Reflective Insulation 101

INSULATION'S ATTRIBUTES MAKE IT A GOOD CHOICE FOR METAL BUILDINGS

BY LAURIE BANYAY

FOR ITS APOLLO SPACE program, the National Aeronautics and Space Administration, Washington, D.C., used reflective foil covering to create a radiant barrier for spacecrafts and spacesuits. The foil shielded the astronauts from the sun by day and reflected internal heat back inside the space shuttle at night. Today, reflective insulation brings the same benefits to buildings here on Earth.

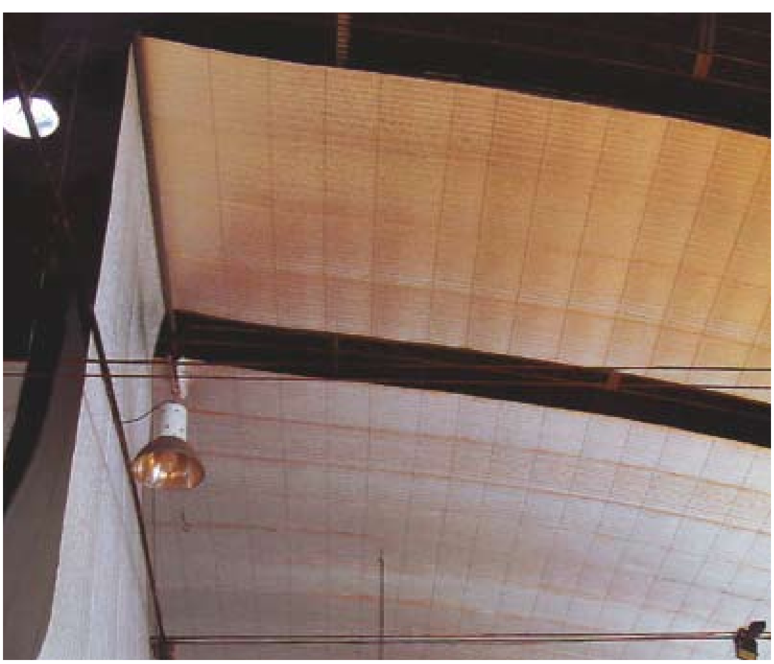
Designed for installation between, over or under framing members for walls, floors and ceilings, reflective insulation is thermal insulation consisting of one or more low-emittance surfaces to form one or more enclosed air spaces. It is designed to reduce the movement of radiant energy across enclosed air spaces and reduce the radiation from warm surfaces. Metal buildings especially can benefit from its qualities, such as energy-saving properties, easy installation, ability to be used with new construction or retrofits, and its dual role as a vapor barrier.

STANDARD VERSUS REFLECTIVE INSULATIONS

Standard insulation, such as fiber glass, open-cell foam and cellulose, has an emittance value of about 0.9 and reduces heat transfer by trapping air. Reflective insulations also trap air but use layers of aluminum, paper or plastic, which are effective in reducing radiant-heat transfer by up to 97 percent, according to the Reflective Insulation Manufacturers Association International, or RIMA-I, Olathe, Kan. The outer layers sandwich one inner layer of inert material, which is used to create an air gap between the two layers to trap convective heat as it rises. That inner layer most commonly is plastic, but materials like fiber glass also can be used. Reflective insulation is lightweight, has low moisture-transfer and absorption rates, does not contain substances that will offgas, and has no risk of change in thermal performance from compaction or moisture absorption.

"Many of the insulations used in the metal-building industry are based on the low thermal conductivity of air," says Dr. David W. Yarbrough of R&D Services Inc., Cookeville, Tenn. "Batts do a very good job of stopping the movement of air in the space in which they are installed and do a fair job of stopping radiation. Reflective systems do a really good job of stopping radiation, but only a fair job in stopping air circulation. Different insulation systems have different ways of reducing heat flow."

Recently, combinations of insulation systems have become available. Hybrid systems combine the benefits of reflective insulation with other insulations, such as fiber glass, to create the most efficient system possible. Yarbrough likens hybrid insulation to hybrid cars that combine gasoline engines with electrical components. "You try to capitalize on the benefits of the two," Yarbrough says. "It's a matter of cost benefit. People are scrambling to figure out how much it would cost to increase the thermal resistance in a building and determine whether the energy saved is worth the added cost of the insulation." Performance and cost differences are based on specific evaluations of a proposed system.



