

Quick reference

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For over fifty years vinyl has provided simple solutions to complex problems. This guide explains the valuable properties associated with this remarkable material.

To learn more, visit us at www.vinylinfo.org

VERSATILE

Form and appearance

Vinyl is the world's most versatile plastic, found in everything from blood bags to flooring. It can be molded, extruded, calendered, and processed in other ways or used as a coating. Depending on the additives used, vinyl can be processed to have a wide array of characteristics:

- Rigid, flexible or semi-liquid
- Thick or thin
- Clear or opaque—in almost any color

Function

Because of its versatility, vinyl has myriad uses in a wide range of industries:

- Building and construction
- Healthcare
- Automobile, appliance, electronics parts
- Packaging
- Upholstery
- Wire and cable insulation
- Consumer products

VERSATILE

RECYCLABLE

Even after a useful lifetime of decades, vinyl products can be recycled into new applications. Companies making carpet, roofing, siding, flooring, pipe and other vinyl products are expanding or exploring recycling programs.

Post-industrial

The scrap and trim recycled from vinyl manufacturing and fabrication adds up to more than 1 billion pounds per year. Vinyl's ability to be recycled back into like products and cross-cycled into different products translates into landfill avoidance.

- Post-industrial recycled vinyl is in such demand that its price is indexed in leading plastic industry publications
- Scrap vinyl is recycled into a variety of products: floor tiles and mats, garden hoses, fencing, automotive sound deadening applications, building and construction profiles, pipe, boots, notebook covers, and traffic cones

Post-consumer

Tens of millions of pounds of post-consumer vinyl are recycled annually. A tremendous additional amount of post-consumer material is not yet available for recycling because it is still in service as pipe, siding, and other products that last decades.

- With a history of providing financial and technical support, the Vinyl Institute is helping to develop a nationwide vinyl recycling infrastructure
- Take-back programs are growing in popularity in many vinyl product areas, including vinyl-backed carpeting, roofing, siding, floor coverings, wall coverings, and pipe

RECYCLABLE

INNOVATIVE

Processes

Since it debuted decades ago, vinyl has continued to evolve. Changing with the times, the vinyl industry has made many improvements in key areas such as:

- **Safety**—workers in companies that make vinyl resin (pure PVC) have a low illness and injury rate as a result of the emphasis placed on employee safety. According to industry data reported to the U.S. government, the illness/injury rate for vinyl manufacturing is 1/3rd that of the chemical industry, and 1/6th that of manufacturing overall.
- **Recycling begins in the manufacture of PVC resin (pure PVC), where materials not converted into vinyl the first time through are recycled back into the process. Also, vinyl is a thermoplastic, meaning it can be chopped, melted and reprocessed over and over.**
- **At least 1 billion pounds of vinyl is recycled at the post-industrial level (that is, manufacturing scrap and trim).**
- **Tens of millions of pounds of post-consumer vinyl are recycled each year, and this effort is growing as companies explore new and better ways to recover products at the end of their lives.**

Applications

Vinyl is used in numerous industries—construction, healthcare, packaging, and automotive, to name just a few. But what is particularly exciting about this material is that new ways to use it are continually being discovered.

Vinyl is often chosen for pioneering architectural projects, as well as internationally recognized art installations such as The Gates® installed in Central Park in 2005 by Christo and his wife Jeanne-Claude.

INNOVATIVE

ECONOMICAL

Vinyl has become one of the most widely used materials in part because of its cost efficiencies. In fact, it consistently scores better than other materials in many economic and performance categories.

Production

Vinyl is based on commonly available raw materials.

- Pure vinyl is 57% chlorine, derived from common salt—an abundant and inexpensive resource
- Pure vinyl is 43% ethylene, which in the US is usually derived from plentiful natural gas

Distribution

Vinyl is lighter to transport than many conventional building materials, reducing the amount of fuel and other resources used for such transportation.

Installation and function

Using low-maintenance, lightweight and long-lasting vinyl products for building and construction can translate into savings on other materials and labor.

- Products like vinyl siding and fencing don't require the use of paint, stain, or harsh cleansers. Similarly, there is no need for asphalt, tar, or other such materials with vinyl roofing.
- Lightweight PVC pipe is cut and installed more quickly than pipe of traditional materials. It is also less likely to corrode or leak than traditional pipe. This translates into savings on repairs and replacement of parts.

