



VINYL'S HEALTH, SAFETY AND ENVIRONMENTAL PERFORMANCE
CHEMICAL FABRICS & FILM ASSOCIATION, INC.

WHY VINYL?

- Vinyl provides **lasting value** for the consumer or end-user – a high-quality, attractive product at an affordable price.
- Vinyl is also the **cost-effective** choice for the manufacturer who wants to provide the best quality product in the marketplace at a competitive price.
- It's not hard to keep vinyl looking like new, even after years of use – vinyl fabrics and film can be **easily cleaned** with no more than soap and water.
- It's also **durable** enough to withstand wear and tear, and resists scrapes, rips and other damage.
- Vinyl products can also be manufactured to provide a **barrier to stains**, and **resist mildew and mold** build-up.
- Vinyl is **easily processed** using a range of simple to advanced techniques to fit the requirements of literally hundreds of end-uses, making it a cost-effective and efficient material choice.
- Vinyl is **versatile** enough to simulate the look of leather or fabric, or to create an entirely new and innovative look.
- Vinyl as a material has inherent **fire-resistant** properties, promoting consumer safety and helping manufacturers meet regulations.
- Vinyl is an **eco-smart material choice**, because it's energy- and resource-efficient, recyclable and long-lasting.
- Vinyl can be manufactured to be **weather-resistant**, so it's appropriate for use in both indoor and outdoor applications.

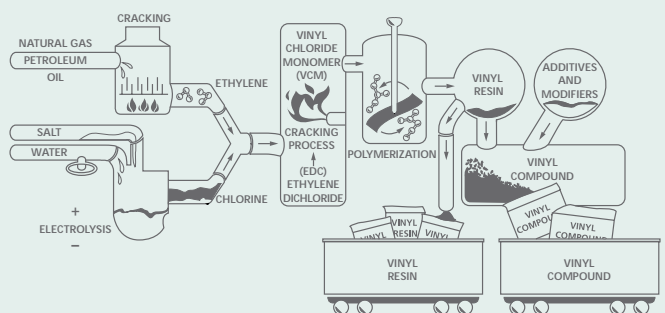
MANUFACTURING

How is vinyl manufactured?

Vinyl is manufactured through a chemical process that begins with basic saltwater, an abundant natural resource. Chlorine is derived from the saltwater and combined with ethylene, a petroleum-based product, to create ethylene dichloride (EDC). In a process called "cracking," the EDC is transformed into a gas called vinyl chloride monomer, or VCM. The next stage turns the monomer VCM into the polymer polyvinyl chloride, commonly known as PVC or vinyl.

At this point the material is referred to as vinyl "resin" and is a white powdery substance, solid and inert. Through a process called "compounding," vinyl resin is combined using heat with various additives and modifiers, such as plasticizers for flexibility, stabilizers for durability and pigments for

color. Vinyl owes its versatility and exceptional performance characteristics to this compounding process, because it allows manufacturers to customize the end product according to their unique needs. This diagram illustrates the vinyl manufacturing process:



Courtesy of The Geon Company

Chlorine is what gives
vinyl inherent fire-resistant
properties and makes
it highly economical and
easier to recycle.

Q&A Q&A Q&A Q&A Q&A

Does the vinyl manufacturing process have an impact on the local environment or on the health of workers and local residents?

Today, vinyl manufacturing is essentially a closed operation, which recycles virtually all waste back into the process and minimizes any potential emissions. The protection of the environment and of the health of workers and local residents is something the vinyl industry takes very seriously. U.S. vinyl manufacturers and manufacturers of vinyl film and sheet products have made a voluntary public commitment to the stringent codes of Responsible Care®, one of the broadest standards of environmental conduct governing any industry.

As a result of the industry's diligence, U.S. vinyl manufacturers have significantly lower worker injury/illness rates than the chemical industry average and a record of constant improvement in lowering emissions.¹ In fact, emissions of EDC have reduced 85 percent in 11 years, and emissions of VCM have decreased about 45 percent in that same span of time. All

of these improvements have occurred while vinyl production has been steadily increasing. Numerous independent studies, including those conducted by the national Centers for Disease Control, have consistently not identified any health risks from living near vinyl production facilities.² Likewise, the process for making vinyl compound into finished products meets all U.S. governmental health and safety standards, and does not harm the environment or the health and safety of workers.³

In the 1970s, the industry discovered that several workers who had been exposed to high levels of VCM for prolonged periods developed a rare form of liver cancer called angiosarcoma. Once this link was discovered, the vinyl industry acted to identify all routes of exposure quickly and voluntarily and to modify the manufacturing process.⁴ The result was the closed polymerization operation that is used today.

