

Avoiding the Landfill

The Recycling of Vinyl Windows and Doors

Following in the footsteps of the industry's best practice of recycling nearly 100% of the industrial waste created in the production of vinyl (PVC – polyvinyl chloride) windows and doors, the North American industry has entered into a new phase in its commitment to environmental sustainability through recycling, via the



Most vinyl windows installed years ago, like those shown here for the Habitat for Humanity home, are still in use today due to their low maintenance, affordability and durability.

post-consumer recycling efforts of the Vinyl Material Council (VMC) of the American Architectural Manufacturers Association (AAMA).

PVC is one of the most versatile polymers available on the market. It is the third largest plastic consumed globally with an estimated demand of 77 billion pounds in 2007 and an annual growth rate of close to 5%. The U.S. and Canada consume about 19% of the total

global demand (14.3 billion pounds in 2007). Over 70% of PVC is used in building and construction end-use applications due to its durability, low maintenance and low cost. Typical applications include windows and doors, pipe, siding, fencing, decking, molding, trim, and wire and cable jacketing.

Vinyl windows began a strong growth period in the early 1980's, driven by their durability, energy efficiency, ease of maintenance

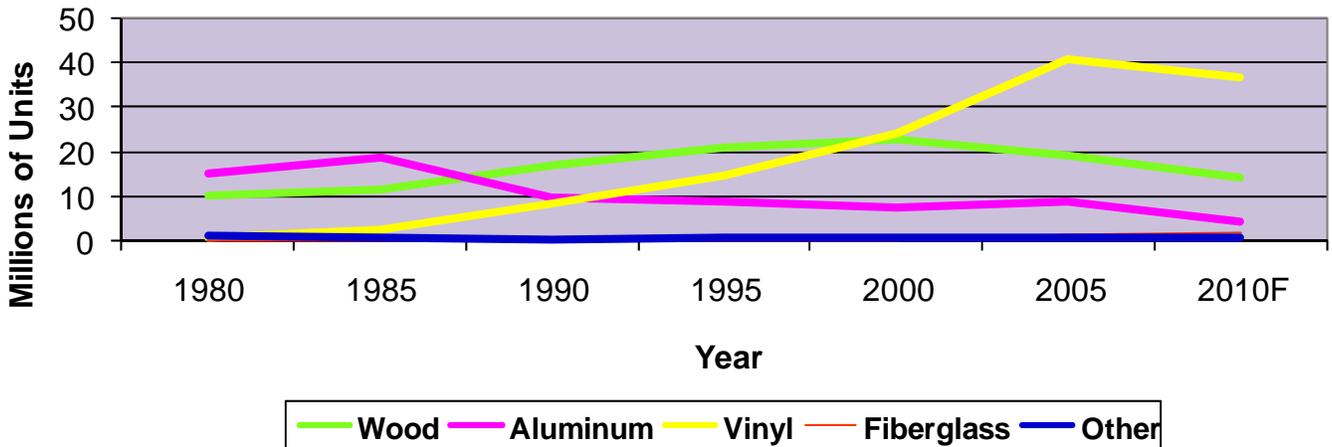
and low cost. Today vinyl windows account for 60% of all conventional residential windows sold in the U.S. (35.7 million vinyl window units in 2007). Similarly, vinyl has also enjoyed strong growth in the patio door market and is now the leading material used in this sector (41% market share and 1.8 million units in 2007). PVC is

a derivative of salt and hydrocarbons (coming from either natural gas or crude oil). Naturally occurring salt is the source of chlorine. Hydrocarbons are the source of ethylene. Together, chlorine and ethylene make up the building blocks for PVC.

PVC has outstanding durability, in many end uses, requires low maintenance and can be formulated with the proper ingredients to give excellent outdoor performance.

