
Walter Scarborough


Stanley Graveline

Questions Answered

Vinyl roofing systems possess sustainability characteristics that should not be ignored

For this issue, MM asked Walter Scarborough, vice president and director of specifications for HKS Architects in Dallas, Tex. to speak with Stanley Graveline from the Vinyl Roofing Division of the Chemical Fabrics and Film Association regarding the merits of reflective single-ply vinyl roofing membranes in commercial construction. Scarborough has specified vinyl on a number of low-slope roofing projects where the material's attributes solved particular design problems, as well as on the new Dallas Cowboys Stadium and the American Airlines Center.

Walter Scarborough: Let's review the basics. What are the key attributes of vinyl roofing systems that every specifying architect should know?

Stanley Graveline: First and foremost, thermoplastic vinyl's heat-welded seams form a permanent, watertight bond that is stronger than the membrane itself. This is a major advantage over roofing systems that rely on adhesives, tapes, and caulks to seal the seams. A second attribute is the composition of the vinyl polymer, which gives it an inherent fire resistance not found in alternative materials.

WS: Okay, so based on those qualities, what building applications are most appropriate for vinyl roofing systems?

SG: Architects working with complex roof lines and curvatures or multiple roof penetrations that may be cosmetically critical to a project should be particularly interested in vinyl. All can be accommodated by vinyl's inherent flexibility and strength. It is easy to form long-lasting tight seals around these details and penetrations, and the result aesthetically can be impressive. But for any project where energy efficiency is a driver, vinyl offers tremendous value because it is an inherently reflective material.

WS: What about TPO? Are there differences between vinyl and TPO membranes?

SG: The formulations are different, to start with, and vinyl is inherently fire resistant. Vinyl (or PVC) membranes contain a base resin modified with plasticizers and UV stabilizers, reinforced with fiberglass non-woven mats or polyester-woven scrims. The basis of TPO is a polyethylene or polypropylene-based resin. Vinyl has been sold as commercial roofing product for more than 45 years; TPO is a newer product with about 15 years' field experience.

WS: Asphalt has been on the market even longer—over a hundred years. Why would an architect specify a vinyl roofing system in lieu of one of the asphaltic roofing systems?

SG: Energy efficiency is certainly one reason. In full sun, the surface of a black, low-slope roof may experience a temperature rise of as much as 50 to 90 degrees, reaching midday temperatures of 150 to 190 degrees in summer. A white vinyl roof on the same building typically increases only 10 to 25 degrees above ambient temperatures. Also, from a sustainability perspective, the feedstock of vinyl resin comprises the least amount (typically less than half) of non-renewable raw materials of any roofing alternative.

WS: Since you've brought it up, where does vinyl fit into the continuum of sustainable building products? Some would say that it has no green properties whatsoever. At the same time, many LEED-certified buildings have vinyl roofs. Please explain the sustainable attributes of the material that should be considered by architects.

SG: Without question, vinyl belongs in the palette of sustainable options that specifiers can consider. Roofs made of vinyl contribute significantly to achieving two major objectives of contemporary green building programs—the reduction of both building cooling loads and the urban heat island effect. That is why the reflectance, emittance and/or solar reflectance index criteria for LEED, ENERGY STAR, Green Globes, and California's Title 24 can all be met through the use of a reflective vinyl roof. Further, while all products have environmental impacts resulting from manufacturing and shipping, vinyl's long service life is second to none, and it is the only commercial roofing material that is being recycled at the end of its service life.

WS: If that's true, why is vinyl's sustainability always being debated by self-identified green advocates?

SG: Here's what those activists won't tell you: vinyl's long life cycle—and the associated lower energy consumption to both produce the raw material and process it into useful products—makes it as sustainable a building product as any other. Furthermore, most alternatives have far more embedded energy than vinyl.

WS: I'll ask you more about vinyl recycling later on. But for now, let's get back to cool roofs for a moment. It's widely believed that the selection of a cool roof can have a significant impact on energy savings and, in fact, many sustainable construction guidance documents and standards recommend cool roofs. Can you explain what makes a roof cool and provide some quantification of the energy savings achievable with a cool roof?

SG: When a roof delivers high solar reflectance and thermal emittance values, it is a cool roof. Quite simply, vinyl roofs achieve some of the highest reflectance and emittance measurements of which roofing materials are capable. They typically reflect more than 80 percent of the sun's rays and emit 70 or more percent of the solar radiation absorbed by the building envelope. Asphalt built-up roofs, by comparison, reflect between 6 percent and 26 percent of solar radiation, resulting in greater heat transfer to the building interior and greater demand for air-conditioning—a strain on both operating costs and the electric power grid.

