins were found in the air, water, surface soil and nearby vegetation following the burning of a plastics recycling plant in Hamilton, Ontario (67). In the World Trade Center fires, dioxins and furans were identified as significant components of the smoke given off by the smoldering buildings (68). In Germany, dioxin levels in indoor soot remaining after a house fire were found to be as high as 45,000 parts per trillion (ppt) TEQ—more than 300 times the German government's health standard (69). After a fire at a plastics warehouse in Binghamton, NY, dioxin levels in soils were found to be more than 100 times higher than other areas of the community not impacted by the fire (70).

Firefighters and emergency responders are especially at risk from smoke and gases generated by fires burning PVC. Exposure to combustion gases from building fires has been linked to a high incidence of leukemia and laryngeal and colon cancers in firefighters at young ages (71) and to other adverse health problems including pulmonary hemorrhage and edema due to chemical pneumonitis (72, 73). This is one of the reasons why the International Association of Firefighters supports the use of alternative building materials that do not pose as high a risk as PVC (74).

The toxic gases generated when PVC is burned in accidental fires have resulted in deaths and injuries, including

workers exposed to toxic gases from burning electrical wires coated with PVC (75); residents exposed to airborne toxics from a Hamilton, Ontario plastics recycling plant fire (76); and guests who died in the MGM Grand Hotel fire in Las Vegas (77). A summary of the public health hazards associated with accidental fires that burn PVC has been published (72).

Accidental fires are unexpected, and thus difficult to regulate, but phasing out PVC could reduce the harm they cause. If PVC was not so widely used as a building material, accidental fires would not produce the toxic combustion products that are specifically caused by the burning of PVC. Both immediate and long-term impacts would be lessened: firefighters and victims alike would avoid exposure to the toxic gases and smoke caused by the fire, and the leftover ash would be largely free of these toxins as well.

The TSAC Report does acknowledge the serious adverse health effects associated with PVC in building fires (Section 3.2.3 PVC fires, pp. 49 to 51). However, the text of the report does not reach any conclusions about the health and environmental risks posed by PVC in accidental fires. In the executive summary of the report, the committee states that “Studies on PVC fires indicate that with proper protective equipment, firefighters are not at increased risk for exposure to combustion products from this plastic” (ES, p. 10, lines 15-16). This cavalier statement ignores the fact that some fire fighters and other emergency responders will be exposed if they do not have protective equipment, that members of the public using the building will not be wearing protective equipment, and that people who live near the building will be exposed to the toxic fumes generated by the fire and they will not be wearing any protective equipment.

4) The Life Cycle Assessment (LCA) and Risk Assessment (RA) models used in the TSCA report ignore the environmental and public health impact of PVC burned in backyard burn barrels.

The TSAC report does briefly discuss backyard burning (Section 3.2.2, pp. 47 to 49) and the committee does find that “Limited data indicate that backyard burning may be a very significant source of localized dioxin concentrations. Dioxin levels emitted from barrel burning varies significantly with the chlorine content of the fuel source” (ES, p. 10 lines 16 to 19). However, the potentially significant impact on public health and the environment that burning PVC in burn barrels poses is not included in the overall environmental and public health assessment conducted in this report.

Backyard burning (also called open burning) generates toxic emissions that are uncontrolled. The smoke and vapors from the open burning of household trash contain many toxic chemicals including dioxins and furans; carbon

monoxide; heavy metals such as mercury, lead, arsenic, and cyanide; volatile organic compounds (VOCs) such as benzene, styrene, and formaldehyde; particulates; polycyclic aromatic hydrocarbons (PAHs); and hexachlorobenzene (78, 79). Exposure to these chemicals have been linked to adverse health problems including, but not limited to asthma, lung cancer, and other respiratory ailments, kidney and liver damage, and nervous system, reproductive and developmental disorders (80). One study found emissions were highest for VOCs such as benzene and styrene, formaldehyde, hydrogen cyanide and hydrochloric acid, followed by polychlorinated biphenyls (PCBs) and arsenic (79).

Among the toxic byproducts of backyard waste burning, dioxins and furans may pose the greatest public health threat. Dioxins are highly toxic even at low levels and have been linked to serious health problems in people that include cancer and adverse developmental and reproductive effects (80, 81). Dioxins are formed primarily because of low combustion temperatures, poor air distribution, and the presence of chlorine (82). The majority of chlorine in household trash comes from PVC plastic. Because the emissions from open burning are released close to the ground, they are particularly dangerous to people and animals located nearby. There are also no pollution control devices on these burners.

The backyard burning of household trash also produces residual ash that contains toxic metals such as lead, chromium, mercury and arsenic, as well as PCBs and dioxins (78, 83). The ash left over from the burning is often used by homeowners in gardens or placed in areas where children may play and come in contact with these toxic substances. In gardens, vegetables can absorb and accumulate the metals (78).

5) The Life Cycle Assessment (LCA) and Risk Assessment (RA) models used in the TSCA Report ignore the environmental and public health impact of PVC burning in landfill fires.