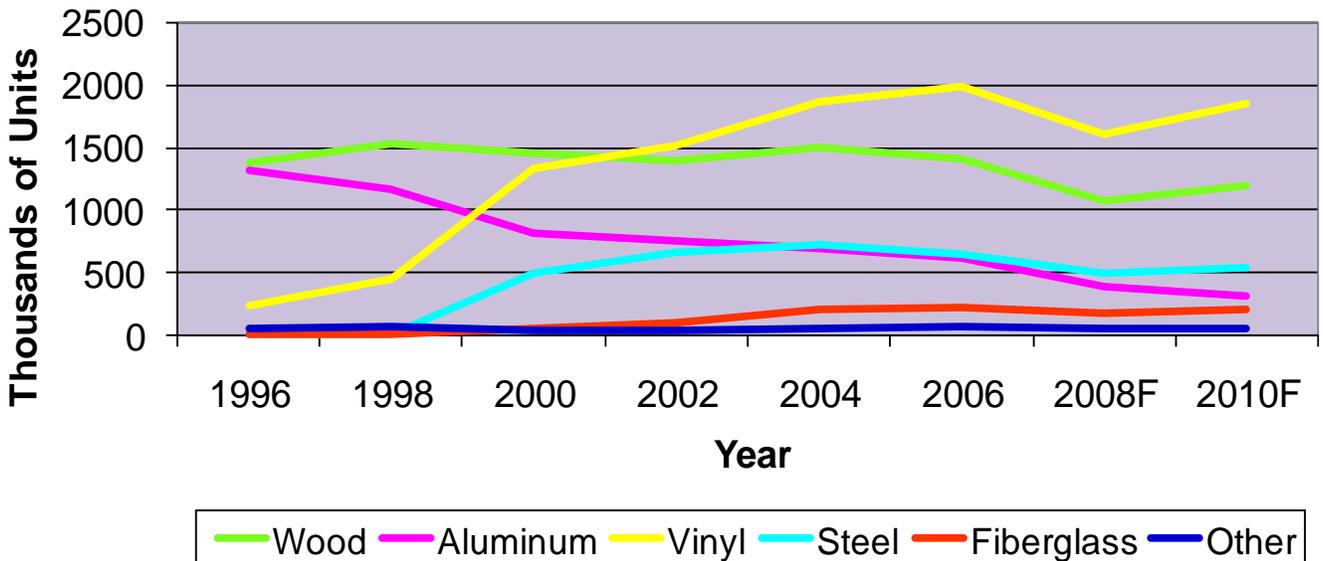
Avoiding the Landfill

U.S. Vinyl Window Growth



Vinyl windows began a strong growth period in the early 1980's and have continued to increase in popularity. Sources: AAMA Industry Statistical Review and Forecast (1987); AAMA/NWWDA Industry Statistical Review and Forecast (1997); AAMA/WDMA U.S. Industry Statistical Review and Forecast (2002, 2008)
 *Fiberglass included in "Other" category prior to 2003.

U.S. Vinyl Patio Door Growth



Vinyl's use in patio doors has experienced tremendous growth, making vinyl the leading material used in this sector. Sources: AAMA/WDMA National Statistical Review and Forecast (2002) ; AAMA/WDMA U.S. Industry Statistical Review and Forecast (2006 and 2008)
 *Beginning in 2000, steel and fiberglass products were introduced as separate categories.

The Recycling of Vinyl Windows and Doors

Since PVC is a thermoplastic polymer, it can be melted and reformed (repeatedly) to make the same or similar end-use products. The only exceptions are highly critical end-use applications such as medical and/or direct food contact applications. As a result, the production of PVC makes efficient use of natural gas and crude oil due to its:

- High chlorine content;
- Outstanding durability which reduces the need for the manufacture of replacement parts;
- Ease of maintenance; and
- Ability to be recycled many times over its useful life.

While most of the U.S. and Canadian installed base of vinyl windows and patio doors are still in productive use in millions of homes and will be for many years to come, AAMA's VMC is preparing for the day when they will be replaced. As a result, AAMA's VMC has initiated a feasibility study to evaluate strategies for making post-consumer recycling viable on a broad scale.

Recycling of Industrial Waste: Sustainability in Practice Everyday

Because vinyl, used in the manufacture of window and door profiles, can be melted and reformed repeatedly, it has long been the industry's practice to recover production trimmings and scrap and return them to their vinyl extrusion supplier or local recycler for reprocessing into the same or other products. When the PVC trimmings and scrap are returned to the original vinyl extrusion supplier, this is called closed-loop recycling. Virtually all of the current vinyl extrusion suppliers practice closed-loop recycling.

Post-Industrial (PI) recycling includes the recycling of converted vinyl material from industrial end

users into the same or different end-use applications. This is also widely practiced within the vinyl industries. According to a 1999 Principia Partners study, 80% of the rigid post-industrial vinyl available to be reclaimed is recycled. The reason for such a high percentage is that the material is relatively easy to collect, tends to be clean and can be easily reduced in size for reprocessing. The same study indicates that out of the total resin produced (both rigid and flexible applications) 99% goes directly into the product or is reclaimed for the same or other use.

