trusted

tested

every day

ENVIRONMENTAL PROFILE:

VINYL ROOFING MEMBRANES

WE'VE DEVELOPED THIS BROCHURE TO PRESENT THE MOST RECENT AND RELIABLE SCIENTIFIC DATA IN RESPONSE TO QUESTIONS ABOUT THE HEALTH AND SAFETY OF PRODUCTS MADE WITH VINYL, AND TO PROVIDE BACKGROUND ABOUT THE VINYL INDUSTRY'S 40-YEAR TRACK RECORD OF COMMITMENT TO PROTECT PUBLIC HEALTH AND THE ENVIRONMENT. FOLLOWING ARE JUST A FEW OF THE MYRIAD, COST-EFFECTIVE USES OF VINYL IN EVERYDAY LIFE.

As the material of choice for blood bags and tubing, vinyl helps to maintain the world's blood supply and supports critical healthcare procedures such as dialysis. As a packaging material, vinyl helps to keep food safe and fresh during transportation and on store shelves, and it provides tamper-resistance for food, pharmaceuticals and other products. Because it will not rust or corrode, vinyl is widely used in water pipes to deliver clean, safe-to-drink water and in sewer pipes to ensure the integrity of wastewater handling systems. Vinyl's resistance to breakdown under high electrical voltage and its ability to bend without cracking make it the leading material for wire and cable insulation. Vinyl's toughness and durability make it the most widely used plastic for building and construction applications such as roofing, siding, windows, fencing, decking, wallcoverings, wall protection and base, and floor covering.

reliable

What is vinyl and where does it come from?

Vinyl is essentially derived from two simple ingredients: fossil fuel and salt. Petroleum or natural gas is processed to make ethylene, and salt is subjected to electrolysis to separate out the natural element chlorine. Ethylene and chlorine are combined to produce ethylene dichloride (EDC), which is further processed into a gas called vinyl chloride monomer (VCM). In the next step, known as polymerization, the VCM molecule forms chains, converting the gas into a fine, white powder – vinyl resin – which becomes the basis for the final process, compounding. In compounding, vinyl resin may be blended with additives such as plasticizers for flexibility, stabilizers for durability and pigments for color. Through various plastics processing operations, manufacturers are able to offer versatile products with customized performance characteristics.

A failing low-pitch shingle roof system on three elementary schools joined by a central rotunda in Plano, Texas, was replaced with the leak-tight security of hot-air-welded vinyl. The light gray reflective membrane formed tight seals around the rotunda's complex curvatures, and rib-like extruded profiles were adhered to replicate the appearance of standing seam metal.

Is the process for manufacturing vinyl and single-ply vinyl roofing membranes safe for workers, the environment and the surrounding community?

Yes. The vinyl production process is extensively regulated by federal and state governments, and is essentially enclosed and computer-controlled, to safeguard the health of industry workers, people living near vinyl manufacturing facilities, and the environment. In addition, North American vinyl resin manufacturers have made a voluntary public commitment to achieve the goals of the chemical industry's Responsible Care® program (www.americanchemistry.com), one of the most comprehensive and conscientious standards of health, safety and environmental conduct created by any industry.

Workplace exposures to VCM are regulated by the U.S. Occupational Safety and Health Administration (OSHA), and air and water emissions associated with the vinyl manufacturing process are regulated by the U.S. Environmental Protection Agency (EPA). In 2002, EPA reviewed the standards applicable to the vinyl industry and determined that compliance with current emission standards reflects "maximum achievable control technology" as mandated in 1990 by the Clean Air Act.

To produce vinyl roofing membranes, manufacturers mix vinyl resin in powder form together with additives to make long, wide sheets that are shipped in large rolls. These processes also must be operated according to state, federal and industry safety standards.

Is the production and use of chlorine in vinyl roofing membranes safe?

Yes. The men and women who work in the high-tech facilities where chlorine is produced from common salt are highly trained and required to practice safety rules. Vinyl roofing products are made with a very stable form of chlorine that is chemically different from the elemental form. No chlorine is emitted from the finished product.

Chlorine is a naturally occurring element that is essential to life and also is used in ways that protect public health and safety and improve the quality of life. For example, 85 percent of all pharmaceuticals contain chlorine or are manufactured using chlorine chemistry. Chlorine is essential to making vinyl what it is – one of the most durable materials in use today, reducing the need to dispose of and replace products.

Is the installation of vinyl roofing membranes safe for workers and building occupants?

