New ORNL roof system means savings for homeowners

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Homeowners could see their summer utility bills fall by 8 percent or more with a new roof and attic system being developed at the Department of Energy's Oak Ridge National Laboratory.

From an energy efficiency perspective, roof technology has not progressed substantially in hundreds of years, but that is changing with the use of active thermal mass components, reflective pigments and coatings, subventing, radiant barriers and other novel techniques being tested by a team led by Bill Miller and Jan Kosny of ORNL's Building Envelopes group. Their prototype roof and attic system works by reducing attic temperatures by about 22 degrees Fahrenheit during a typical summer afternoon and decreasing the amount of heat that gets transferred through the attic floor to the living space.

At the heart of new roof system is a proprietary inorganic phase change material sandwiched between two reflective surfaces made of aluminum foil. This material is installed as a dynamic thermal barrier between the roof and attic area, creating separate air channels between roof rafters. The configuration is compatible with traditional wood and steel framing technologies. Moreover, the new phase change material overcomes problems that have plagued phase change materials for the past 40 years.

"In the 1970s and 1980s the housing industry made several moderately successful attempts to use phase change materials," Kosny said. "While these materials enhanced building energy performance, they were in many cases chemically unstable, were subject to corrosion or other

durability problems and suffered from loss of phase change capability."

Another shortcoming of some previous phase change materials was their susceptibility to fire. Fire is not a problem with the ORNL material, according to Kosny, who noted that ORNL researchers are working with leading manufacturers of phase change material on the development of non-flammable organic material.

In tests at ORNL, phase change materials perform like conventional materials by absorbing heat as the temperature increases. However, as the material melts it continues to absorb large amounts of heat without a significant increase in temperature. Then, as night falls and the ambient temperature around the liquid phase change material decreases, it solidifies again and releases the stored heat to the night sky, Miller said.

With an outside temperature of 92 degrees Fahrenheit, tests at ORNL's Buildings Technology Center show temperatures of conventional attics at 127 degrees Fahrenheit vs. attic temperatures of 105 degrees with the Dynamic Attic Heat Exhaust System. Kosny and Miller filed a patent last year for this technology.

"The next generation roof will consist of infrared reflective materials that are dark in color yet reflect light as if they were white," Miller said. "In addition, radiant barriers and phase change materials will be integrated into a dynamic attic system that reduces utility bills for homeowners. The conservation strategies contribute on a much grander scale by lowering peak demand on utilities, reducing carbon emissions and, ultimately, they could lead to cleaner air."

If just half of the homeowners in the U.S. made sure they had R30 attic floor insulation and used this roof and attic system, the nation could reduce its Btu (British Thermal Unit) demand by about 100 trillion Btu.

Source: Oak Ridge National Laboratory