Typical examples of post-industrial end-use applications include (but are not limited to) non-pressure pipe, fencing and

decking substrate, molding, gutters, artificial Christmas trees, hose, seawall and cooling tower baffles/trays.

PVC recycling is one of the major initiatives being undertaken by the Vinyl 2010 organization in Europe. Vinyl 2010 is a voluntary commitment of a majority of European companies involved in the PVC industry. Set up in 2000,



Recycling plants have the capability to recycle vinyl windows and doors; however, the machines may need retooling in order to function more efficiently.

Avoiding the Landfill



To recycle vinyl windows, the frames must be detached from the glass to separate the varying materials.

the organization has focused activities on covering all parts of the PVC life cycle, from production to usage, waste collection, recycling and efficient recovery technologies. Included in this 10-year commitment was a target for the recycling of collectible window profiles to reach 25% by 2003 and 50% by 2005. The European PVC Window Profile Association contends that the industry has met this target.

In an effort specifically designed to stimulate the collection and recycling of post consumer PVC, the Vinyl 2010 organization launched the Recovinyl program in June 2003. Recovinyl provides financial incentives to support the collection of PVC waste and send it to accredited waste recovery companies and recyclers. The payments of incentives help to make up for the

higher cost of recycling compared with other end-of-life solutions, such as landfills. The incentive aims to encourage the recycling of PVC products on an industrial scale. Full implementation of this concept within each European Union country took on average roughly one and a half years. Since its inception, this program has continued to grow with its adoption in additional countries and an increasing list of certified recycler and waste recovery companies. In 2007, Recovinyl reported that close to 90 million pounds of post-consumer PVC was recycled in Europe. This was 36% above their target for the year. A significant contributor to this increase was a major boost in the volume of post-consumer windows being recycled.

The Technology is Here: North American Vinyl Recycling Infrastructure

There already exists a significant infrastructure for vinyl recycling in North America. The Vinyl Institute's Vinyl Recycling Directory lists over 70 vinyl recyclers currently in operation spread out geographically across

the U.S. and Canada. They also have a Directory for Manufacturers who make products using recycled vinyl. This directory lists over 80 manufacturers currently in operations who are also spread out geographically across the U.S. and Canada.



Many of the vinyl windows that are normally being replaced are done as a result of a failure in the glass, glazing system, faulty installation or simply as part of a home renovation, rather than as a result of a failure of the PVC itself. As a result, the number of units being replaced has been historically very low. However, due to the sheer number of vinyl windows and doors being used in the market since the early 1980's, this figure is expected to increase rapidly over time.

The Recycling of Vinyl Windows and Doors

Collection

There are several sources for the collection of post-consumer windows and doors:

- Construction and renovation businesses
- Demolition businesses
- Individuals making home improvements
- Waste-management company transfer stations
- Collection sites and container parks managed by local authorities.

Post-consumer windows and doors can be brought to a local authority collection site, to a waste management company transfer station or directly to a recycler. Local authorities and waste collection companies, however, are not obliged to segregate and direct the PVC to a recycler. They may send it to a landfill or opt for another form of disposal. Because of this, it's preferable to help channel this material to a recycler capable of handling post consumer windows and doors.

Sorting

PVC windows and doors are highly engineered products containing multiple materials. De-

pending on the capabilities of the recycler, the windows and doors can either be shipped as is to the recycler or if the recycler does not have the capability to shred and separate the individual components, they will need to be separated before recycling. For windows, this means separating the frames from the glass.



600 windows removed due to faulty installation were selected for the case study. After all the windows were removed and collected, half of the windows were separated by hand into frames and glass and shipped separately to a vinyl recycler and a glass recycler. The glass was recycled into fiberglass and the vinyl was recycled into fence rails.

Recovery and Recycling

At the recycler, the doors, windows or frames (again depending on the capabilities of the recycler) will be shredded and sorted into separate materials. The recovered PVC is then collected and shipped to manufacturer(s) who will use

this recycled PVC to make new products.

Pilot Project Identifies Opportunities and Challenges

To further define the opportunities and challenges of recycling vinyl windows and doors in the U.S. and Canada, AAMA's VMC established a task group

charged with evaluating the challenges of establishing an industry-wide vinyl window and door recycling program. As part of this assessment, the task group developed a window recycling case study to help evaluate each step in the recycling process.