Landfill fires generate a range of hazardous gases including carbon dioxide, carbon monoxide and hydrogen chloride. Dioxins and furans are also formed (2). Such fires are not uncommon. An average of 8,400 landfill fires are reported each year in the U.S. (84) and their ignition can be traced to a number of causes. Though over half of reported fires have no information available as to the initial cause, 40% of reported fires are classified as deliberate or suspicious, 20% are attributable to smoldering waste, and 5% ignite spontaneously. Highly flammable methane gas, released by landfilled waste as it decays is a primary factor in many cases.

PVC products disposed of in landfills contribute to the formation of dioxins and furans in the event of a fire. Four PVC

products—pipes, rigid foils, floorings and cable wires—contribute about 40% of the chlorine content in landfills (23). As previously discussed, the chlorine in PVC contributes to the formation of dioxins. Other factors that influence the amount of chlorinated dioxins and furans formed include fire temperature, and the availability of oxygen and catalysts (e.g., copper). Lower oxygen concentrations and lower temperatures (500-700° C) correspond with elevated dioxin formation (85). Both these conditions occur frequently at landfill fires. Measured concentrations of dioxins and furans in the air of landfill fires are generally high and consistent with evidence gathered from test fires (86).

6) The Life Cycle Assessment (LCA) and Risk Assessment (RA) models used in the TSCA Report ignore the contribution of PVC to dioxin air emissions nationwide.

The relationship between PVC and the formation of dioxins in incinerators is a major concern with the disposal of PVC waste material. PVC is a significant chlorine donor in the incineration process, spurring the formation of dioxins. The strongest evidence of this comes from laboratory studies. The German EPA found that burning waste that includes PVC or other organochlorines produced dioxins, while burning waste without PVC did not (87). Two Danish studies found similar results (88, 89). In Japan, researchers found that adding 4% PVC to a mixture of PVC-free material increased dioxin emissions ten fold (90). When PVC was added to a mixture of newspapers or to chlorine-free paper and burned, dioxin emissions increased significantly with chlorine and PVC content (91). In a similar study, dioxin levels in fly ash were 200 to 1,200 times higher when PVC was added to a mixture of newspaper or chlorine-free plastics (92). Several other studies found that increased dioxin levels in fly ash or unburned residue were correlated with increased PVC levels in the waste stream burned (93, 94, 95).

When elemental chlorine was added to a mixture of coal and salt, dioxin levels were 130 times higher than when the same mixture was burned without the chlorine (96). Adding PVC or chlorine gas to chloride-containing vegetable matter resulted in increased dioxin formation (97). In another study, as the level of organochlorines in a waste stream increased, so too did the amount of dioxins formed (98). A study in Finland found that burning perchloroethylene in a laboratory produced more dioxins, chlorobenzenes and chlorophenols than burning sodium chloride (99).

There is also evidence from small-scale incinerators that support a relationship between burning organochlorine compounds like PVC and dioxin formation. The Danish EPA found that doubling the PVC content of an incinerator's waste feed increases dioxin emissions by 32% (100). Conversely, reducing the PVC feed results in a reduction in dioxin emissions. Researchers in Japan found that burning a mixture of PVC and polyethylene produced large amount of dioxins (101, 102). A study conducted for the Dutch Environment Ministry found that PVC levels in the waste

stream increased dioxin levels in the air emissions (103). Other studies in both the U.S. (104) and Europe (89, 105, 106, 107, 108, 109) have found a positive correlation between PVC content in a waste stream and dioxin emissions.

An excellent review of the evidence linking chlorine content in the waste stream and dioxin emissions has been published (1). This paper identified 47 studies involving laboratory and pilot scale combustion system/processes; 12 studies involving small-scale and other combustion systems/processes; and 31 studies involving full-scale combustors that are relevant to the relationship of chlorine content and dioxin emissions. The author found that reduced chlorine content was correlated with reduced dioxin formation in all three study groups and concluded that there is “a compelling body of evidence that dioxin formation in waste incinerators decreases when chlorine input is reduced.”

The USEPA confirmed that PVC is a dioxin precursor in 1997 (110). They also acknowledged that, “several studies have identified strong correlations between chlorine content and CDD/CDF [dioxin/furan] emissions during combustion tests.” As part of their inventory of sources of dioxin, the USEPA has acknowledged that a “review of experimental data clearly indicates an association between chlorine content of feed/fuels and ... synthesis of CDDs and CDFs” (2), though the agency concluded that the overall results “were not unequivocal.”

7) The Life Cycle Assessment (LCA) and Risk Assessment (RA) models used in the TSCA Report ignore the limitations on the ability to recycle or reuse PVC and its impact on the ability to recycle other plastics.

It is extremely difficult to recycle PVC. The primary reason for this is the lack of uniformity in the composition of PVC products. Vinyl products are made using various formulations that are designed to achieve certain properties and create specific products. To achieve these features, additives such as lead, cadmium and phthalates that enhance properties such as durability and plasticity are mixed together with PVC. For example, vinyl siding and windows are made with lead to make them more durable, whereas infant chew toys contain phthalates to make them more soft and pliable.

