

Avoiding the Landfill:

The Recycling of Vinyl Roof Membranes

By Carl De Leon

With its European counterparts blazing the trail, the North American vinyl (PVC) roofing industry has entered a new phase in its commitment to environmental sustainability through recycling.

Because thermoplastic single-ply vinyl membrane can be heated and re-formed repeatedly over its lifespan, it has long been an industry best practice to recover production trimmings and scrap and recycle the material into new membrane. Well-run and properly equipped vinyl-membrane production plants are capable of converting virtu-

ally all of the raw material and components that go into making the membrane into the final installed roof system or other applications.

Typical post-industrial recycled products have included accessories such as roofing walkway pads, commercial-grade flooring, and concrete expansion joints. In addition, scrap can be reintroduced as a raw material into a subsequent membrane-manufacturing process. Some roofing manufacturers collect their customers' scrap as well as the general-purpose scrap of other vinyl fabricators for reuse in production of new membranes.

Building on this track record, the mem-

ber manufacturers of the Chemical Fabrics and Film Association (CFFA) Vinyl Roofing Division have initiated a feasibility study to evaluate strategies for making post-consumer recycling viable on a broad scale, as has been done in Europe for many years.

Skyrocketing raw material costs, higher landfill tipping fees, legislation to restrict disposal of construction material, and an architectural community that demands the lightest environmental footprint that can be achieved are all leading toward the mainstreaming of post-consumer recycling and a vision of the day when specifiers call for post-consumer content in a roof project.

Post-Consumer Vinyl-Roof Recycling – Where It All Began

Vinyl roofs have been in use for more than 40 years in Europe, and roofing manufacturers there have been recycling retired roofs into other useful products since 1994. That was the year a consortium of companies funded the construction and operation of a facility in Germany to reclaim the growing volume of vinyl membranes at the end of their service lives and return them to the original manufacturers.

Over the years, the material taken back has been used in a variety of applications, including as feedstock in the production of new roofing



Contractors easily lift a flexible sheet of retired membrane from the roof to be rolled in preparation for transport off site. Image courtesy Vinyl Roofing Division, CFFA.



Contractors segregate the fasteners from the seam strips after the main vinyl sheets have been removed from the substrate. Image courtesy Vinyl Roofing Division, CFFA.

membranes. Typically incorporated into the back side of the sheet where potential color variations are not a factor, the recovered material can comprise 5 to 15 percent by weight of the finished product. Reports from the field indicate that, at 10+ years of age, the first membranes made with recycled post-consumer material are performing the same as membranes produced of virgin raw materials.

Today, ROOFCOLLECT, a program of the European Single-Ply Waterproofing Association (ESWA), coordinates the recovery and processing of post-consumer vinyl roofing membranes. In conjunction with the European Commission, ESWA sets annual targets for post-consumer roof recycling; in 2006, 4.4 million pounds of roofing membrane were recycled due to its efforts.

ESWA is now working with the recycler Interseroh to establish a pan-European collection system that would facilitate recycling in closer proximity to the job site. ESWA is also investigating strategies for incorporating higher percentages of recycled material into finished membranes.

Less Is More; The Technology Is Here

According to the U.S. Environmental Protection Agency (EPA), construction and demolition waste in the U.S. totals an estimated 136 million tons annually.¹ The vinyl roofing industry is committed to combining existing post-consumer recycling technologies with logistical expertise to limit its contribution to these numbers.

Post-consumer recycling of vinyl roof membranes in the U.S. began in 1999. Working in tandem with a vinyl membrane manufacturer, a Massachusetts recycling

company produced a highway cold patching material made from old vinyl roofing membranes and other recovered plastics. Today, state-of-the-art grinding equipment makes it possible to process roofing membrane and convert it to feedstock for new materials.

Only membranes that have been mechanically attached or loose-laid have been reprocessed in North America. There is no experience, as yet, with membranes that have been adhered to insulation or to other substrates, but CFFA members are watching some approaches that have been developed in Europe.

Pilot Projects Shed Light on Opportunities and Challenges

Post-consumer recycling of roof membranes has occurred on a limited basis in the United States. To date, the savings in disposal fees and the value of the salvaged materi-

als have generally exceeded the cost of the additional labor, shipping, and grinding fees. However, the total net costs are dependent on total roofing square footage, the distance that the old roof must be shipped to be processed, and avoided landfill tipping fees.

The reroofing of Boston's Marriott Long Wharf Hotel was a pilot

project where the recycling scenario reflected the ideal logistics: (1) all involved parties were motivated to recycle as much of the complete assembly as practical; (2) the pro-



Contractors separate the vinyl membrane from the wall fasteners and plates, which will also be recycled. Image courtesy Vinyl Roofing Division, CFFA.



Recyclers use specialized grinding equipment to convert retired vinyl membrane to chunks or a powder. Image courtesy Vinyl Roofing Division, CFFA.

ject was close to the membrane manufacturer's head office; and (3) a local recycler had an established program for handling thermal insulation, resulting in minimal incremental freight charges as a percentage of overall salvage costs, in addition to the necessary experience in handling and processing the old roofing membrane.

Other recycled system components included the gravel ballast, the metal flashings, and the extruded polystyrene insulation. In the end, 95 percent of the existing materials of the assembly, by weight, were recycled. The membrane was returned to

the manufacturer for use in other membrane products. The contractor estimated a savings of 25 percent versus the traditional disposal costs, even with the additional handling required.

A more typical scenario occurred with the University of Iowa's Carver-Hawkeye Arena. This project's building team was committed to incorporating a recycling strategy into its roof replacement project; however, there was no local insulation recycling program to help defray the shipping costs, and the manufacturer was much further away from the job site.

