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Special Report

on cool
roofing

A special report
in conjunction with
the U.S. EPA's
ENERGY STAR®
Roofing
Products Program

Roofing As an Energy Asset

Evidence grows that reflective roof materials can help facilities control cooling costs

By David Kozlowski, Senior Editor

Summertime is peak energy demand time for most commercial and institutional buildings, and maintenance and engineering managers must look under every rock for savings. One of the biggest rocks that has been largely overlooked is the roofing system.

Developments in light or white-colored roofs can turn the roof into an energy asset by helping to keep buildings cool, reducing peak energy demand and cutting overall energy cost significantly.

The use of typical dark-colored flat or

low-slope roofs dramatically affects the cooling energy use in buildings, as well as the urban climate. For these highly solar absorptive roofs, summer rooftop temperatures can reach more than 90 degrees above the ambient air temperature in most U.S. locations. Roof surface temperatures on buildings in cooling dominated climates can easily reach 180 degrees on a windless day.

Unfortunately, that heat is not just absorbed by the roof and stored. The roof radiates the heat upward into the atmosphere and downward into the building.

The radiated heat contributes to a phe-

nomenon called the urban heat island. Dark-colored roofs and paved surfaces can help raise the temperature of urban areas 2-8 degrees above the surrounding countryside. This temperature increase creates a greater demand for energy to cool buildings. The Lawrence Berkeley National Laboratory (LBNL) reports that the summer demand for electric power rises nearly 2 percent for every 1 degree increase in temperature.

Ninety percent of the energy in the United States is generated by burning fossil fuels, which creates air pollution associated with smog, acid rain and global climate change. By reducing the amount of energy needed to cool buildings, cool roofing products help reduce pollution, says Steve Ryan, program manager, for the U.S. Environmental Protection Agency's ENERGY STAR® Roof Products Program.

Inside buildings, a similar heat effect takes place. Heat absorbed by the dark-colored roofing is radiated back into poorly insulated buildings. In the plenum space below the roof, temperatures can be well above 100 degrees. If ductwork runs under

the roof, chillers must do double duty to condition return air from the space and compensate for the heat load provided by the roof. Not only does this increase pollution and energy costs, but HVAC systems have to be sized to match the load.

Buildings that could most benefit from an ENERGY STAR labeled roof products are those with:

- air-conditioning bills of more than \$30 per 1,000 square feet
- a large roof surface as compared to the building's overall size
- R-11 levels of insulation or less in the ceiling.

"A reflective roof application be a cost-effective investment when it's done when roof repairs or replacement are necessary anyway," Ryan says.

Color and solar energy

Researchers have recognized for years that certain roofs keep buildings cooler than others. These roofs reflect more sunlight than they absorb. Only recently have researchers have developed a method to

measure the reflectance, or albedo, of a roof surface. The key element is color, but the condition of the roof surface can also have an effect.

Typical roofing materials — mineral cap sheets, modified bitumen, tar and gravel — have albedo ratings of 0.1

to 0.3, meaning they absorb more than 70 percent of the solar energy that falls on them. When these materials are coated with a white reflective coating, their albedo can rise to as much as 0.85 initially and can maintain albedos greater than 0.65 over the life of the product.

What does this finding mean for roof temperatures? A roof that has a smooth, white roof coating will reflect up to 80 percent of the sun's energy. A white membrane roofing material will reflect 70-80

**A cool roof
could mean
50% energy
savings**

percent. The temperature of white roofs will be only 15-25 degrees warmer than the ambient air temperature. The cost benefit can be quite dramatic, too.

Potential net energy savings from changing roof reflectivity is huge. Building managers in Los Angeles could save \$35 million, those in Houston could save \$27 million, those in New York could save \$16 million and those in Chicago could save \$10 million, according to researchers at LBNL.

According to ENERGY STAR, individual buildings could get as high as a 50 percent energy savings with cool roofs. Also, a reflective roof can reduce peak cooling demand by 10-15 percent.

According to the Florida Solar Energy Center at the University of Central Florida, a small, private elementary school with a white acrylic elastomeric coating reduced energy costs considerably. Data analysis of two years, one before resurfacing and one after, reveals that roof surface, roof plenum and class room air temperatures were significantly lower during the second year.

