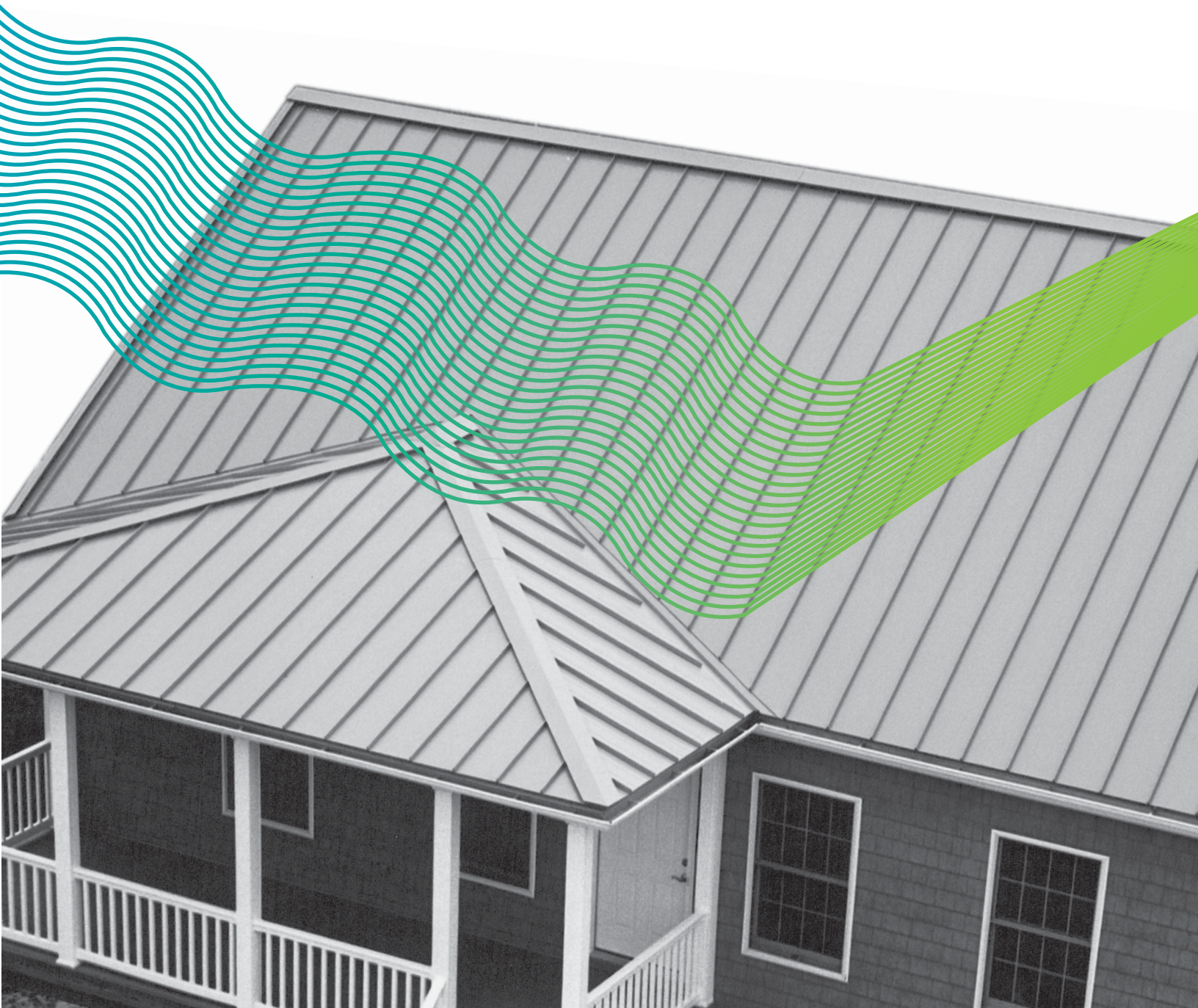
COOL CHEMISTRY® Series

Improved energy efficiency with superior performance

AkzoNobel
Tomorrow's Answers Today

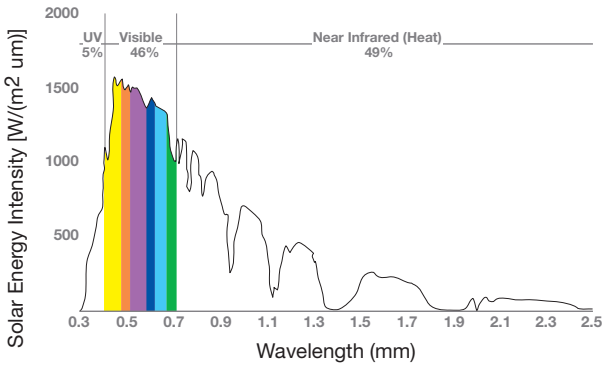


It starts with the sun - cause and effects

Components of solar energy

Energy from the sun that strikes the earth has three components, most of which we cannot see. The energy that determines the color of an object, the visible spectrum, represents only 46% of the sun's energy. Ultraviolet light (UV) is about 5% of the spectrum and is the energy that can cause damage to our bodies and skin, as well as degrade paints and polymers. Infrared light, the invisible portion, represents about 49% of the spectrum.

Spectrum of solar radiance



Invisible spectrum

Infrared light contributes to heat build-up. Products containing infrared-absorbing pigments will heat up faster and to a greater degree than products colored with infrared-reflecting pigments. The benefits of reducing temperature are well known. Heat accelerates the degradation of color, gloss, elasticity, and other physical properties of roofing materials. Thermal expansion and contraction may shorten the life of roofing.

Energy efficiency