Disposal

Most vinyl products have long lifespans. Once they are no longer usable, these products can be recycled if local collection and sorting operations are available or disposed of safely.

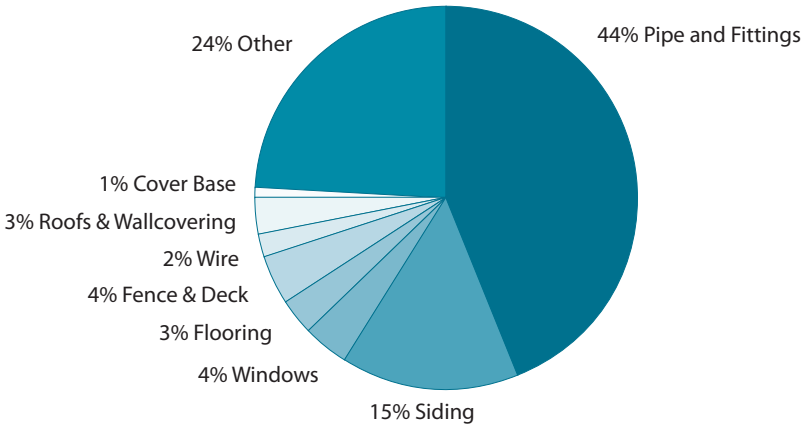
- Post-industrial and post-consumer vinyl is highly recyclable
- "Take-back" programs are being used successfully to recycle increasing amounts of vinyl cost-effectively into new products
- Like other materials used in consumer products, at the end of its life vinyl can be landfilled, or it can be incinerated in modern waste-to-energy facilities and its energy recaptured and reused

ECONOMICAL

DURABLE

Building and construction

Because of its durability and versatility, vinyl has found use in numerous building applications. In fact, approximately three-fourths of all PVC goes to these applications. Not only is vinyl long-lasting, it's resistant to rot and corrosion, leaks and breaks.



Affordability

PVC products provide durability, energy efficiency and other benefits at an affordable price.

- Vinyl products annually save North American consumers an estimated \$20 billion in direct/indirect costs compared to using competing materials

Low-maintenance

For many vinyl products, durability also means low-maintenance—a benefit that reduces material usage and labor.

- PVC pipes do not rust or corrode and break infrequently
- Vinyl building products like siding and fencing don't require the use of paint, stain, or harsh cleansers as many wood and fiber cement products do on a regular basis

DURABLE

EFFICIENT

Energy efficiency

Vinyl takes less energy to produce, pound for pound, than many competing materials, including other major plastics. Its principal raw material is chlorine derived from common salt—an abundant and inexpensive resource—which displaces a significant amount of fossil fuel that would otherwise be required.

- Vinyl saves more than 34 million BTUs per 1,000 pounds manufactured compared to the highest energy-consuming plastic
- PVC building products are highly energy-efficient

Thermal efficiency

Vinyl has low thermal conductivity, so finished products like vinyl window frames reduce heat exchange. Also, vinyl frames are chambered, using the insulating properties of air to help insulate. White vinyl roofing membranes are excellent heat reflectors that reduce the burden on air conditioning systems.

Water efficiency

PVC pipes are less prone to breaks and failures than pipes of traditional materials, so it's no wonder they continue to be used for our water and sewage systems. Because PVC pipes do not rust or corrode, they save precious water resources. Because they resist internal pipe-wall buildup, they also require less energy to pump water through than pipes made from traditional materials.

- Every year, 2.6 trillion gallons of treated water are lost because of leaks in corroded metal and concrete pipes
- In a major study comparing break rates of pipe materials, vinyl water distribution pipe had on average 0.5 per 100 km (62 miles), versus 32.6 for cast iron and 7.9 for ductile iron

Reduced material use

Advances in vinyl formulations have made today's vinyl products durable, low-maintenance, and lightweight, all which translate into reduced use of other materials.

- Vinyl building products like siding and fencing don't require the use of paint, stain, or harsh cleansers, unlike most wood products that need these treatments on a regular basis
- Vinyl roofing is highly conformable to a roof's shape and eliminates the need for asphalt, tar, and other materials used in built-up roofing
- Vinyl pipe is lighter to transport than traditional pipe materials, saves time in cutting and installation, and lasts longer because it does not corrode or rust

Efficient products

PVC building products have numerous energy and environmental benefits. Since the late 1980s, more than 20 life-cycle evaluations have been completed on PVC building products, many of them comparing those products to ones made of other materials. PVC products were found to perform favorably in terms of energy efficiency, thermal-insulating value, low contribution to greenhouse gases, and product durability.