Yes. Adherence to a manufacturer's recommended installation guidelines provides the necessary safeguards for both installers and building occupants.

Vinyl roofing membranes can be installed to the roof deck or substrate with fasteners or adhesives, or loose laid in green roofs and plaza decks using pavers. Vinyl roofing adhesives are available that comply with regulations in all air pollution control districts in California, including SCAQMD Rule 1168 and the California Air Resources Board (CARB) model regulation.

The seams of vinyl roofing systems are welded together with hot air. No solvent wiping or solvent-based adhesives are required for the seaming as with alternative roofing systems. No torches, open flames or kettles are needed as with some other roof systems.

A National Institute for Occupational Safety and Health (NIOSH) study conducted on behalf of the United Union of Roofers, Waterproofers, and Allied Workers in Baltimore, Md., found no health hazards from exposure to hydrogen chloride during the hot-air welding of seams during roofing.[1]

performance

How do vinyl roofing membranes behave in accidental fires?

Vinyl has excellent fire performance qualities. Vinyl building products are based on a naturally fire retardant polymer, and vinyl roofing membranes often contain additional flame retardants, which generally means they are slow to catch or spread fire. In the U.S., vinyl roofing systems are available with Underwriter Laboratories Class A fire ratings and Factory Mutual Class 1 approvals.

ASTM E-108, "Standard Test Methods for Fire Tests of Roof Coverings," is the standard test method for evaluating exterior flame spread of all roof coverings. A simple vertical fire test can reveal how vinyl roofing membranes tend to self-extinguish when the flame source is removed, whereas alternative membranes often support fire even after the source is removed. For direct comparisons of the fire performance of given materials or products, individual suppliers should be contacted for testing results.

Vinyl roofing membranes also are lightweight – about a third of a pound per square foot of membrane – and thus a small component of a building in the context of smoke development. The smoke produced in a roof fire typically is external to the building.

Certain vinyl formulations are able to meet the stringent requirements of the National Electrical Code of the National Fire Protection Association for insulating electrical cords and wires and data transmission cables, even in plenum applications.

The vinyl industry and third-party organizations have conducted research on the combustion toxicity of vinyl products. The contribution of the combustion products from vinyl roofing products to the overall toxic threat of fires containing many types of combustibles is insignificant.

Most fire scientists recognize that the largest hazard in a fire is carbon monoxide (CO), an odorless asphyxiant gas produced in abundance by all organic materials, natural and synthetic.[2 3] The mix of gases produced when vinyl products burn, including hydrogen chloride (HCl), is very similar in terms of combustion toxicity to those of other common building materials when they burn. HCl, an irritant gas having a pungent odor, is detectable in very small quantities long before it reaches a dangerous concentration. An argument can be made that HCl can act as an early warning that there is a fire, and alert occupants to evacuate. HCl is unique in that its concentration in the air decreases rapidly when it reacts with humidity and most construction surfaces, like cement block, ceiling tile and gypsum board.[4 5 6 7 8]

The U.S. fire death rate is decreasing, dropping from a rate of 76 per million in the 1940s to 15 per million in the 1990s (during which time vinyl and other plastics had achieved dominant market share in numerous applications). This downward trend can be attributed in large part to improved building codes, as well as the broader use of sprinkler systems and smoke detectors. However, the increased use of more fire-retardant materials – like vinyl – deserves part of the credit for this improvement.

Is there cause for concern when vinyl membranes burn due to the formation of dioxin?

Normal use of vinyl roofing products does not pose a threat from dioxin exposure.

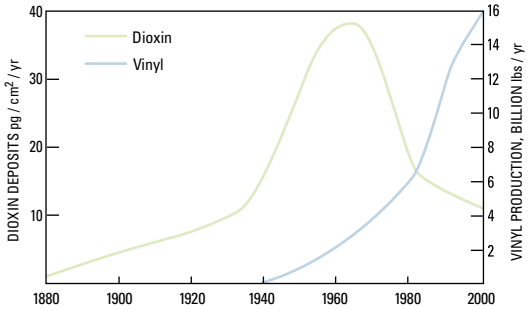
Dioxin is not produced intentionally; it is a byproduct of natural events like forest fires, lightning and volcanoes, as well as human activity such as burning wood and backyard trash, diesel vehicle emissions and various manufacturing processes. Dioxin can be produced when almost anything burns. This is because chlorine, a component of dioxin, is found in almost all organic (flammable) material. There is no relationship between manufacturing or use of vinyl products