Various scientific studies document that the energy efficiency of a building is dependent upon many factors, including the building age, occupancy and the design and selection of construction materials. One study, of more than 200 homes in central Florida, reports that air conditioning accounts for 33% of electrical consumption. The report notes that higher levels of ceiling insulation and lower attic temperatures produced by reflective roofs are major factors in reducing air conditioning energy use and demand.

Important Definitions

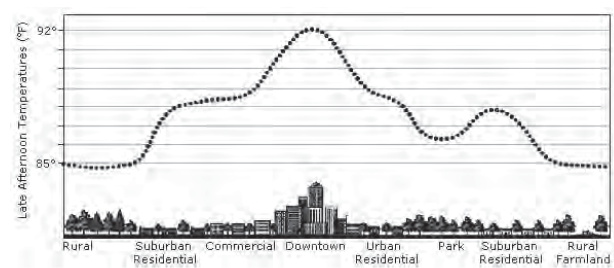
Total Solar Reflectance (TSR) - Amount of infrared radiation reflected from a surface, expressed in terms of % or decimal (i.e., 68% or 0.68).

Thermal Emittance (TE) - Percentage of radiation emitted from a heated body, compared to a perfect black body, expressed in terms of % or decimal (i.e., 68% or 0.68).

Heat island effect

Growth in urban areas has produced "Urban Heat Islands." These urban heat islands may be as much as 12 degrees warmer than surrounding, less developed areas. Surface temperatures of roads, sidewalks, and building roofs may be 70 degrees higher than the ambient air temperature. These higher temperatures result in high air conditioning costs and the need for greater electrical production. The excess heat and increased energy production leads to increased levels of ozone and pollution/smog. Reducing temperature by as little as one half degree can reduce smog by 5%. Using highly reflective roofing materials can reduce cooling costs by as much as 23%.