- Vinyl windows and doors conserve energy. For example, air chambers in the frame of vinyl windows resist heat transfer
- Some vinyl frames and sash corners are fusion-welded for added strength and protection against air and water infiltration
- Many vinyl windows, glass doors, and roofing membranes have received EnergyStar® ratings
- Because vinyl roofing membranes typically are light in color, their "reflective" roof surfaces help structures to stay cool and reduce energy use for air conditioning

EFFICIENT

SAFE

Fire retardance

Vinyl's chemical makeup gives it excellent fire properties. Rigid vinyl building products are slow to ignite, have slow flame spread, and cease to burn after the flame source is removed. Flexible vinyl building products may contain plasticizers, which are flammable, but most resist burning either because the amounts of plasticizer are sufficiently low or because the materials also contain additional fire retardants.

Fire toxicity

The byproducts of vinyl combustion are no more hazardous than those produced by burning many other common materials, both natural and synthetic.

Hydrogen chloride (HCl)

HCl is a byproduct of burning vinyl, but it does not incapacitate or become dangerous until it reaches concentrations far higher than those that have been measured in actual fires. HCl air concentration declines rapidly in fires as it adheres to surfaces. Because it is an irritant with a pungent odor, HCl can serve as a warning to evacuate. Since the 1970s, while the production of vinyl and the use of vinyl building products have increased, fire incidence and deaths have steadily declined.

Dioxin from Accidental Fires

Systematic investigations of large-scale accidental fires in Germany, Sweden, and Canada have indicated that dioxins will be produced in such fires whether vinyl is present or not, and that the quantities produced pose no threat to human health or to the environment. Individuals most exposed to fire gases showed low blood-dioxin levels.

Electrical applications

Unlike metal tubing, vinyl conduit will not arc or short, thereby reducing the hazard of fires in electrical applications. Vinyl's flexibility and resistance to breakdown under high electrical voltage make it the leading material for wire and cable insulation.

- Vinyl is one of few materials that meet the stringent National Fire Protection Association (NFPA) requirements for insulating electrical and data transmission cables, even in plenum applications

Incineration

Vinyl can be safely incinerated and its energy recaptured and reused. A large-scale study of combustion facilities by the American Society of Mechanical Engineers found no link between the chlorine content of incoming wastes and the amount of dioxin emitted. Instead, the study found, the operating conditions of combustors are the critical factor in dioxin generation. Other scientific studies confirm this conclusion. Most important, governments around the world that regulate incinerators to control dioxin emissions do so by specifying performance, not by prohibiting vinyl.

Chlorine

Vinyl won't harm the atmosphere. Once chlorine is processed into vinyl, it is chemically locked into the product more tightly than it was in the salt that it came from. When vinyl is recycled or landfilled, chlorine gas and hydrochloric acid (HCl) are not released into the atmosphere.

Plasticizers, stabilizers, and other vinyl additives

Because of vinyl's physical nature, additives such as plasticizers, stabilizers and antioxidants are tightly held in the fabricated product, limiting the potential for human contact or release into the environment. Concerns in recent years regarding exposure to phthalate plasticizers have led to restrictions on their use in toys and childcare articles despite the fact that consumer and health agencies have not found actual harm from exposure to them. Alternative plasticizers developed and tested by several companies are now being used in a number of such vinyl products. The accumulated scientific data from years of research into this issue suggest that phthalates do not pose a threat to human health or well-being.

- Vinyl additives have been studied closely by independent scientists, the federal government, and industry and used safely for more than 50 years

Infection control

Vinyl healthcare products are trusted when lives are on the line. For decades, vinyl products such as flooring, wallcovering, and cove base have proven their value in healthcare facilities by providing durable, tightly sealed and easy-to-clean surfaces that help reduce the spread of pathogens and maintain a sterile environment. Vinyl does double-duty in healthcare: it is also a material of choice for critical-care medical products such as blood bags and tubing, offering clarity, kink resistance, toughness, the ability to be frozen or steam-sterilized and other benefits.

