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Energy savings hit the roof

'Cool' colors that reflect heat now top some houses

By Edie Lau -- Bee Staff Writer

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The brown roof on this Fair Oaks house features a pigment that reflects heat, rather than absorbs it. It's expected that energy-saving colors will see much wider building use. Sacramento Bee/Lezlie Sterling

The houses on Mariah Place look largely the same -- two stories, tidy and new, with buff-colored stucco exteriors and brown roofs.

But two of the houses on the small court in Fair Oaks have a distinguishing, if not distinguishable, feature: Their brown roofs are painted with pigments that absorb a lot less heat of the sun than your standard brown.

These "cool-colored" roofs are in the vanguard of high-tech energy-efficient roofing materials coming into vogue in California and beyond.

"This is (part of) a wave," said Chris Scruton, a project manager in the California Energy Commission's research program in building energy efficiency. "The whole notion of the 'green' building is something that's just taken on a life of its own."

The Mariah Place houses, located just off Sunrise Boulevard, are part of a study by Oak Ridge and Lawrence Berkeley national laboratories and funded by the Energy Commission to explore how well the cool colors work.

The data show they do.

The scientists have been comparing the two cool-roofed houses against identical houses on the same street with roofs colored by conventional pigments.

On typical hot summer afternoons, they found the temperature in the attic of the house with cool-brown concrete tiles between 5.4 and 9 degrees cooler than the attic of the house with regular brown concrete tiles.

The effect is even greater in the second demonstration house, which has metal shingles painted a cool brown. Its attic temperature was 9 to 12.6 degrees cooler than its counterpart's.

John Zaichkin, owner of the concrete-tile cool-roof house, saw the difference in his utility bill.

Zaichkin moved there in the summer of 2004 from a nearby townhouse.

All the houses on Mariah Place were designed to be more energy-efficient than standard dwellings.

Even so, because his new house was larger than the townhouse by about 550 square feet, and because he kept the thermostat at 78 degrees in both places, Zaichkin assumed his energy costs would go up.

In fact, his bill was less, almost by half.

"I thought it would go through the roof, but that was one roof it didn't go through!" he said.

Understanding how cool colors work requires letting go of the dogma that light colors reflect heat, and dark colors absorb it.

While that's true of many pigments, it's not universally true.

One need only to look at nature to find exceptions: Green leaves are cool to the touch even in the sun. So is wood.

One reason many conventional colorants take up heat is the common use of carbon black, a cheap and plentiful pigment that happens to be highly absorptive, said Ronnen Levinson, a research scientist at Lawrence Berkeley National Laboratory.

Not only is carbon black used to color things black, it's also blended into other hues to adjust their shade, he said.

But a cool black color is possible; materials manufacturers have developed one.

Here's how it's possible:

The human eye perceives color based upon the wavelength of visible light reflected by an object.

For instance, an orange object reflects orange wavelengths on the solar spectrum and absorbs the rest.

A white object reflects all visible light; a black object absorbs all visible light.

But only part of the sun's energy comes as visible light. More than half of its energy falls in the near-infrared portion of the spectrum, which we sense as heat.

Because infrared is invisible, it is possible to change the near-infrared reflectance of a pigment without changing its color.

"We are tinkering with what your eye cannot see," Levinson said.

The science of making reflective pigments goes back decades. Ferro Corp., a materials manufacturer in Cleveland, Ohio, is a pioneer in the field.

"It's still really in the learning mode," said Ken Loye, Ferro's market-development manager for pigment systems. "Some industry professionals know about it, but it's been a pretty well-guarded secret."

Maybe not for long. California last year put cool-roof efficiency standards into the building code for certain commercial structures.

Now the Energy Commission is considering extending the standard to all commercial buildings and residences.

If adopted, the standard would require anyone installing a new roof to meet the energy budget of a building with a cool roof.

In other words, if a building owner opts not to install a cool roof, he or she would need to do something else, such as increase insulation, to make the building as efficient as if it had a cool roof.

Cool colors are available commercially to a limited but growing degree. They do cost more. Researchers said the extra expense amounts to only a few cents per square foot at the wholesale level.

But Bill Miller, a research scientist at Oak Ridge National Laboratory, said that at today's electricity prices, the payback on the extra cost might take a while.

So far, energy efficiency is not a major draw for prospective home buyers. Zaichkin's Mariah Place house is on the

market since he moved this summer to Oregon for a job.

Realtor Dan Abraham, who showed the house to The Bee last week, said most buyers are concerned mainly with financing.

"What it boils down to is people's monthly payment. I don't think people see the big picture," he said.

Because utility companies and society as a whole benefit from cool roofs -- perhaps more than individual building owners -- government and power providers need to step in, Miller said.

"It's not rocket science," he said. "It's going to have to be, No. 1, regulations that are going to drive people this way, then legitimate (utility) rebates to make this work."

The Sacramento Municipal Utility District, according to its Web site, began this year to offer rebates for cool roofs on certain residential dwellings.

Pacific Gas & Electric Co. does not give cool-roof rebates, but a spokesman said it may in the future.

Besides roofing materials, scientists are studying other applications for cool colors.

Possibly coming in the future: cool car paints.

About the writer:

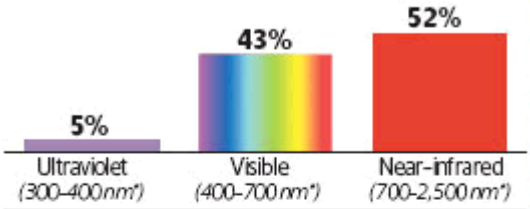
- The Bee's Edie Lau can be reached at (916) 321-1098 or elau@sacbee.com.

The science of color and heat

Scientists working for federal energy laboratories and in the private sector are designing and studying special pigments that can be used in roofing materials to throw off the sun's heat. How this science of "cool" colors works:

Many conventional colors absorb heat

More than half the energy of sunlight arrives in the near-infrared (NIR) portion of the solar spectrum. Invisible to the human eye, infrared radiation is sensed as heat.



- **Human eyes see different colors depending upon which wavelengths of visible light are reflected by objects:** Objects seen as white reflect all the visible wavelengths. Objects seen as black absorb all visible wavelengths. Objects seen as red reflect the red part of the visible spectrum, while absorbing the rest.
- **Because so much of the sun's energy is contained in the invisible near-infrared region,** that heat energy can be reflected from a roof without changing the roof's color.
- **To learn more, see: http://coolcolors.lbl.gov**

*Wavelength in nanometers

Sources: Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory, National Roofing Contractors Association, Cool Colors Project

Sacramento Bee/Olivia Nguyen

Applications for energy savings

Tests have been conducted using conventional and "cool color" paints covering concrete roofing tiles at a demonstration site in Fair Oaks.