A global registry was established to track cases of angiosarcoma, and still exists today. No cases of angiosarcoma have been reported worldwide in vinyl industry workers who began work after these changes were implemented, and no cases have ever been found in residents living near vinyl production facilities.⁵

Some activist groups have been campaigning against chlorine. Is the use of chlorine in vinyl a problem?

Chlorine is a naturally occurring element that is essential to life. At least one international environmental group has an active campaign against chlorinated materials, and has actually advocated the elimination of chlorine as a stepping stone to its ultimate goal of eliminating the entire petrochemical industry.⁶ Not only is chlorine present in the human body and essential to life, but it is also used in ways that protect public health and safety and improve the

quality of life. Some good examples are pharmaceuticals, water purification and hundreds of different manufacturing operations that are based on chlorine chemistry. When used in vinyl, chlorine is inert and stable. Chlorine is what gives vinyl inherent fire-resistant properties and makes it highly economical and easier to recycle (because it acts as a "marker" for automated sorting equipment).

What is dioxin? Is the vinyl industry a source of dioxin emissions?

The general term "dioxin" is used to refer to a family of chemicals which includes polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). Dioxin is an unintended byproduct of incomplete combustion in the presence of chlorine. The identified sources of dioxin include incineration, forest fires, metal smelting, and certain industrial

processes involving chlorine and other organic compounds. Research has shown dioxin to be toxic and carcinogenic to animals, and the International Agency for Research on Cancer (IARC) has classified one PCDD called "2,3,7,8-TCDD" as a known human carcinogen.⁷

The U.S. Environmental Protection Agency (EPA) is in the process of conducting a complete review of current dioxin science, termed its "dioxin reassessment." When EPA embarked on this reassessment in 1991, the vinyl industry offered to voluntarily study its own emissions of dioxin, according to EPA protocols and under the guidance of an independent third-party panel of scientists. That research is now complete, and indicates that the vinyl manufacturing process is likely accountable for less than one percent (12 grams or about 0.01 pounds) of the approximately 3,000 grams (6.6 pounds) of dioxin that EPA estimates is emitted in the United States each year.⁸

Toys and medical devices "are safe and pose no harm to adults or children."

PRODUCT SAFETY

I've heard a lot of concerns about chemicals called phthalates leaching out of vinyl products like toys and medical products. Can you explain this?

Phthalates are one kind of plasticizer used in vinyl products to make them flexible. Because of the nature of the vinyl compound, the phthalates used in flexible vinyl products are locked in or tightly held in the finished product. Although it is possible for minute quantities of phthalate plasticizers to leach from vinyl products, study after study has shown that products containing phthalates do not pose a health hazard.⁹

This issue has received public attention recently as a result of a media campaign being led by some environmental groups. They have been successful in capturing attention worldwide despite the growing number of scientists declaring the safety of phthalate-plasticized vinyl products. Certainly the best endorsement of the safety of flexible vinyl products came from former Surgeon General



found supporting a hazard from toys made of vinyl even when sucked, there is certainly no danger from other vinyl products used around the home.¹¹

What other additives are used in your products? Are they safe?

The vinyl composite material used in vinyl-coated fabrics and substrates is manufactured as a complete article with individual additives such as stabilizers, colorants, processing aids and plasticizers included in the process formula. These materials and others are compounded with vinyl resin to form an inert composite that is stable and safe for its intended use.

Do vinyl products have any impact on indoor air quality?

Although flexible vinyl products used indoors – such as wall-covering – may have an initial characteristic odor or “new” smell, these odors dissipate quickly once they are removed from their original packaging. Overall, vinyl products used indoors have an inherently low potential for emissions and haven’t been shown to have a significant negative impact on indoor air quality.

How do vinyl products perform in a fire?

The chlorine used to make vinyl products gives them inherent fire-resistant properties. What’s

more, additives can be included in vinyl compounds to further enhance a product’s fire performance. These unique combinations of additives enable many vinyl products to meet even the most stringent flammability requirements. Vinyl sheet products manufactured with a textile reinforcement and proper retardants are often engineered to provide added fire retardancy.

