High-Performance PVC Roofing – An Active Asset

By Drew Ballensky

Roofing has become more than just a lid on a building. It has become an active asset – even generating payback. The rooftop is now a place that provides "value-added" benefits like energy savings, energy generation, and environmental enhancement. For a roof system to be considered truly *high performance*, it should offer superior sustainability. Sustainability in roofing involves avoiding or minimizing the impacts of a building on its occupants and the environment, both local and global, from design to construction, through maintenance, rehabilitation and eventual demolition with an emphasis throughout its life cycle on using natural resources efficiently.

There are ten key reasons why a cool, high-performance PVC roofing system is sustainable:

1) High reflectivity and emittance provide energy savings. Saving energy is an obvious sustainability benefit that helps reduce a roof system's total life-cycle cost and conserve limited resources.

2) PVC membranes have a low carbon footprint compared to products like TPO or EPDM. A typical PVC may have only 44% carbon versus almost 100% for EPDM or TPO.

3) Custom pre-fabrication reduces jobsite waste. With its flexibility and ease of welding, some PVC membranes are custom prefabricated specifically for each job, meaning less scrap is generated at the jobsite.

4) PVC is completely recyclable, meaning virtually no fabrication scrap goes to landfills, and post-consumer membranes can be re-utilized.

5) By following strict quality-control procedures during manufacturing, PVC roofing system performance is enhanced and maintenance issues are minimized or eliminated.

6) PVC membranes contain a chlorine component that makes them inherently fire resistant, making it much easier to achieve Class A fire ratings with PVCs than with some other systems.

7) PVC roofing works well as the waterproofing component of rooftop photovoltaic systems that provide renewable energy and reduce dependence on non-renewable sources.

8) PVC also supports vegetative systems through its durability and waterproof characteristics – vegetative roofing reduces a building's energy consumption and water runoff.

9) PVC roofing is long-lasting with some systems boasting over 30 years of proven service. A longer life reduces total life-cycle costs.

10) A solid warranty also helps reduce life-cycle costs and gives the building owner peace of mind.

"Cool" performance is a big part of what makes PVC roofing systems so sustainable. High reflectivity is a key characteristic that helps keep buildings cooler and reduce energy usage. Reflectivity, or albedo, is the ability to reflect energy from the sun. Stated in percentage terms, the higher the percentage, the more energy is reflected. As much as 40% less cooling energy may be needed for buildings that have highly-reflective roofs.

Cool roofing delivers other benefits that are not as tangible as dollars saved, but are valuable nonetheless:

Insulation can be 25%-50% more effective
Extremely high temperatures reduce the effective R-value of the most widely used types of insulation (Leonard & Leonard, 2005). Cooler surfaces help preserve and keep rooftop insulation materials cooler.

HVAC equipment can operate more efficiently
Inlet air temperature can be 5–15 degrees cooler 30 inches above a cool roofing surface compared to a black surface. Most HVAC units are designed with efficiency ratings evaluated at 95 degrees F (York International, 2005); rooftop temperatures on a black surface can reach 160 degrees F or higher.

Substrate deterioration may be slowed by as much as 75%
Ultraviolet and infrared radiation and moisture penetration accelerate substrate deterioration. A cool roofing system will reflect this radiation and help protect the substrate (Kirn et. al., 1994).

Ambient interior temperatures can be up to 20 degrees F cooler than outside
Studies of worker performance with machine operation and high physical activity reveal that productivity drops 10% at 84 degrees F and 38% at 95 degrees F (Schweisheimer, W., 1962).

Sustainability attributes of all components for the entire system should be considered, including film production, reinforcement scrim, fabrication scrap, flashing parts and accessories, shipping materials and methods, installation components, fasteners, and so on. This is more than just a consideration of direct product attributes. It involves a deeper

look into the facilities and activities that are utilized in the production and delivery of the system. Modern, highly-efficient closed-loop manufacturing equipment and processes make the most of valuable resources. Here are examples of actions taken by some companies to glean the most out of their processes:

- Reinforcement scrim and film production: polyester yarn tailings can be saved and recycled; vinyl film edge trim can be routed back into the film production; laminator trim and scrap can be reground and used in other products
- Fabrication plant scrap: materials can be collected and reground for use in products like roofing walkpads, flooring, and concrete expansion joint products
- Component fabrication: roof flashing components can be fabricated from portions of material scrap; roof system fastening plates are made from post-consumer recycled components
- Shipping: cardboard cores used for rolled membrane products are made from recycled material and can themselves be recycled; undamaged pallets used for receiving and shipping goods can be returned for re-use; foam cradles used for holding rolls of material can be re-used and/or re-cycled;
- Post-use reclamation: post-consumer roof materials can be reground and recycled
- Screws and fasteners: the wire coil used to make these items typically has recycled content
- Metal edge details: steel coil used for fabricating metal edge details typically has recycled content

Architects and specifiers who are interested in designing high performance buildings can get help from green design programs. LEED® and Green Globes™ are two well-established programs that aid specifiers in the high-performance design process and recognize the installation of high performance PVC roofing systems by offering opportunities to attain credits toward certification.

LEED, a program of the United States Green Building Council, stands for Leadership in Energy and Environmental Design and was one of the first green design programs to become widely accepted. While some streamlining is being pursued through standardized documentation and auditing, a typical LEED application currently requires a large time commitment. Of more than 50,000 projects registered since 2000, only about 6300 have achieved certification to date.

