CFFA COATED FABRICS & FILM ASSOCIATION, INC.
VINYL ROOFING DIVISION

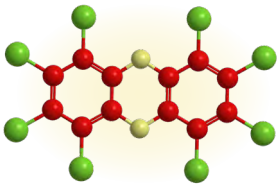
TECHNICAL BRIEF

The Truth about Dioxins and Furans and PVC Roofing

Background:

PVC has often been associated with dioxins and furans in public discussions, leading to questions about whether PVC roof membranes contain dioxins or furans or create unique health concerns. ***PVC roof membranes do not contain dioxins or furans, nor are installers exposed to these compounds during installation.*** *The Vinyl Roofing Division of the Coated Fabrics and Film Association has prepared this Technical Brief about how dioxins and furans are formed, where they may occur in relation to PVC production, and why these compounds are not ingredients in finished PVC roofing materials.*

What are Dioxins and Furans?



Dioxins and furans are a class of halogenated and oxygenated aromatic hydrocarbon type chemicals with similar chemical structures. The halogen types include chlorine, bromine, and fluorine. Detailed technical information about dioxins and furans is available from the U.S. Environmental Protection Agency (EPA).[i]

Why are Dioxins and Furans Associated with PVC?

Vinyl Production

Dioxins and furans are not intentionally manufactured for commercial use; they are mainly by-products of industrial processes and most combustion processes. Common sources can include pulp and paper processing, metal/steel processing, cement production, production of herbicides and pesticides, incineration of municipal, medical, and industrial wastes, combustion of fuels such as wood, diesel and heating oil, accidental building fires, landfill fires, and natural processes such as forest fires and volcanic eruptions.[ii]

A small amount of dioxin and furan is emitted to the air and water during the manufacture of PVC resin and its monomers. This is tightly regulated by US EPA standards, and PVC facilities comply with these standards through extensive control systems, regular compliance checks and annual reporting. Calculations by the Vinyl Institute estimate that the chlorvinyl chain was responsible for just under 7% of the regulated ambient emissions of dioxins and furans to air and water (Figure 1). This estimate is based on data from the U.S. EPA's 2024 toxic release inventory (TRI) that requires all regulated industries to report their annual toxic emissions according to the Emergency Planning and Community Right to Know Act and EPA's dioxin sources assessment in 2000.[iii]

Vinyl Production Emissions Performance: Dioxin in Perspective

(Chlor-Vinyl Dioxin Ambient Emissions amount to 6.8% of all 2024 regulated sources)

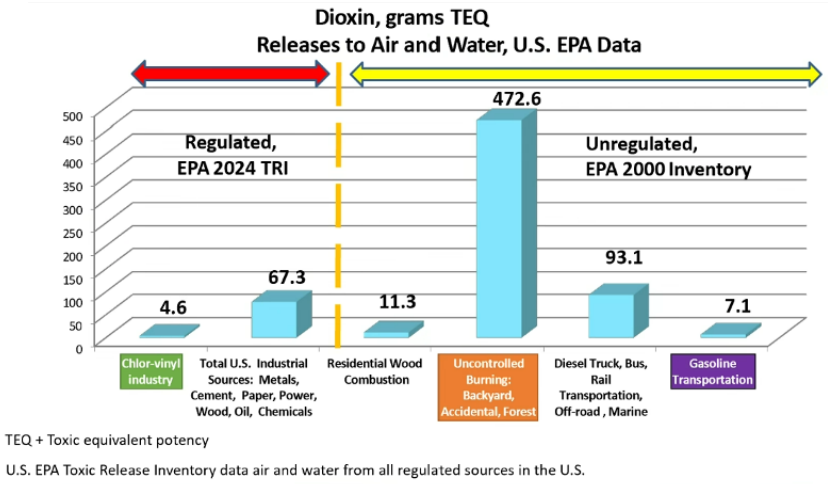


Figure 1: U.S. Dioxin Sources in Perspective - U.S. Dioxin Releases to Air and Water, grams TEQ, U.S. EPA 2024 TRI Data and 2000 Dioxin Inventory. (Courtesy of the U.S. Vinyl Institute).

U.S. EPA tightly regulates dioxin and furan emissions from industrial processes by using Maximum Achievable Control Technology (MACT) standards. Because of EPA's MACT standards, dioxin emissions from all industrial and commercial processes have been dramatically reduced over the past three decades. PVC producers, as well as all other plastics, petroleum refining, chemical, and all other major materials producers comply with MACT regulations, and all have achieved significant reductions of their dioxin emissions as a result. According to U.S. EPA TRI data the amount of dioxin created by chlor-vinyl production has decreased significantly over the past 25 years as depicted in Figure 2.[iv]

U.S. Chlor-Vinyl Production, Dioxin Ambient* Emissions

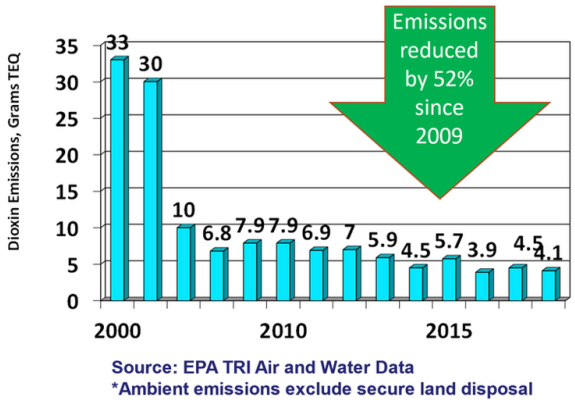


Figure 2: U.S. EPA TRI dioxin emissions to air and water from chlor-vinyl production (Courtesy of the U.S. Vinyl Institute).