When the different formulations of PVC are mixed together, such as when they are collected as part of a recycling effort, they cannot be readily separated which is necessary to reprocess the PVC back into its original formulation and to retain the unique properties of the original formulation (9, 111). This problem is further complicated because PVC formulations for the same materials have changed over time.

There are other problems with collecting mixtures of PVC for recycling. One difficulty is color. Recycled products must be separated by color, which in most cases is not practical (111). Another difficulty is that soft PVC cannot be used in rigid PVC applications, and rigid PVC cannot be used in soft PVC applications since the material has to be reformulated (i.e., new additives need to be added). Thus, when different formulations of PVC are mixed together, it becomes virtually impossible to create a formulation that can be used for any application that requires specific properties.

As a result, a lower quality PVC plastic is produced which cannot be used for the same purpose as the original product (111). Thus, PVC can never be truly recycled into the same quality material. It usually ends up being “downcycled” into lower quality products with less stringent requirements such as speed bumps, parking bumpers, or park benches. When PVC is downcycled, it does not reduce the overall demand for the raw materials (virgin resin) used in making plastic, and has no effect on the amount of vinyl produced each year (112).

The difficulty in separating PVC from other plastics, such as polyethylene terephthalate (PET) bottles or nylon carpet facing, makes it extremely difficult, if not impossible, to recycle those otherwise recyclable materials. PVC also increases the toxic impacts of recycling of other valuable commodities such as copper from wiring and cable used in electronics like computers, steel from the scrapped automobiles and corrugated cardboard containers sealed with PVC tape (113).

For example, PVC severely impacts the recyclability of other plastics such as PET. Bottles made of PET and high density polyethylene (HDPE) make up 95% of all plastic bottles compared to only about 2.3% for PVC bottles (114). PET bottles (recycling code #1) are commonly used to contain water, soda, vegetable oil and many other products (114) and are highly recyclable. Lower quality recycled PET (which has greater tolerance for contaminants such as PVC) is often used to make a polyester fabric known as “fiberfill” that is used in coats, sleeping bags, pillows and carpeting. However, higher quality recycled PET (containing very little PVC) is increasingly being recycled directly back into bottles. It also has an economic benefit as it is sold for fiber at seven times the price of PET contaminated with PVC (114).

When PVC is mixed together with PET or other highly recyclable plastic, such as in the “all-bottle” recycling programs favored by the plastics industry, the few PVC bottles likely to be collected will be virtually indistinguishable from PET containers due to their similar appearance and density. Sophisticated separation technology that uses optical systems is available to identify and remove unwanted plastic bottles, such as PVC (115). However, the effectiveness of these

systems is greatly reduced when the bottles are damaged or dirty. This makes accurate readings difficult to achieve and as a practical matter separation of PVC almost impossible (114, 115).

If the PVC cannot be separated from the PET, it will severely effect the processing of the PET bottles into reusable plastic resin. This is because PET and PVC behave very differently when they are processed for recycling. PVC burns at a lower temperature than PET. It burns at the temperature that simply melts PET (114, 116). When this occurs, "black spots" get into the PET resin contaminating the batch and ruining or seriously downgrading the quality of recycled PET residue (114). According to one plastics recycler, "introducing one PVC bottle into the recycling process can contaminate 100,000 PET bottles" (114, 116). In addition, when PVC is melted, it generates hydrochloric acid, which will damage the processing equipment (117).

8) The TSCA Report dismisses the environmental and public health impact of PVC production facilities on communities living near these facilities.

After an extensive discussion of ambient exposure data (see pp.79 to 87), the TSCA report concludes that "additional data are needed to determine the potential health risks of individuals living in neighborhoods near vinyl manufacturing facilities" (p. 87). Because the data was limited, the TSCA committee dismissed the impact on surroundings communities.

Scientists always want more data, but that does not mean that these risks should not be estimated and in some way incorporated into the overall assessment of the impact of PVC production facilities on the environment and public health. U.S. communities surrounding vinyl chloride chemical facilities, half of which are in Louisiana, suffer from serious toxic chemical pollution of their groundwater supplies, surface waters and air. Residents of the town of Mossville, LA had dioxin levels in their blood that were three times higher than normal (118).

In 2000, there were 12 facilities in the U.S. that produced vinyl chloride monomer (VCM) (119). Seven of these plants also produced PVC. As of 2003, there were 24 facilities operated by 12 companies that produced PVC resin in the U.S. (120) and an estimated 2,332 PVC fabricating facilities (121). These PVC production facilities released 811,000 pounds of VCM and 670,000 pounds of ethylene dichloride (EDC) into the environment in 2002 (122). In addition, 6.5 million pounds of VCM and 2.5 million pounds of EDC were sent off-site to sewage treatment plants or waste treatment facilities (122). It should be noted that these are self-reported numbers that represent an absolute minimum. The actual releases are likely to be greater.

## References

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