A new version of LEED was introduced in 2009. It offers several areas to consider where high performance PVC roofing systems may help contribute to LEED certification.

Some Possible Credit Considerations for LEED-NC *(New Construction)*

LEED Credit Category	*Requirement*
Sustainable Sites Credit 7.2: Heat Island Effect: Roof	*Solar Reflectance Index of 78 (some systems exceed 110)*
Energy and Atmosphere Prerequisite 2: Minimum Energy Performance	*Comply with ASHRAE Std 90.1-2004: If at least 70% reflectivity / .75 emittance may be able to reduce amount of insulation based on adjustment factors*
Energy and Atmosphere Credit 1: Optimize Energy Performance	*Reduce energy costs when compared to the energy cost budget of building's design; cool roofing reduces building's cooling load*
Materials and Resources Credits 1.1 and 1.2: Building Re-Use of Walls, Floors and Roof	*Extend the life of existing building, conserve resources, reduce waste and reduce environmental impacts; roof longevity extends the life of existing structure and HVAC equipment*
Materials and Resources Credits 2.1 and 2.2: Construction Waste Management	*Divert construction and demolition debris from disposal in landfills and incinerators; custom pre-fabrication virtually eliminates jobsite scrap*
Materials and Resources Credits 4.1 and 4.2: Recycled Content	*Use materials with pre- and post-consumer content; pre-consumer recycled into walkpads; post-consumer programs recycle roofs as flooring*
Materials and Resources Credits 5.1 and 5.2: Regional Materials	*Use building materials or products extracted or manufactured within 500 miles of project site; some companies strategically locate facilities within proximity of major markets*
Indoor Environmental Quality Credit 2: Increased Ventilation	*Provide additional outdoor ventilation to improve indoor air quality; systems with two-way breather vents keep negative air pressures and condensation in check*
Indoor Environmental Quality Credit 7.1: Thermal Comfort	*Provide a comfortable thermal environment for occupants; cool roofing helps keep building cooler making HVAC more effective*

Some Possible Credit Considerations for LEED-EB (Existing Buildings)

LEED Credit Category	*Requirement*
Sustainable Sites Credit 7.2: Heat Island Effect: Roof	*Solar Reflectance Index of 78 (some systems exceed 110)*
Energy and Atmosphere Prerequisite 2: Minimum Energy Performance	*Achieve at least 2 points in EA Credit 1 (Cool Roofing reduces cooling load)*
Energy and Atmosphere Credit 1: Optimize Energy Efficiency Performance	*Demonstrate ENERGY STAR® energy performance rating of at least 69; efficiency in at least the 19th percentile; or follow LEED-EB Operations & Maintenance Reference Guide (Cool Roofing reduces cooling load)*
Materials and Resources Credit 9: Solid Waste Management; Facility Alterations and Additions	*Divert construction and demolition debris from disposal in landfills and incinerators; custom pre-fabrication virtually eliminates jobsite scrap*
Indoor Environmental Quality Credit 1.3: Increased Ventilation	*Provide outdoor air ventilation and improve indoor air quality; two-way breather vents keep negative air pressures and condensation in check*

Another green design program that is gaining wide acceptance comes from the Green Building Initiative (GBI) and is known as Green Globes. This program, Internet based and very user-friendly, was developed from BREEAM, a program originating in Europe and Canada. Green Globes has actually been in existence longer than LEED and has similar goals for promoting green design but is less costly for registration and auditing. The program has relevant weighting of credits and looks at the entire chain of the product's life. Green Globes doesn't require an energy engineer to calculate energy performance. GBI is pursuing an ANSI Standard for Green Globes with approval anticipated in 2010.

A high performance roof also offers possibilities as an active asset through photovoltaics and rooftop gardens. Emerging new technologies with photovoltaic (PV) systems are increasing efficiencies, improving paybacks, and making PVs a more viable electricity generating source. PV systems offer a clean source for energy and, with net metering arrangements, building owners have the opportunity to sell excess electricity to the power grid, further enhancing system payback.

Rooftop gardens can go by many names with many different techniques, but generally they involve planting various forms of vegetation on a rooftop. Besides aesthetic enhancements, the vegetation offers other benefits. In urban areas that experience significant water runoff during rainstorms, vegetative roof systems help reduce runoff

that stresses the capacities of storm sewer systems. Vegetation also acts to insulate and keep the roof surface cool, reducing building cooling requirements and mitigating urban heat island effects. Drawbacks of rooftop gardens include the added weight, increased maintenance requirements, and a much higher initial cost for the roof system.

Sustainable building design can take many forms and utilize many different approaches to obtain similar performance results. But regardless of what design actions are taken or what products are used, profit is a key criteria for sustainability – if an act is not profitable it is not sustainable. As roofing systems take on the role of active assets, they will contribute more toward helping typical facilities become high performance buildings.

Reference Information

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About the Author

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Drew has over 29 years experience in business and industry in various engineering and managerial capacities. He has worked in the U.S. and Canadian operations for a major international manufacturer of pre-engineered steel buildings, was a financial analyst with a major athletic apparel manufacturer and was an owner of a general contracting company.

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