Chiller electric power use was reduced by an average of 10 percent from one year to the next, totaling 13,000 kilowatt-hours in annual savings. The impact on peak demands was even more noticeable. Daily average annual demand reductions of 1.5 kw were observed between 9 a.m. and 4 p.m. on an annual basis.

Ryan reports one school retrofitted its roof with additional insulation and white roof coating, a move that saved \$30,000 the first year and \$35,000 the second.

There's another benefit. Light-colored roofs tend to last longer. The constant heating and cooling of a roof causes it to

Cool Roofs: Supplier Perspectives

Cool roofs are receiving greater attention, and rightfully so. Who wouldn't want lower heating and cooling costs and a new roof that will last for 10-20 years, or to add energy savings and 10-15 years of life to a current roof by adding a new coating?

Aside from making sense, cool roofing is starting to become a mandate. More building codes, especially in the Southern United States, require cool roofs or offer enticements to facilities that use cool roof products.

Finding a fit

All major roofing companies offer thermoplastic-polyolefin (TPO) roofing, and what used to be considered a high-end product has decreased in price so it is now more in line with other roofing options.

"The benefit for the manager is that TPO roofing fits in the single ply market between two products, but doesn't have the Achilles heel of either," says Tom Gallivan, marketing manager for Stevens Roofing Systems. "The black rubber weathers well, but has always been limited by its seams. PVC welds very easy, but has a problem with plasticizer migration. With TPO, managers get the benefit of seam strength without any plasticizers."

Now, some TPO system manufacturers make wider sheets. "The wider sheets make TPO systems easier, quicker and less expensive to install," says Ron Head, sales and marketing manager for Carlisle Syntec's thermoplastics group.

While TPO systems appeal to managers looking to replace a current roof, coatings also provide savings for newer roofs. Adding a coating is cheaper than a new roof, and coatings that are cool roof capable are becoming environmentally friendlier.

"There are coating systems available with solvents and with waterborne technology," says Mike DeSouto, research and development director for Topcoat Inc., a subsidiary of GAF Materials Corp. "Waterborne technology is a little more color stable, but it's more based on the quality of the formulation.

You can have very reflective solvent-based and water-based coatings. The big difference is the environmental impact."

While the benefits of cool roofing is documented, managers also look first at cost. Managers are willing to go green, Gallivan says, as long as it's not too expensive.

"It is easy to demonstrate to the owner the cost of the roof on the installation," Gallivan says. "Now when you show a life-cycle analysis, you can add into it the energy savings in terms of saved energy and reduced air conditioning costs to get a true picture of what the roof costs."

Looking ahead

Significant advances in cool roof coatings are on the way. "The race is on to come up with more reflective coatings and better reflectivity retention," says Chris Salazar vice president of sales and marketing for Karnak Corp. "As far as coatings go, there are a variety of them available, since there are different needs, different chemicals and climates."

Says DeSouto, "There are more performance related coatings. The industry is improving the products, compared to the old, not so environmentally friendly versions. Coatings are also now more usable on existing stock of roofing systems, such as EPDM and modified bitumen type roofs."

Roofing system manufacturers are devoting more effort to products designed to benefit the environment.

"The next big thing is not just cool, but also sustainable roofs that never have to be removed or disposed of," Head says. "The industry continues to move toward products that are totally green with no negative impact on the environment."

Managers, however, are still a little shy when it comes to new programs, Gallivan says.

"Owners don't want new products because they believe it is an untried product," he says. "People are looking for next generation systems all the time, but it takes a long time for testing.

— Dave Karrels, Associate Editor

expand and contract, causing wear and tear on the materials.

White flat roofs are not maintenance free. Like all roofs, they require regular inspection and repair procedures. Also, white roofs need to be kept clean in order

to provide the energy payback.

Roofing system manufacturers can be good sources of for managers seeking input on inspection, maintenance and repair procedures, Ryan says.

As is the case with all ENERGY STAR pro-

grams, Ryan says, there is an environmental and economic benefit to ENERGY STAR roofing products.

Says Ryan, "Saving energy, no matter how you do it, reduces pollution and saves managers money." MS