- Mildew-resistant wallcoverings discourage moisture accumulation associated with microbial growth

SAFE

RESPONSIBLE

Life cycle assessment (LCA)

Many experts agree that to truly understand a product's environmental impact, its entire life cycle should be evaluated. This is known as LCA.

Environmental effects associated with a product's manufacture and disposal can be counterbalanced over time by a long, beneficial, low-impact life. For example, impacts associated with the production of vinyl building products such as windows, roofing, and cladding are far outweighed by decades of energy-saving benefits.

- Vinyl products perform favorably in terms of energy efficiency, thermal-insulating value, low contribution to greenhouse gases, low maintenance, and product durability
- Recent life-cycle studies show the health and environmental impacts of vinyl building products generally are comparable to—and can be less than—the impacts of alternatives

Worker safety

In the early 1970's, doctors at a company making vinyl chloride monomer (VCM), an intermediate material in vinyl production, noticed several cases of a rare form of liver cancer among certain employees, and took action to report this in the medical literature. Within two years, the U.S. Occupational Safety and Health Administration (OSHA) issued regulations reducing workplace exposure, and the entire vinyl industry completely re-engineered its production operations to create an essentially closed-loop system, minimizing worker exposure.

- There have been no documented cases of this cancer among vinyl workers whose careers began after the changes took effect, or in other vinyl workers who make compound or finished products

Vinyl chloride monomer (VCM)

The industry's vinyl chloride monomer (VCM) emissions have been reduced by more than 99% since the 1970s. Moreover, there is no confirmed case on record in which a member of the general population has been harmed by exposure to VCM. No other confirmed community health effects have been linked to the presence of vinyl or VCM production facilities. VCM breaks down quickly when exposed to sunlight.

Dioxin

Vinyl is an extremely small source of dioxin, so small that levels in the environment would be essentially unchanged even if vinyl were not being manufactured and used every day in important products. The vinyl industry has studied and worked to reduce its contribution to dioxin. In fact, vinyl manufacturing sources emit only a few grams of dioxin per year. Other dioxin sources include forest and agricultural burning, volcanoes, burning wood in fireplaces, exhaust from diesel-powered vehicles, and manufacture of other building materials. Overall dioxin levels in the environment have been declining for more than 40 years, according to data from the U.S. Environmental Protection Agency (EPA). During this time, production and use of vinyl have more than tripled. According to the EPA:

- Dioxin emissions from industrial sources in the United States have decreased by more than 90% since 1987

Indoor air quality (IAQ)

Properly installed vinyl products have no adverse impact on IAQ, and the small amount of volatile organic compounds (VOCs) emitted will dissipate quickly through normal ventilation. Tests have shown that the initial odor of vinyl wallcoverings dissipates much faster than odors from most paints. Vinyl products are able to meet low VOC requirements in standards such as FloorScore®, Green Label Plus, and GREENGUARD.

IAQ can be affected by biological factors as well. Vinyl products such as flooring and wallcovering are easy to clean and maintain, thus helping healthcare facilities reduce the spread of pathogens.

For hot and humid climates, manufacturers have developed innovative products such as mildew-resistant wallcovering or "microvented" wallcovering that discourage condensation and the creation of moist conditions associated with mold from forming inside walls.

Recycling

Millions of pounds of post-consumer vinyl are recycled each year, and some one billion pounds or more are recycled at the post-industrial level (for example, scrap and trim from manufacturing). Many finished vinyl building and construction products contain some amount of recycled content.

The vinyl industry has a history of supporting recycling, and this effort continues as companies, alone and through their trade associations, expand existing programs and explore new opportunities to recover vinyl products at the end of their useful life. Product take-back programs are one example, where used products can be returned to the manufacturer to be recycled into the same product for another useful life.

Landfill Avoidance

Vinyl products are highly resistant to the corrosive conditions found in many landfills. In fact, vinyl is used to make landfill liners and caps because it is so stable.

- Vinyl accounts for less than 0.6% of landfilled waste by weight
- Because it is predominantly used for long-life applications, less vinyl goes to landfills each year than other widely used plastics used in short-term applications

RESPONSIBLE

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1737 King Street, Suite 390
Alexandria, VA 22314
phone 571.970.3400
fax 571.970.3271
www.vinylinfo.org

Vinyl In Design
www.vinylindesign.com

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www.achievegreen.net