The definitive study on this was conducted in 2001 by the Lawrence Berkeley National Laboratory (LBNL), which measured and calculated the reduction in peak energy demand associated with the surface reflectivity of a vinyl roof that replaced a black rubber roof on a major retail store in Austin, Tex. LBNL found that the average daily summertime temperature of the black roof surface was 168 degrees, but once retrofitted with a white reflective surface (with the same insulation and HVAC systems in place), it measured 125 degrees, a decrease of 43 degrees. LBNL also found that the retrofitted vinyl membrane delivered an 11 percent decrease in aggregate air conditioning energy consumption, and a corresponding 14 percent drop in peak hour demand, compared to the original black roof. Without considering any tax benefits or other utility charges, annual energy expenditures were reduced by $7,200 or $0.07/sq. ft.

WS: Does that mean vinyl roofs are best specified in southern climate zones only, or is there value to having a reflective roof in a northern climate?

SG: Actually, net annual energy savings are typical even in northern climates. Cool roofs can have more impact on energy cost than energy use, cutting consumption during peak power demand when the rates are the highest and offsetting any minimal wintertime increases in use when there is less sunlight to reflect. And no matter where they're installed, they cut down on the urban heat-island effect and lower a building's carbon footprint.

Regardless of the climate you're building in, a cool roof increases the long-term performance and life expectancy of the roof system by reducing the temperature stress on those components. As well, a cool roof reduces that flat expanse's contribution to the urban heat-island effect.

WS: About recycling: Can vinyl roof membranes be recycled at the end of their useful life? More importantly, are they being recycled? And is there an expectation that recycling companies will accept vinyl in the future?

SG: Yes to all three. Typically more than a billion pounds of vinyl from myriad applications are recycled annually. Because vinyl can be heated and re-formed repeatedly over its lifespan,

it has long been a roofing industry best practice to recover (post-industrial) production trimmings and scrap and recycle the material into new membranes. This year, North American roof manufacturers announced our commitment to develop the infrastructure for a viable broad-scale post-consumer vinyl recycling program—similar to what's been going on in Europe for 15 years, where these roofs have been in service longer and thus retired sooner. Pilot projects over the past three years here confirm that it is both economically and technically feasible to recycle these membranes at the end of their service life. One company expects to recycle more than three million square feet of post-consumer membrane this year alone. Skyrocketing raw material costs, higher landfill tipping fees, legislation to restrict disposal of construction materials—and an architectural community that demands the lightest environmental footprint that can be achieved—all are leading toward the mainstreaming of post-consumer recycling. We believe the time is right for roof recycling to grow.

Developers of the American Airlines Center in Dallas, Tex. appreciated the design flexibility and durability of a vinyl membrane for the facility's 200,000 sq. ft. of multi-sloped roofs joined at right angles. The tan coloring matched the exterior façade's Indiana Limestone and GFRC; separately, vinyl film membrane for the custom logo was welded directly onto the main membrane.

WS: How does the fire performance of vinyl roofing membrane compare to alternative roofing materials?

SG: The best way to grasp the answer is to visit the Fire Performance part of our Web site, www.vinylroofs.org, where you can watch a dramatic fire test conducted by Southwest Research Institute's Fire Technology Department. It compares the behavior of the three primary commercial single-ply roofing materials—vinyl, TPO, and EPDM—after they are ignited by a Bunsen burner flame. In the test, the vinyl sample self-extinguishes in seconds (13 in one, 12 in the other) after the flame source is removed, while the other two samples continue to burn for between three and six minutes before they are completely consumed.

WS: Solar applications are gaining momentum in the commercial building sector. Are building integrated photovoltaic (BIPV) systems compatible with a vinyl roof? Is there any potential that photovoltaic systems will prematurely age the vinyl roofing?

SG: Very compatible; in fact, some solar companies will only use vinyl membranes for their systems because the material's proven long lifecycle, high reflectivity, superior fire ratings and hot-air welded seams assure that the roofing substrate will be functioning as long as the PV modules themselves. Roof membrane and PV cell manufacturers have studied the issue of premature aging and do not foresee any reduction in life expectancy.

WS: How well do vinyl roofs withstand ultraviolet light degradation, wind loads, structural movement, temperature extremes, and thermal cycles?

SG: Around the world, and going back decades, billions of square feet of vinyl roof are installed on buildings in climates of every imaginable extreme. It is a material that has proven performance to withstand all of those stressors.

WS: Can vinyl membranes be used for green roof applications?

SG: Absolutely. They are often used in concealed applications such as the waterproofing layer in planted roofs and plaza decks. The permanent hot-air welded seams do not deteriorate in the perpetually moist environment of a green roof, and those same seams provide the highest resistance to root penetration of any waterproofing membrane.

WS: Last question. Has the vinyl roof industry developed a way to keep vinyl roofs exposed to view from looking . . . dirty?

SG: All roofs get dirty and the degree of soiling depends on the building's geographic location, what's surrounding it, the roof slope, and production activities within the building. In the library of our Web site (www.vinylroofs.org), you can find cleaning guidelines and an equipment list for restoring both the reflectivity and aesthetic appearance of a warranted roof system. •

Photo: VINYL ROOFING DIVISION, CHEMICAL FABRICS & FILM ASSOCIATION