Nonetheless, university officials found this approach a cost-effective choice (compared to tipping fees at a landfill) and more environmentally friendly. The aged roof was rolled up, and, to minimize the volume of material to be shipped back to the membrane manufacturer and the associated freight charges, it was first sent to a Cedar Rapids recycler to reduce the material volume via grinding.

Later, the membrane manufacturer processed the material into roofing walkway membrane, an installation safety product normally made of virgin post-industrial

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Vinyl membranes made of recycled post-consumer materials. Image courtesy Vinyl Roofing Division, CFFA.

vinyl. Scheduling of this project allowed for some of the walkway material produced from the recycled roof membrane to be used on the new roof.

Recycling Durable Building Products: What Are the Challenges?

Many end users and plastic recyclers recognize that the plastics used in durable goods are often more valuable than those found in packaging. But mainstreaming recovery of these plastics is complicated by a number of unique challenges, among which are a much wider range of different and incompatible plastics, a less developed collection infrastructure, more varied end products, lower overall volumes of these materials (particularly on an individual-grade basis), and a much wider range of attached foreign materials such as metal, rubber, foams, fabrics, etc.²

A sustainable recycling strategy requires high-quality reclamation in the tear-down, reprocessing efficiency, and a ready customer base for the recycled product. With this in mind, the CFFA feasibility study on post-consumer vinyl roof recycling is looking at ways to address the following issues on a large scale.

Issue: Reclamation

Any long-term approach to reclaiming old roofs will need to address the training of roofing contractors in the logistics of tearing down roof systems for recycling instead of landfill disposal. Slightly more handling is

involved, as the contractor must separate the membrane from other waste materials and prepare it for shipping off the site. Issues include:



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BUILDING ENVELOPE KNOWLEDGE ASSESSMENT

Test your knowledge of building envelope consulting with the following questions developed by Donald E. Bush Sr., RRC, FRCI, PE, chairman of RCI's RRC Examination Development Subcommittee.

1. **Spray Polyurethane Foam (SPF) comes in two basic types. What are they?**
2. **What is 1/2-lb SPF?**
3. **What is the expansion rate of 1/2-lb SPF?**
4. **What is the expansion rate of 2-lb SPF?**
5. **What are the R-values of 1/2-lb and 2-lb SPF?**
6. **What blowing agents are used in 1/2-lb and 2-lb SPF, respectively?**

Answers on page 44

BUILDING ENVELOPE KNOWLEDGE ASSESSMENT

Answers to questions from page 43:

1. 1/2-lb and 2-lb
2. Generic spray polyurethane foam weighing between 0.4 and 0.6 lb/ft³ when fully cured.
3. Approximately 150 times its original volume to form a semirigid, non-structured plastic.
4. Approximately 35 to 50 times its original volume and forming a rigid plastic with a compressive strength between 15 and 25 psi.
5. 1/2-lb = R - 3.5 per inch, and 2-lb = R - 6 per inch (aged).
6. 1/2-lb typically uses water, and 2-lb uses HCFCs and HCFs.

Reference: Spray Polyurethane Foam Alliance

Preparing and Storing the Membrane for Transport to the Recycler

Old membranes must be cut into strips of prescribed widths and lengths and tightly rolled and tack welded before leaving the job site for the recycler. As part of the planning process, roofing contractors will need to preorder Gaylord boxes and pallets from the membrane manufacturer based on the surface area of the roof, the membrane thickness, and the existing assembly construction. Scrap membrane and trimmings from the new installation can be added to the Gaylord for recycling as well.

Delivering a "Clean" Product to the Company Providing Size Reduction and Grinding Services

For best results, the processor needs to receive a membrane free of foreign materials like stone ballast and metal fasteners.

Issue: Processing

Many processors can grind reclaimed materials, but for vinyl roofs to be size reduced to chunks or a powder, equipment that can separate such components as felt backing material and the reinforcing polyester matrix is needed. Issues include:

Finding a Recycler that Can Process Reinforced Material

Until recently, felt-backed membranes could not be reprocessed and had to be landfilled. Newer equipment can separate the felt, allowing the sheet to be recycled with ease. This equipment can also extract the encapsulated scrim reinforcement from the polymer matrix. The felt backing and scrim can be used as fibrous filler when fabricating concrete blocks for landscaping or other applications.


Issue: Identifying the Market

The success of roof recycling, as is the case with all recycling, is dependent on the

will of the participants in the process. Issues include:

Developing a Customer Base and Collection Infrastructure

The North American vinyl roofing manufacturers are committed to developing the infrastructure to establish a viable program. With a strong desire for sustainable construction in the marketplace and efforts to divert construction waste from landfills, it appears that the time is right for roof recycling to grow.

For more than 40 years, durable, highly engineered, light-colored vinyl roofing membranes have cooled and protected buildings in climates around the world. Their long life cycle – and the associated lower energy consumption to both produce the raw material and process it into useful products – is a significant determinant of their sustainability as a building product, but it doesn't stop there. The vinyl roofing industry is committed to taking it to the next level and establishing a North American post-consumer recycling program. 

References

- 1 "Characterization of Building-Related Construction and Demolition Debris in the United States," U.S. Environmental Protection Agency, Municipal and Industrial Solid Waste Division, EPA530-R-98-010, June 1998.
- 2 Biddle, Dr. Michael B.; Dinger, Peter; Fisher, Dr. Michael M.; "An Overview of Recycling Plastics from Durable Goods: Challenges and Opportunities," presentation before Identiplast II, Brussels, Belgium; April 1999.

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