An AAMA member project to remove 600 windows from a development due to faulty installation was selected for the case study. The windows were removed over the course of a year and sent to a collection site. After all the windows were re-

moved and collected, half of the windows were separated by hand into frames and glass and shipped separately to a vinyl recycler and a glass recycler. The glass was recycled into fiberglass and the vinyl was recycled into fence rails. The vinyl fencing is being donated to Habitat for Humanity builds.

Avoiding the Landfill

The other half of the windows was shipped to a recycler to test the compatibility of recycling whole window units with recycling equipment currently used to recycle computer monitors. This method was chosen because computer monitors are: 1) regularly recycled by mixed material recyclers, 2) similar to vinyl windows in terms of material mix and 3) processed as whole units, potentially eliminating the material separation step.

Unfortunately, the type of shredder used for monitors is designed for larger, boxier materials rather than thin materials like window lineals. The recycler was forced to stop/start the shredder and run other material in-between to help clean the vinyl from the blades. Another issue is that metal (such as screws, rein-

forcements, etc.) became embedded in the vinyl and required hand sorting. Shredders more conducive to lineal-shaped materials are in regular use by many recyclers of post industrial window lineals. If there is a sufficient volume of whole window units being recycled, then the recycler can red-

esign their process, using readily available technology, to more efficiently process whole window units – similar to what is being done in Europe.

Each window weighed 100 pounds on average. After shredding and sorting the recycler ended up with 90 pounds of glass, 9 pounds of PVC and 1 pound of metal from each window unit. The glass was sold to a glass recy-

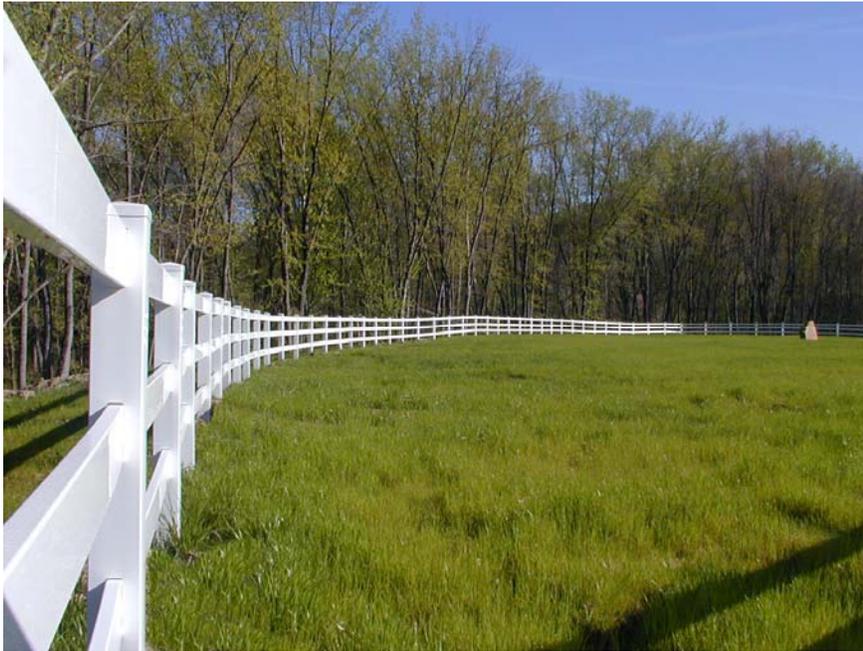
cler for use in roll stock. The PVC was sold to a manufacturer who uses 35-50% recycled PVC to make hose reels, fencing, edging, outdoor furniture, trellises, patio accessories, sheds, storage systems and dog houses.

Future Implications for Post-Consumer Vinyl Window and Door Recycling

As a result of the information learned from the vinyl window case study, it is clear that for an industry-wide window and door recycling program to be established it must be done as truly an industry-wide initiative which includes all windows and doors, not just vinyl windows and doors. The issues identified in establishing a

window recycling program are the same regardless of the type of window – vinyl, aluminum, fiberglass, wood, etc. Vinyl windows are not advantaged or disadvantaged versus other window types as it relates to recycling.

The basic issues that need to be addressed for a successful industry-wide window and door recycling program are addressed in the following paragraphs.



The uses of vinyl from recycled windows and doors are plentiful. The material can be used in many applications in addition to the fencing shown here. These uses include (but are not limited to) non-pressure pipe, decking substrate, molding, gutters, artificial Christmas trees, hose, seawall and cooling tower baffles/trays.