Even when exposed to an open flame source, vinyl will resist ignition much longer than most materials, which could serve to slow or even stop the spread of a fire. If the flame source is removed, vinyl typically does not continue to burn. Even when a vinyl product does catch fire, the flames spread very slowly and produce comparatively little smoke.¹² A slow-burning material can provide those in danger additional time to escape.

Are there health concerns regarding gases emitted when vinyl products burn?

All fires generate gases, some of which can be toxic. When a building burns, the products

Dr. C. Everett Koop. Dr. Koop led an international panel of distinguished scientists and doctors who reviewed all of the current science on phthalates in vinyl toys and medical products and confirmed that flexible vinyl products are not a health hazard.¹⁰ In an editorial in *The Wall Street Journal*, Dr. Koop announced his conclusion that two types of phthalates used in toys and medical devices “are safe and pose no harm to adults or children.”

Do any other vinyl products contain phthalates? Are they safe?

All flexible vinyl products – including seating and upholstery, IV bags, wallcovering and flooring, just to name a few – contain plasticizers, but not all come from the phthalate family. The Chemical Manufacturers Association’s Phthalate Esters Panel has stated that flexible vinyl products do not pose health risks to children or adults when used properly. In fact, the U.S. Environmental Protection Agency (EPA), when asked if parents should try to keep infants and children from playing with or chewing on plastic objects, responded by saying, “At present, EPA does not believe the scientific evidence supports this recommendation.” Since no data have been

inside emit a wide range of gases, including carbon monoxide, carbon dioxide, phosgene, acrolein and hydrogen chloride, that can be toxic. But any firefighter will tell you that the greatest toxic hazard in any fire is carbon monoxide, which is produced in all fires. Although hydrogen chloride is created when vinyl burns, studies have consistently shown it is a virtually insignificant hazard in real fire situations.¹³ The vinyl industry has worked closely with many independent organizations such as the National Fire Protection Association to study the emissions created in fire situations, and has found consistently that fires involving vinyl are no more toxic than any other fire.¹⁴

So if vinyl is safe, why have some countries and companies chosen not to use it or specify it in certain applications?

There are a few localities in the world that have restricted the use of vinyl, and a few companies that have chosen to eliminate the use of vinyl in products they sell or manufacture. Instances of such restrictions or “deselections” are not common; in fact, it’s important to point out that both demand for and sales of vinyl are growing at record rates, in the United States and abroad. The growth in vinyl’s use is most striking in the developing world, where

vinyl’s durability and affordability play a major role in the continuous improvements to the standard of living there. Australia’s leading scientific research organization recently conducted a comprehensive analysis of vinyl’s environmental performance in building products and found it to be as good or better environmentally than alternatives.¹⁵ And several European countries and cities in recent years have rejected proposed restrictions on vinyl or rescinded earlier laws after conducting similar analyses.¹⁶

In most cases where vinyl has been deselected, those decisions have been made under pressure from environmental activist groups campaigning against vinyl, and typically without any scientific evaluation of vinyl’s safety. Conversely, when a government agency or company has conducted a thorough analysis of the available scientific data on vinyl’s safety, those organizations have typically decided against any restrictions on the material.¹⁷ In some cases, companies have replaced vinyl with other materials because of specific performance requirements. Some activists have interpreted these actions to suggest problems with vinyl that do not exist.

DISPOSAL ISSUES

Is it safe to landfill vinyl products?

When vinyl products are landfilled, they remain inert and do not degrade.¹⁸ Although some see biodegradability as an environmental benefit, that’s not always the case. Some products can release chemicals as they biodegrade, which can contaminate the groundwater. Vinyl products, however, remain inert in landfills. In fact, a recent study conducted in Europe analyzed the behavior of several vinyl products under landfill conditions and found no long-term degradation or hazardous releases.¹⁹ Perhaps the best anecdotal evidence of vinyl’s safety in a landfill is the fact that vinyl membrane liners have been used in landfills to contain leachate from other waste.

Is it safe to incinerate vinyl products?

Since incinerators have been identified as one of the largest sources of dioxin emissions, some activists have advocated the removal of vinyl products from the waste stream as a means to reduce dioxin from this source. But a landmark 1995 study showed clearly that taking such action would have no effect on emissions of dioxin. The American Society of Mechanical Engineers (ASME) analyzed more than 1,900 test results from 169 commercial

Vinyl meets the critical needs of an exploding world population by helping to provide durable and affordable housing, safe water transportation and much more.

