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ECHA call for comments – Proposal for restriction on polyvinyl chloride PVC and PVC additives

The Health and Environment Alliance (HEAL) strongly supports a restriction on polyvinyl chloride (PVC) and PVC additives.

PVC and its additives are associated with many adverse human health and environmental impacts during all phases of its life-cycle, from production, use, to disposal. This consultation response focuses on the building and construction sector as it is one of the single largest sectors globally to use PVC [1]. Many of the chemicals used in PVC are hazardous, but regrettable substitution of newer hazardous chemical technologies is only compounding the problem, while safer alternatives to PVC are available.

Hazardous chemicals found in production, use, and disposal of PVC

Production:
The building and construction sector uses more chlorine gas than any other sector in its production of PVC. This is of paramount concern as chlorine gas production involves many hazardous substances, produces a large amount of harmful by-products, and is very energy intensive. [2]. The five phases of chlorine processing – ethylene and chlorine gas production, feedstock production, polymerization, formulation/compounding, and moulding – all have their own set of hazardous inputs and emissions. PVC production also puts workers and fence-line communities at disproportionately higher risk of harmful exposure to many of these harmful chemicals during production [3].

There is no sustainable, safe technology for production of chlorine gas, which is the first phase of PVC production. Furthermore, regrettable substitutes are introducing more hazards. Older Mercury and asbestos technologies used to separate chlorine from the alkali in chlorine industrial processing are being phased out and replaced with newer PFAS technologies, trading one set of hazardous substances for another [4]. Although most of the chlorine produced in the EU now uses newer PFAS technologies, exemptions have been granted for the continued use of asbestos and mercury-based technologies for several of the EU's largest chlor-alkali plants [5]. Researchers are finding that newer perfluorosulfonic acid membranes – specifically Nafion® (CAS Number 66796-30-3) from Chemours (formerly DuPont) – used in chlorine production have been found in aquatic environments and have proven nearly impossible to remove in advanced water treatment facilities [6]. All of these technologies pose significant, irreversible health and environmental hazards from releases into soil, groundwater, surface water, and air [7].

Chlorine production also uses hazardous feedstocks of ethylene dichloride and vinyl chloride monomer that create many very persistent, very bioaccumulative, and toxic organochlorine by-products during synthesis. These include such hazardous substances as dioxins, chlorinated furans, polychlorinated dibenzofurans (PCB), hexachlorobenzene (HCB), and octachlorostyrene (OCS) [8].

PVC industrial processes beyond chlorine gas production utilise and produce a large swath of other hazardous substances. Heavy metal stabilisers including lead, cadmium, and organotins are used in PVC industrial processing [9]. CFCs and Carbon tetrachloride are known to destroy the ozone layer and are potent GHGs that are emitted during production, as well [10]. Phthalate plasticizers are used during the formulation and moulding process and are released in large quantities into the environment. Occupational exposure to very high concentrations of diethylhexyl phthalate (DEHP) during PVC production have been found in many biomonitoring studies [11] [12]. PVC workers with higher total urinary metabolites of DEHP have also been found to have higher aromatase activity and decreased sperm quality [13] [14]. Microplastics from PVC resins also pose many health and environmental hazards [15].

Use:
PVC is used in many different building materials such as pipes, flooring, siding, roofing, wall coverings, window frames and window treatments, gutters, carpeting, and more [16]. There is a growing body of scientific literature documenting the many adverse health and environmental outcomes associated with its use. PVC contributes to harmful indoor and outdoor air emissions – from chemical interactions and off-gassing, phthalates and heavy metals in suspended and settled dust, increased risk of mould growth, and unintentional burning. PVC plumbing and service lines have also been found to leach toxins into drinking water, in addition to allowing permeation of external contaminants from the nearby environment into water distribution systems [17].