Watertight, UL-listed vinyl membrane was selected to protect the structural and historical integrity of Washington, D.C.'s Union Station. Rehabilitation of the arching barrel roof without ruining the priceless suspended plaster ceiling underneath or old cement falling on the shoppers and travelers below were key requirements.

integrity

and dioxin levels in the environment. In the past 30 years, dioxin levels in the environment have sharply and steadily declined **while production of vinyl has more than tripled.**

Dioxin declining as vinyl production rises



EPA attributes the dramatic declines in dioxin emissions to regulations and voluntary industry actions. Incinerators are a good case in point. Studies consistently show that dioxin emissions from waste incinerators are primarily the result of how things are burned, not what is burned.[9] Regulations have improved how incinerators operate, resulting in reduced dioxin generation.

EPA has stated that its "best estimates of emissions from sources that can be reasonably quantified indicate that dioxin emissions in the United States decreased by about 80% between 1987 and 1995, primarily due to reductions in air emissions from municipal and medical waste incinerators, and substantial further declines continue to be documented."[10] As of 2004, EPA estimates dioxin emissions will be down more than 90 percent from 1987 levels, which were some two-thirds below 1960-70 levels.

Emissions from vinyl production are a small fraction of total emissions. Sources of greater dioxin emissions than vinyl manufacturing include backyard trash burning (the largest source), fireplaces, coal-burning utilities, vehicle emissions and metal smelting. Go to www.epa.gov/ncea/pdfs/dioxin/part3/chapter1-6.pdf for more from EPA on dioxin sources.

Are the additives used in vinyl roofing membranes safe?

Yes. When used properly, these additives pose no hazard to manufacturing workers, roofing installers or others who come into contact with a vinyl roofing membrane.

Are plasticizers a health issue?

Independent scientists, international governmental bodies and phthalate producers have conducted extensive studies on the safety of phthalates – the plasticizers used to make vinyl flexible. In more than 40 years of study and use, phthalates have never been shown to cause harm to humans from their normal, intended use.

Asthma is a growing concern today, and extensive research is being conducted on its possible causes. The Institute of Medicine (IOM) of the National Academy of Sciences has reviewed the research on possible sources (including phthalates), and phthalate plasticizers are not on IOM's list of more than a dozen chemical and biological agents to which exposure was found to be associated with asthma.[11]

EPA does not list phthalates as persistent, bioaccumulative, toxic (PBT) substances.

Phthalate-plasticized vinyl is the material of choice for many medical products – such as blood bags and tubing – regulated by the U.S. Food and Drug Administration. The U.S. Consumer Product Safety Commission has studied the use of phthalates in vinyl toys and found no demonstrated health risk.[12] On this basis, the Commission in February 2003

Restoring the original, cosmetically critical roof of Times Square's Candler Building called for a highly weather- and pollution-resistant material that could simulate a batten seam copper roof and offer a long service life. A custom turquoise vinyl membrane provides both the aesthetics and the performance the project demanded.

resistant

denied a petition to ban vinyl children's products.[13] And, the safety of medical devices and toys made of flexible vinyl was further affirmed by a blue-ribbon panel headed by former Surgeon General C. Everett Koop.[14] A list of published or presented research is available at www.phthalates.org/resources/index.html.

Are there any restrictions to disposing of vinyl in landfills?

No. In fact, landfills are often lined or capped with vinyl membranes to protect groundwater. This is because the vinyl sheets are long lasting and virtually inert. And because they consist of a single ply and are lightweight, vinyl roof membranes, if disposed of in landfills, will take up far less space compared to multi-layered built-up roofs.

Can vinyl roofing membranes be recycled?

Vinyl can be reprocessed and recycled repeatedly. During manufacturing of vinyl roofing, scraps are routinely recycled directly back into the process or into accessory products such as roof walkway pads, making it a material-efficient operation. This can result in nearly zero waste from manufacturing.

Because vinyl roofing membranes have a long service life, many are not available for post-consumer recycling. Nevertheless, there are several specific building refurbishment projects in the U.S. where post-consumer vinyl roofs have been recovered and recycled into useful products such as speed bumps and asphalt road-patching material.

As with any building product, the key to effective post-consumer vinyl recycling is to find a cost-effective way to collect, separate and transport clean material for recycling at the end of its useful life.