Collection

For any material to be effectively recycled there needs to be a constant source of material to feed the recycling process. Because vinyl windows are extremely durable, almost all of the vinyl windows that have been installed to date, beginning back in the early 1980's,

The Recycling of Vinyl Windows and Doors

are still in active use. The vinyl windows which are replaced normally are done as a result of a failure in the glass, glazing system, faulty installation or simply as part of a home renovation, rather than as a result of a failure of the PVC itself. As a result, the number of units being replaced has been historically very low. However, due to the sheer number of vinyl windows and doors being used in the market since the early 1980's, this figure is expected to increase rapidly over time.

To stimulate collection, one possibility is for window and door manufacturers to help fund the collection and delivery of vinyl window and doors to certified window and door recyclers. This is similar to what is being done now in Europe under the Recovynyl program. To be both sustainable and economically feasible, however, there needs to be sufficient numbers of collection centers spread throughout North

America along with a logistic network to support the transportation of materials to recyclers.

One opportunity currently under investigation by selected mixed materials recyclers is partnering with the existing wide-ranging network of big-box retailers who already have established national distribution capabilities. As noted earlier, if a regular material stream can be established; there are already a significant number of vinyl recyclers who could potentially process these whole window units.

Sorting and Separating

Since windows and doors are highly engineered, multiple material systems, these materials must be separated and reduced in size so that recycling these materials back into a manufacturing stream is possible. If the volume of window units being recycled is sufficient, recyclers currently possess the technology to tailor their processes to handle this type of feed-

stock. An industry-wide program involving all types of windows and doors will help ensure that recyclers receive a sufficient volume of windows to make this feasible.

Conclusion

As the use of post-consumer recycled content becomes an increasing requirement in end-use products as a result of state and local regulations or voluntary programs such as LEED and Green Globes, the ability to recycle windows will become a natural extension of this trend. As demonstrated in Europe and as part of the task group case study, vinyl windows are recyclable but post-consumer window and door recycling is only done on a limited basis today. However, as more and more green and sustainable programs take hold, window recycling will be a natural part of this evolution. As such, AAMA's VMC remains committed to finding ways to support and increase the recycling of post-consumer vinyl windows.

To request a subscription to the VMC Newsletter, please send your name, email address, company name, company address and phone number to Lori Benshoof at lbenshoof@aamanet.org or call 847-303-5859 x 261.



American Architectural
Manufacturers Association
1827 Walden Office Square
Suite 550
Schaumburg, IL 60173

Phone: 847-303-5664
Fax: 847-303-5774
Email: webmaster@aamanet.org

www.aamanet.org

Vinyl Material Council (VMC) Home Page

Visit the Vinyl Material Council (VMC) Home Page to view the latest information on vinyl fenestration products:

- Product information for homeowners and industry professionals
- Market and educational information, including continuing education and newsletters
- Environmental stewardship and sustainability information
- Vinyl-related technical specifications, certification information and documents

VMC Home Page
[http://www.aamanet.org/
general.asp?sect=1&id=168](http://www.aamanet.org/general.asp?sect=1&id=168)

Vinyl Recycling Resources

Vinyl Material Council (VMC) of the American Architectural Manufacturers Association (AAMA)

www.aamanet.org/general.asp?sect=1&id=168

National Vinyl Recyclers Directory

www.vinylinfo.org/Recycling/VinylRecyclingDirectory.aspx

The Vinyl Institute

www.vinylinfo.org

Vinyl Institute Recycling Page

www.vinylinfo.org/Recycling.aspx

Recycled Vinyl Products Manufacturers Directory

www.vinylinfo.org/Recycling/VinylManufacturersDirectory.aspx

1999 Principia Partners Report of Post-Industrial and Post-Consumer Vinyl Reclaim

www.vinylinfo.org/Recycling/VinylRecyclingReport.aspx

Vinyl In Design Targeted Toward Product Specifiers, Architects and Construction Professionals

www.vinylbydesign.com/site/new_index.asp

U.S. Green Building Council's LEED Green Building Rating System

www.usgbc.org/DisplayPage.aspx?CategoryID=19

Green Building Initiative (GBI) Green Globes Rating System

www.thegbi.org/home.asp

National Association of Home Builders National Green Building Program

www.nahbgreen.org

Recovinyl PVC Recycling Program, Initiative of Vinyl 2010

www.recovinyl.com

Vinyl 2010 – The European PVC Industry Commitment to Sustainability

www.vinyl2010.org

Vinyl News Service (VNS)

www.vinylnewsservice.com