Vinyl Roofing as a Cool Roofing Solution

Reduced air conditioning demand. Lower surrounding air temperature, or "heat island" effect. What building product can deliver both of these features to the environmentally-conscious specifier?

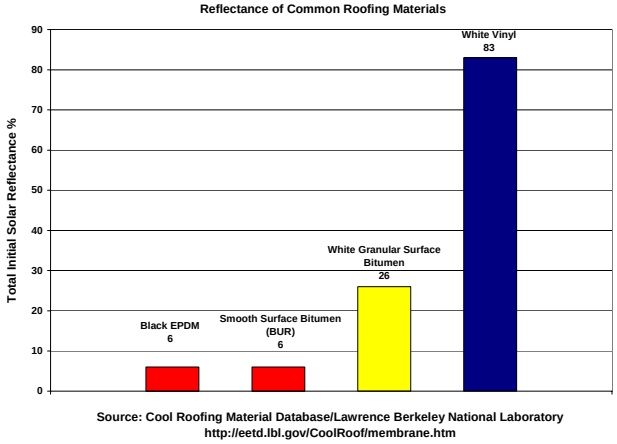
Reflective, or "cool," roofing is the answer, and it is one of the fastest-growing building and construction trends today. Owners of large commercial and industrial buildings have more incentives than ever before to reduce heat gain in their interior spaces while curbing the large roofing surface's contribution to the urban heat island effect, and they are taking advantage of those incentives.

At present, there is no agreed-upon industry-wide definition of a cool roof, but roofing is increasingly included in energy efficiency standards proceedings, and specifiers are turning to the Cool Roof Rating Council's (CRRC) product rating database to help make purchasing decisions, although at this time CRRC listing is only required in California. Reflectivity and emissivity data for more than 100 products from 30 manufacturers can be found at www.coolroofs.org. This program provides roofing manufacturers with a means to label various roof surface products with radiative property values rated under a strict program administered by the CRRC.

Reflectivity is the starting point

Probably the most universally referenced guideline today is the U.S. Environmental Protection Agency's ENERGY STAR® guideline on reflectivity.

For low-slope roofs, a roof product must have a minimum solar reflectivity of at least 65 percent when new, and at least 50 percent after three years in service. The higher the percentage, the more solar energy reflected. Non-reflective asphalt built-up roofs, by comparison, reflect between 6 percent and 26 percent solar heat.



Source: Cool Roofing Material Database/Lawrence Berkeley National Laboratory
http://eetd.lbl.gov/CoolRoof/membrane.htm

No matter how reflective the surface, however, some energy will be absorbed. Emissivity is the ability of a material to shed that retained heat from the building envelope. In 2005, EPA began an assessment of ENERGY STAR to identify modifications or enhancements that may effectively expand the market of energy-efficient products and accelerate their market penetration. Chief among them is the possibility of adding roofing emissivity to the ENERGY STAR guideline.

Another standard comes from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). Standard 90.1 establishes minimum requirements for energy-efficient building design and sets minimum roof reflectivity at 70 percent and minimum emissivity at 75 percent.

How does a roofing system become "cool"?

There are several ways to attain the benefits of a cool roofing system. They range from short-term solutions such as paints and coatings that can temporarily turn dark roofs white to long-term waterproofing solutions such as highly reflective white or light-colored single-ply vinyl membranes. Green, or planted, roof systems also fall into this category.

Vinyl, or PVC, membranes achieve some of the highest reflectivity and emissivity measures of which roofing materials are capable. Because it is lightweight, a white, gray or tan vinyl membrane can often be installed over a dark roof on an existing building (provided an appropriate separator is used), eliminating the need to dispose of discarded roofing materials. Its ability to repel dirt also maximizes reflectivity over time.

The U.S. EPA recognizes all vinyl roofing manufacturers of the Chemical Fabrics and Film Association as ENERGY STAR Partners for their commitment to continue to produce specific products that exceed aggressive energy-efficiency criteria and to further the market's acceptance of these products. The program's product list includes vinyl roof membranes with aged reflectivity from 77 percent to as high as 86 percent. Vinyl membrane emissivity can measure as high as 95 percent.