RIMA INTERNATIONAL; ENVIRONMENTALLY SAFE PRODUCTS INC.

INSULATION IN METAL BUILDINGS

Reflective insulation is used in metal buildings to moderate the changes in interior temperature as the outside conditions vary. One reflective insulation project is the parabolic metal shed of a basketball stadium in Bahia Blanca, Provincia de Buenos Aires, Argentina. This former venue of San Antonio Spurs star, Manu Ginobili, won the award in the metal building category of RIMA-I's 2009 It's About Saving Energy competition. The city sees temperatures of 23 F (-5 C) in the winter and up to 95 F (35 C) in the summer. The temperature fluctuations coupled with the city's proximity to the sea often resulted in condensation dripping on the basketball court. Prior to this installation, the shed had no insulation. Fiber glass and spray polyurethane foam were considered, but because of aesthetic reasons and installation difficulties in an already-built metal building, reflective insulation was chosen. It easily was installed under the roof and covered the entire roof surface as a continuous blanket.

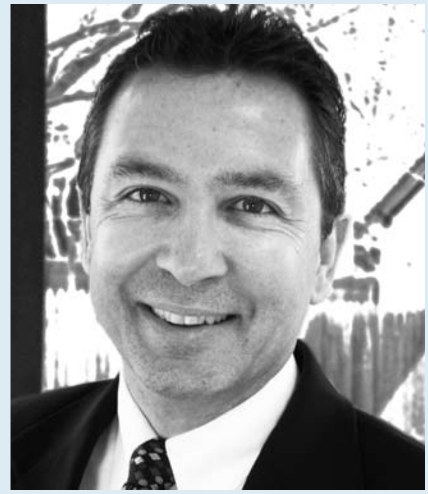
The builder installed a 0.39-inch- (10-mm-) thick polyethylene foam faced with aluminum foil below the existing roof. Steel cords were fixed and tightened from the front to the back wall of the stadium. The cords were separated by 24 inches (610 mm) in accordance with the roof's shape. The insulation material was passed over the tightened cords perpendicularly, keeping with the roof's shape. Each roll was fixed to the surrounding walls with a metal frame. Once all rolls were installed, they were bonded to ensure a continuous vapor barrier with no thermal bridges. To maintain shape, cords again were tightened and tied to the metal structure every 16 feet (4.8 m). The transformation of the basketball court was significant. The white side of the insulation on the inside of the structure helps the lighting reflect better and provides more brightness inside the court. Condensation problems also disappeared and the stadium is able to maintain stable temperatures year-round.

SUSTAINABILITY

Reflective insulation fares well in green-building rating systems, such as the Washington-based U.S. Green Building Council's LEED, the Washington-based National

Q&A

METAL-ROOF AND REFLECTIVE-INSULATION RATINGS



Scott Kriner
LEED AP
President, Green Metal Consulting, Macungie, Pa.

Q: Do metal-roofing ratings for reflectivity and emissivity differ from reflective insulations? The way reflective insulations are rated, the lower the emissivity the better. On a scale of 0 to 1, most reflective insulations' reflectivity ratings are around 0.03. Wouldn't it make more sense to have a universal number, like R-value, when metal roofs and reflective insulations are referring to the same performances? *— CORY GROFT*

A: Reflective insulation is designed to reflect as much solar radiation away from the surface as possible while retaining the remaining heat energy, rather than re-radiating it into an attic cavity. This is the same principle as low-E glass. Windows with low emittance will not re-radiate the heat energy that is absorbed, thereby keeping that energy from flowing inside a room. A low-E window is warm to the touch because the heat energy is retained rather than emitted.

In most situations where cooling loads dominate, the desirable combination for painted metal roofing is for the surface to have high solar reflectance and high thermal emittance. The high solar reflectance allows a large percentage of the solar radiation that strikes the surface to be immediately reflected away. The energy that is not reflected is absorbed at the roof surface. To cool the roof-surface temperature, a surface with high thermal emittance is desirable so that a percentage of that heat energy at the surface is emitted to the sky in the form of infrared energy. The result is a cooler surface, which then lowers the load placed on the air-conditioning equipment to cool the building space below the roof.