Q&A Q&A Q&A Q&A Q&A

incinerators and came to a conclusion that there was no relationship between the amount of vinyl in the waste stream and the amount of dioxin emitted from the combustors. Instead, the ASME found that the key to controlling dioxin emissions was incinerator design and operating conditions, especially temperature.²⁰ U.S. EPA has established operating standards for incinerators that address these factors.

Are vinyl products recyclable?

Vinyl products are recyclable, and they are recycled on a regular basis, both during the manufacture of the finished product (post-industrial) and after consumer use (post-consumer). In fact, vinyl products are especially conducive to recycling because they can be reprocessed using heat with little or no loss of properties. It's very common for vinyl product

manufacturers to simply regrind off-cuttings or off-spec products and recycle them back into the process, creating very little waste. In fact, a recent study sponsored by the Vinyl Institute found that of the 17 billion pounds of vinyl manufactured each year, more than 99 percent ends up in a finished product.²¹

SUSTAINABILITY

What is sustainability? Is vinyl a sustainable material?

Although sustainability can be defined in many different ways, perhaps the best definition comes from the President's Council on Sustainable Development – "meeting the needs of the present while ensuring that future generations have the same opportunities." In practice, sustainability may

take any number of forms – diligent reuse and recycling, optimized manufacturing practices and using renewable resources, just to name a few.

The vinyl industry strongly supports the concept of a "sustainable" future and is committed to doing its part to ensure that the needs of future generations are met. The industry believes that vinyl is a sustainable product because it is recyclable, energy- and resource-efficient to manufacture and a low consumer of non-renewable resources. Perhaps most importantly, vinyl meets the critical needs of an exploding world population by helping to provide durable and affordable housing, safe water transportation, quality health care, and much more.

- 1 "Performance Report for the Vinyl Industry," Second Edition, The Vinyl Institute, 1999
- 2 Numerous studies, including J. Brady et al, "Morbidity, Mortality Weekly Report," Centers for Disease Control, 1976
- 3 "Performance Report for the Vinyl Industry"
- 4 Ibid.
- 5 Ibid.
- 6 Greenpeace International Toxics Campaign website, <www.greenpeace.org>
- 7 D.B. McGregor, C. Partensky, J. Wilbourn, and J.M. Rice, An IARC evaluation of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans as risk factors in human carcinogenesis. Environmental Health Perspectives, 106, 755-760, 1998
- 8 W. F. Carroll, Jr., T.C. Berger, F. E. Borrelli, R. A. Jacobs, J. Ledvina, J. W. Lewis, R. L. McCreedy, T.P. Smith, D.R. Tuhovak, and A. F. Weston, "Characterization of Emissions of Dioxins and Furans from Ethylene Dichloride (EDC), Vinyl Chloride (VCM) and Polyvinyl Chloride (PVC) Facilities in the United States. IV. Consolidated Report," The Vinyl Institute, 1999
- 9 Chemical Manufacturers Association (CMA), Phthalate Esters Panel
- 10 C. Everett Koop et al, "A Scientific Evaluation of Health Effects of Two Plasticizers Used in Medical Devices and Toys: A Report from the American Council on Science and Health," 1999
- 11 CMA Phthalate Esters Panel, European Council for Plasticizers and Intermediates (ECP)
- 12 "Fire and Polyvinyl Chloride," The Vinyl Institute, 1996
- 13 Ibid.
- 14 Ibid.
- 15 "The Environmental Aspects of the Use of PVC in Building Products," Commonwealth Scientific and Industrial Research Organization (CSIRO), Second Edition, 1998
- 16 "Rumor vs. Reality: Vinyl's Legislative Status in Europe," The Vinyl Institute, 1998
- 17 Ibid.
- 18 "Vinyl is a Small, Manageable Part of the Solid Waste Stream," The Vinyl Institute, 1996
- 19 "Long-Term Behaviour of PVC Products Under Soil-Buried and Landfill Conditions," I. Mersiowski and R. Stegmann, Technical University of Hamburg-Harburg, Germany, and J. Ejlertsson, Linköping University, Sweden, 1999
- 20 Prepared by H.G. Rigo, A.J. Chandler and W. Steven Lanier, "The Relationship Between Chlorine in Waste Streams and Dioxin Emissions from Combustors," The American Society of Mechanical Engineers.
- 21 "Post-Industrial and Post-Consumer Vinyl Reclaim: Material Flow and Uses in North America," Principia Partners, December 1998