Combating the urban "heat island" while reaping energy savings

A significant attribute of cool roofing is the role it plays in reducing the urban heat island effects – and resulting poorer air quality – experienced by most major cities.

Urban heat islands are those areas where the combination of asphalt parking lots and road pavement, sparse vegetation, and expanses of black rooftops can raise air temperatures as much as eight to 10 degrees higher than the temperature of the surrounding countryside. In some densely developed areas, a quarter of the land cover may be roof surface alone. The standard black roof can have a temperature rise of as much as 90 degrees F in full sun, while the corresponding temperature rise for the standard white reflective roof is 14.6 degrees F under the same conditions.

Naturally, buildings located in these heat islands stand to consume more energy for air conditioning than a cooler building would – a strain on both operating costs and the electric power grid. Cool roofs offer both immediate and long-term savings in building energy costs.

In a 2001 federal study, the Lawrence Berkeley National Laboratory (LBNL)[1] 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

membrane delivered an average decrease of 42 degrees 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. The average daily summertime temperature of the black roof surface was 168 degrees F, but once retrofitted with a white reflective surface, it measured 125 degrees F.

With vinyl roofing systems that can last for more than 20 years, the investment can pay off many times over. Numerous vinyl roofing membranes installed in the United States as far back as the 1970s are still in place and performing well.

Saving money in cool climates

In climates where there are more heating days than cooling days, cool roofs remain a worthwhile investment, according to Hashem Akbari, a scientist at the LBNL's Heat Island Group. The cooling benefits of a highly reflective roof surface far outweigh the potential winter month heating benefits of a less reflective, or black, roof surface.

Various calculators that predict how much energy can be saved with cool roofs in different climates generally show a yearly net savings. This is true because the sun is lower to the horizon in winter and not hitting the roof as directly or as intensely as it would in summer, it shines fewer hours and there are more cloudy days, and snow cover reflects the sun's energy. Another reason: because cool roofs cut peak use during the summer when rates are the highest, they can help reduce the demand charge that a building pays all year on the basis of its greatest energy use.

Abating the urban heat island effect is just as critical in cooler climates as it is in the southern regions. An LBNL study showed that, if strategies to mitigate this effect, including cool roofs, were widely adopted, the Greater Toronto metropolitan area could save more than $11 million annually on energy costs.[2]

A leader in sustainability

Building owners concerned with the lifecycle performance of their structures are increasingly striving to achieve the U.S. Green Building Council's Leadership in Energy & Environmental Design (LEED) certification. Reflective vinyl roofing systems can help achieve – usually in combination with other actions – as many as 22 points toward LEED certification. Some of the ways these points can be accumulated include:

- Credit 7.2 Sustainable Sites (currently, via use of an ENERGY STAR-labeled product);
- Credit 1.1-1.5 Energy and Atmosphere (a product complying with ASHRAE 90.1 helps meet a prerequisite in this section); and
- Credits 2 and 7.1 Indoor Environmental Quality (high reflectivity/efficiently operating HVAC = cooler building).

With energy efficiency accepted as a significant component of sustainability, the public sector is motivating the building, design and construction community to look hard at building energy consumption. To reduce peak energy use in a meaningful way, federal, state and local regulations and incentives are increasingly supporting and encouraging – and in some cases, requiring – the use of reflective roofing.

Effective October 2005, the State of California requires cool roofs for most non-residential new construction, reroofing and recoating. The CRRC is the only entity recognized for labeling and rating of roof surfaces covered by this new legislation, which is known as Title 24. Details are available at www.energy.ca.gov. Currently, Florida, Georgia, Arizona and the City of Chicago have or are considering similar requirements.

More than just a sensible “green” building design approach, cool roofing has gone mainstream – becoming a significant solution to critical national energy and environmental challenges.

[1] S. Konopacki and H. Akbari, “Measured Energy Savings and Demand Reduction from a Reflective Roof Membrane on a Large Retail Store in Austin,” Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division, June 2001.

[2] S, Konopacki and H. Akbari, “Energy Impacts of Heat Island Reduction Strategies in the Greater Toronto Area, Canada,” Lawrence Berkeley National Laboratory, Heat Island Group, November 2001.