Scientists have documented many adverse impacts of PVC materials on indoor environments. Multiple studies have shown that phthalate plasticizers and heavy metal stabilisers are released in indoor suspended and settled dust particles. These contaminants can be ingested, inhaled,or absorbed through the skin by occupants where PVC is present in building materials [18] [19]. Studies have also detected high levels of 2-Ethyl-1-hexanol (2E1H) released in indoor air, which is attributed to chemical interactions between adhesives and DEHP used PVC flooring [20] [21]. A 2008 systematic review and meta analysis found an increased odds of developing asthma and allergies in adults and children exposed to PVC indoors [22]. Infant and pregnant women's exposures to phthalates in household dust have also been investigated. Researchers observed an association between exposure to soft PVC flooring and significantly increased urinary levels of phthalate metabolites in both infants and pregnant women [23] [24].

Heavy metal release and mould pose additional environmental health implications for use of PVC building materials indoors. PVC wall coverings have been associated with increased mould growth due to its tendency to trap moisture, which is linked to many adverse health outcomes [25]. A recent study looked at the presence of heavy metals released from PVC microplastic and found potential bioaccessibility *in vitro* in the gastric and small intestinal phases [26].

PVC plumbing and service lines present other potential exposure risks. Drinking water distribution systems have been found to leach lead and other harmful chemicals into water during normal use and during extreme events like fires [27]. Volatile organic compounds and vinyl chloride have also been detected in drinking water, potentially exposing building occupants to harmful contaminants permeating through PVC plumbing [28]. In addition, wildfires have been reported to emit harmful contaminants into water and also put firefighters at increased risk of exposure to harmful airborne toxins released when PVC is heated and burned [29] [30].

Disposal:

There is no proven safe, sustainable method for PVC disposal or recycling, contributing to increasing, irreversible environmental contamination and health hazards. PVC is disposed of either in landfills or via incineration, both of which have deleterious effects on human health and environment. PVC mechanical and feedstock recycling, or rather downcycling, presents its own set of consequential health and environmental challenges, as well [31] [32].

Demolition and renovation waste contribute to substantial amounts of PVC ending up in landfills or being incinerated [33]. PVC also lasts decades in landfills, all the while leeching highly persistent, bioaccumulative toxins such as phthalates and heavy metals into soil and groundwater [34] [35]. PVC disposal poses a fire hazard, in addition to releasing harmful chemicals when incinerated. When burned, it emits dioxins, furans, and heavy metals [36] [37].

PVC recycled and reused in other consumer products also contributes to hazardous downcycling due to mixtures of different additives that when combined in the recycling process do not meet specifications and quality standards for certain PVC uses [38]. The hazards of downcycling have been well documented, including reintroducing harmful chemicals such as lead and cadmium into a wider range of consumer products. In addition, those hazardous chemicals that are not recycled, but rather captured during downcycling are then disposed of in landfills or incineration, creating additional harmful environmental emissions. Finally, downcycling has not been shown to reduce the amount of virgin PVC produced globally, but rather results in accumulation of more toxins in the environment [39].

Health hazards

While PVC is ubiquitous in the building sector, its life cycle is associated with harmful indoor and outdoor occupational and consumer exposures. Hazardous substances are directly released, leach into ground, surface, and drinking water, migrate into house dust, and are intentionally incinerated or accidentally burned in fires. Below is a list of health hazards associated with PVC use documented in the scientific literature [41]:

- Cancer (testicular, liver, and brain cancer)
- Disruption of the endocrine system
- Reproductive impairment
- Impaired child development and birth defects
- Neurotoxicity (damage to the brain or its function)
- Immune system suppression
- Respiratory irritant

Safer alternatives

The list of PVC building materials is quite extensive and highlights the urgent need for transition to safer alternatives. Healthy Buildings Network and Healthcare Without Harm put together a list of potential safer alternatives for building materials in hospital settings [42]. The Natural Resource Defense Council alongside many other environmental health and human rights organisations recommend copper as a safer alternative for water distribution systems, especially as lead pipes are being readily replaced [43]. These two examples alone provide evidence of existing safer alternatives and opportunities to minimise harm to human health and the environment.

For all of these reasons, HEAL strongly supports a restriction that mandates phase out of non-essential PVC production and incentivises safer replacements in the building sector. This restriction would prevent further harm from the many hazardous substances found in secondary materials and overall hazardous lifecycle emissions.

Resources:

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