Finished PVC Roof Membranes

PVC roof membranes do not contain dioxins or furans. Dioxins or furans are not present in PVC resin nor are they found in the other ingredients in the PVC compounds used, and are therefore not present in finished PVC roofing membranes. Likewise, because dioxins and furans are unlikely to be formed during the installation process, workers installing PVC roof membranes are not expected to be exposed to dioxins or furans during roof installation from PVC membranes. Questions about PVC roof membranes and dioxins or furans generally stem from two separate issues. The first is emissions that may occur during upstream vinyl resin production and the second is combustion byproducts that can be generated during accidental fires. Neither means that dioxins or furans are present in the finished roofing material.

For more information on how PVC/vinyl is made and what the vinyl industry is doing to continue to reduce production emissions, see the Vinyl Institute's *Modern Vinyl, Part 1, Responsible Vinyl Manufacturing* webinar.[v]

Is Chlorine Used in Other Roofing Ingredients or Products?

Chlorine is used to make many useful and lifesaving products such as clean drinking water and pharmaceuticals, and the role of chlorine should also be recognized in the manufacture of another important component of most single ply roof membranes. Titanium Dioxide (TiO_2) is a key ingredient for all reflective roofing membranes (PVC, TPO, white EPDM and white colored Modified Bitumen) and roof coatings. Most, if not all, TiO_2 used in roofing products relies on the chloride process to produce the high-quality TiO_2 needed for white roof membranes.

Also, chlorine is needed to make methylene diphenyl diisocyanate (MDI), a key precursor in making polyisocyanurate insulation, a widely specified and installed commercial roof insulation.

What Happens During an Accidental Fire?

Halogens must be present in the combustion process to yield dioxins and furans. Chlorine is a ubiquitous substance found in common table salt, foods and liquids containing salt, including salt water, many types of wood, and even plain old dirt (potassium chloride is a widely used soil nutrient). Because of the ubiquitous nature of chlorine and other halogens, low temperature combustion such as accidental fires, woodland burning and cropland renewal, backyard grilling, and recreational bonfires in firepits can also produce dioxins and furans under the right conditions.

The notion that certain materials like PVC produce toxic smoke byproducts while others do not is simply false. Burning of any combustible material (including any roofing material) produces a plethora of persistent bioaccumulative toxins, not just dioxins and furans. All smoke from any organic material combustion should be considered toxic in some form or another. The claim that burning PVC roof membranes creates toxic smoke ignores the reality that burning any roofing material has an equal propensity to produce toxic smoke.

Important additional byproducts of combustion that are normally not discussed are polyaromatic hydrocarbons (PAH) which are also formed simultaneously from practically all materials during these same accidental fires even when chlorine is not present. PAH are produced in significant quantities by the combustion processes described above. As such, PAH are ubiquitous and many PAH are classified as persistent, bioaccumulative toxins.[vi]

Comparing the safety data sheets of all major roof membrane technologies will confirm that any roofing material on fire is a hazard and smoke inhalation should be avoided.

Conclusion

PVC roof membranes do not contain dioxins or furans. These compounds are unintentional byproducts of certain industrial processes and combustion, not ingredients in finished PVC roofing materials. Emissions associated with vinyl production are tightly regulated and have declined substantially over time. During accidental fires, many combustible materials, including both PVC and non-PVC roofing materials, can generate hazardous combustion byproducts. As with any fire, smoke inhalation should be avoided. ■

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i U.S. Environmental Protection Agency (EPA). "Learn About Dioxin." https://19january2021snapshot.epa.gov/dioxin/learn-about-dioxin_.html

ii U.S. Environmental Protection Agency (EPA). "Common Sources of Exposure to Dioxin." https://19january2021snapshot.epa.gov/dioxin/learn-about-dioxin_.html

iii U.S. Environmental Protection Agency (EPA). *Toxics Release Inventory (TRI) Basic Data Files, Reporting Year 2024*, https://enviro.epa.gov/triexplorer/release_fac?P_VIEW=USFA&fld=&trilib=TRIQ1&TAB_RPT=1&sort=RE_TOLBY&Fedcode=&FLD=RELLBY&FLD=TSFDSP&sort_fmt=2&industry=ALL&STATE=All+states&COUNTY=All+counties&chemical=N150&YEAR=2024&TopN=All, and U.S. Environmental Protection Agency (EPA). An Inventory of Sources and Environmental Releases of Dioxin-Like Compounds in the United States for the Years 1987, 1995, and 2000. EPA/600/P-03/002F, 2006. https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100CINS.TXT

iv U.S. Environmental Protection Agency (EPA). *Toxics Release Inventory (TRI) Basic Data Files*, https://www.epa.gov/toxics-release-inventory-tri-program/tri-basic-data-files-calendar-years-1987-present

v Vinyl Institute. "Modern Vinyl Part 1: Responsible Vinyl Manufacturing." Modern Vinyl Town Hall. https://www.vinylinfo.org/modern-vinyl-town-hall/

vi National Toxicology Program (NTP). Report on Carcinogens, Fifteenth Edition: Profile – Polycyclic Aromatic Hydrocarbons. 2021. https://ntp.niehs.nih.gov/sites/default/files/ntp/roc/content/profiles/polycyclicaromatichydrocarbons.pdf