This combination of high solar reflectance and high thermal emittance on a roof system would not be as advantageous in cooler climates where heating loads dominate. In those regions, a relatively high solar-reflectance value would be desirable for the roof to deal with summertime air-conditioning loads, but a low thermal-emittance value would be desirable, so during cooler days the energy that has been absorbed at the surface can be retained, or not emitted, to aid in the heating of the building. That type of roof product typically is an unpainted metal roof, such as Galvalume or other natural metals.

Association of Homebuilders' Model Green Home Building Guidelines and Energy Star from the Washington-based U.S. Environmental Protection Agency.

It can contribute toward earning LEED points within Energy and Atmosphere criteria because of its heat-transfer qualities, Materials and Resources because of its ability to be reused, and Indoor Environmental Quality because of its contribution to increasing thermal comfort. It also helps qualify for the "Renewable energy/solar heating and cooling—Using passive Cooling" credit under NAHB's Model Green Home Building Guidelines.

Reflective insulation helps meet requirements for the Home Energy Rating, or HERS, Index requirements, which are part of Energy Star. The HERS Index, established by the Residential Energy Services Network, Oceanside, Calif., involves an analysis of a home's construction plans and an on-site inspection. A home built to the specifications of the HERS Reference Home, based on the 2006 International Energy

Reflective insulation attached below the bottom flange of an 8-inch (203-mm) purlin produces an enclosed reflective air space. If the space between purlins has R-19 insulation that is 6-inches (152-mm) thick, then there is an air space of approximately 2 inches (51 mm) between the insulation and reflective insulation that has been added. The added reflective insulation increases the thermal resistance between the purlins and provides a continuous layer of added insulation. The resulting U-value estimates are shown in the table. Additional thermal benefit would be realized if the bottom side of the reflective insulation has a low-E surface.

Estimated U-Values for a hybrid metal-building insulation system consisting of R-19 fiber-glass insulation and a continuous layer of reflective insulation

MATERIAL R-VALUE OF ADDED INSULATION	SUMMER R-VALUE INCREASE BETWEEN PURLINS	U	WINTER R-VALUE INCREASE BETWEEN PURLINS	U
1.0	6.75	0.052	4.05	0.055
1.5	7.25	0.050	4.55	0.053
2.0	7.75	0.048	5.05	0.051

R-value units are ft^2·h·°F/Btu
U-value units are Btu/ ft^2·h·°F

The U-value for this assembly before the reflective insulation is added is 0.065. The heat loss or gain from the conditioned space is reduced as the U-value is reduced.

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RIMA-I
North American Members

Astro-Foil—Innovative Energy
Lowell, Ind.
www.insul.net

BASF Building Systems
Shakopee, Minn.
www.buildingsystems.basf.com

Covertech
Etobicoke, Ontario, Canada
www.covertechfab.com

DuPont Tyvek
Richmond, Va.
www.dupont.com

Environmentally Safe Products Inc./Low-E Insulation
New Oxford, Pa.
www.low-e.com

Fi-Foil Co. Inc.
Auburndale, Fla.
www.fifoil.com

Innovative Insulation Inc.
Arlington, Texas
www.radiantbarrier.com

Insulation Solutions Inc.
East Peoria, Ill.
www.insulationsolutions.com

Louisiana Pacific
Franklin, Tenn.
www.lpcorp.com

Polyair
Atlanta
www.polyair.com

Radiant GUARD
Frisco, Texas
www.radiantguard.com

Reflectix Inc.
Markleville, Ind.
www.reflectixinc.com

Resisto (division of Soprema Inc.)
Beauport, Quebec, Canada
www.ayr-foil.com

RoyOMartin
Alexandria, La.
www.royomartin.com

STS Coatings Inc.
Comfort, Texas
www.heatbloc.net

TVM Building Products
Acton, Ontario
www.tvmi.com

Conservation Code, scores a HERS Index of 100. A zero-energy home scores a HERS Index of 0. The lower a home's HERS Index, the more energy efficient it is in comparison to the reference home. Reflective insulation contributes to this score because it provides the envelope with thermal resistance.

Combined with the inherent greenness of metal buildings, reflective insulation can help create an even more efficient, durable building. Just as NASA turned to reflective foil coverings for its space program, metal-building owners can rely on reflective insulation to help their buildings' performance.

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