Members of the European Single-ply Waterproofing Association (ESWA) joined forces in 1994 to collectively organize the recycling of vinyl roofing membranes. Arbeitsgemeinschaft für PVC-Dachbahnenrecycling (AfDR) GmbH created a company for the promotion and recycling of used vinyl roofing membranes. AfDR also established the required logistical systems and recycling plant. ESWA company members commit to recycle at least 50 percent of the collectable available quantity of vinyl roofing membrane waste by 2005. Transportation from construction site to the recycling plant is fully organized in Germany and the system is to be extended to the rest of Europe.

Has vinyl's environmental performance been endorsed by any national or international environmental, scientific or government organizations?

When vinyl is evaluated according to unbiased scientific principles, it is often endorsed as an environmentally safe and beneficial material. A few recent examples:

- The U.S. Environmental Protection Agency has recognized certain vinyl roofing manufacturers as Charter Partners of the ENERGY STAR® Roof Products Program for their commitment to continue to develop products that exceed current energy-efficiency criteria and to further the market's acceptance of these products. For low-slope roofs, a roof product qualifying for the ENERGY STAR label must have an initial solar reflectivity of at least 0.65, meaning that only 35 percent of solar heat is absorbed, and after three years of use it must maintain a solar reflectivity of 0.50 or greater in accordance with EPA testing procedures.
- The British Board of Agrément, which provides authoritative and independent information on the performance of building products via its certificate system, found that some vinyl roofing membranes can last "in excess of 30 years," based on site inspections and laboratory tests of the material as it naturally ages. This kind of performance translates to waste minimization.[15]

leak-tight

An Oval Office desk and the complete presidential papers were among the irreplaceable objects to be protected by project engineers in the re-roofing of Boston's John F. Kennedy Library and Museum. National archives officials sought a leak-tight system for the replacement project to safeguard the treasures during and after construction.

- CSIRO, Australia's premier scientific organization, completed a multi-year study in 1998 which determined that vinyl performs as well as or better than alternative building materials environmentally.[16]

Is there any research that benchmarks the environmental qualities of vinyl roofing materials in particular?

In a 2001 federal study, the Lawrence Berkeley National Laboratory (LBNL) measured and calculated the reduction in peak energy demand associated with a vinyl roof's surface reflectivity. LBNL found that, compared to the original black rubber roofing membrane on the Texas retail building studied, a retrofitted vinyl roofing membrane delivered an average decrease of 42° F in surface temperature, an 11 percent decrease in aggregate air conditioning energy consumption, and a corresponding 14 percent drop in peak air conditioning energy consumption.[17]

LBNL's Heat Island Group, under contract to the U.S. Department of Energy, created a Cool Roofing Materials Database of roofing surfaces it has tested for reflectivity and emissivity. Known as the Solar Reflective Index, the SRI measures a roof's ability, on a scale of 1-100, to reject solar heat, as shown by a small temperature rise. Materials with the highest SRI values are the coolest choices for roofing. For example, the standard black roof has a temperature rise of 90° F (50° C) in full sun, and the standard white roof has a temperature rise of 14.6° F (8.1° C). Due to the way SRI is defined, particularly hot materials can take slightly negative values, and particularly cool materials can exceed 100. The membranes of several vinyl roofing manufacturers have scored off the scale, receiving an SRI of 104.

What do life cycle studies show about vinyl?

Since the late 1980s, at least 26 life cycle evaluations have been published on vinyl building products, many of them comparing vinyl products to similar products made of other materials. Vinyl products generally have been found to perform favorably in terms of energy efficiency, thermal-insulating value, low contribution to greenhouse gases and product durability, which means using fewer resources.

A life cycle analysis (LCA) conducted for the United Kingdom's Department of the Environment, Transport and the Regions showed that vinyl is the best material for some uses and that the differences between the alternatives are small when environmental impacts are considered from the extraction of raw materials to final disposal.[18]

Why have some companies chosen to replace vinyl with other materials?

Vinyl competes with many materials on a cost/performance basis and is not competitive in all applications. However, for every company that has decided not to use vinyl, numerous others select it as a material of choice – particularly in roofing applications – because of its proven long-term durability, energy efficiency, low maintenance requirements, fire performance, recyclability and cost effectiveness. Ease of application, cleanliness and the absence of strong fumes during installation are other reasons why vinyl is specified for this critical building application. In Europe, vinyl roofing membranes make up 61.6 percent of the single ply roofing market. Today vinyl roofing membranes can be found on schools, hospitals, commercial and government buildings, stadiums and arenas and manufacturing facilities.

What is the outlook for vinyl?

Vinyl has grown to become the third-largest plastic material sold globally and has grown steadily – faster than GDP in most parts of the world.

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