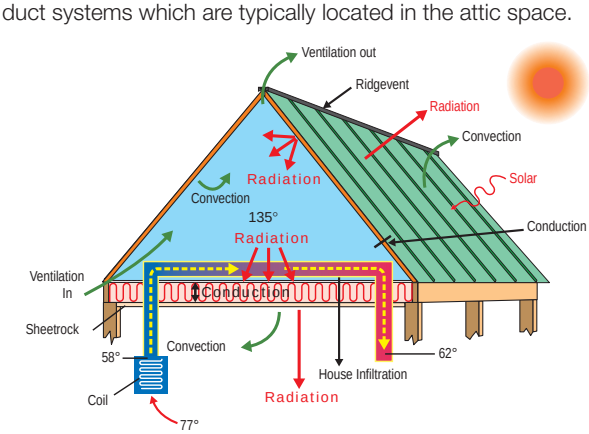
Sketch of an urban heat island profile



SOURCE: NASA/GHCC PROJECT ATLANTA

Vented attic thermal processes

Roof and attic thermal performance exerts a powerful influence on cooling energy use in Florida homes. Unshaded residential roofs are heated by solar radiation causing high afternoon attic air temperatures. The large influence on cooling is due to increased ceiling heat transfer as well as heat gains to the duct systems which are typically located in the attic space.

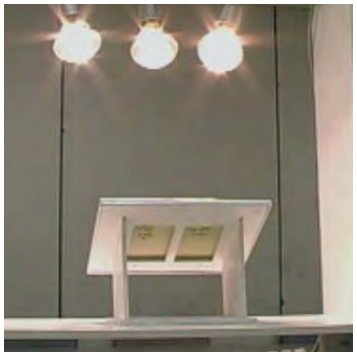


SOURCE: FLORIDA SOLAR ENERGY CENTER

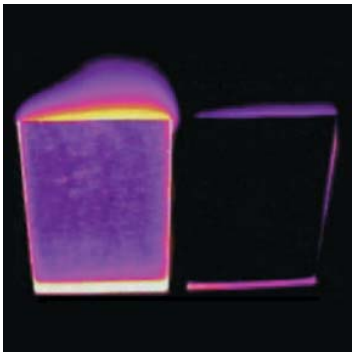
Painted metal outshines them all

IR camera - laboratory demonstration

In the laboratory, the effect of infrared light can be demonstrated on various materials through a simple arrangement. New materials can be tested, and the amount of heat generated directly observed , under controlled conditions, without the need to construct test buildings.



A bank of infrared lamps is arranged to shine on test materials mounted at an angle approximating a roof exposure.



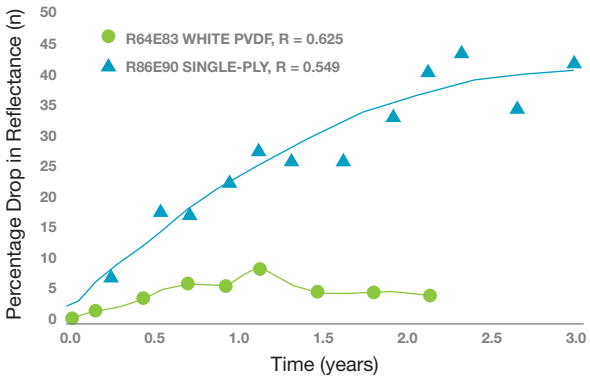
Through the use of a thermal imaging camera, a visual record is made of the temperature of the test materials. The panel on the left uses traditional pigments, while the panel on the right uses COOL CHEMISTRY® pigmentation.

Research into the benefits of cool metal roofing

Studies conducted by several independent and government sponsored research organizations have demonstrated the improved energy efficiency attributable to the use of more solar reflective materials on roofs. More recently, these organizations have concluded, based on additional studies, that prepainted metal outperforms other construction materials for reducing energy costs when used on roofs.

Oak Ridge National Labs

In a three-year study conducted with the cooperation of several industry groups, various metal roofing systems were compared for energy efficiency and service life. “Early data suggests both, that metal panels maintain high reflectance, even after continuous exposure to the elements and also that painted and unpainted metal panels maintain their energy efficiency better over time than other roofing materials under test.”



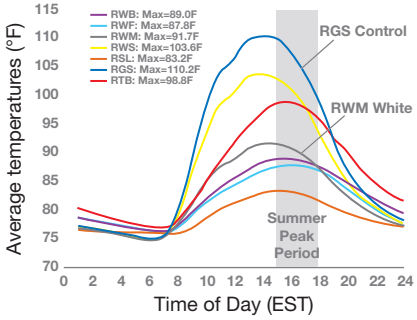
SOURCE: OAK RIDGE NATIONAL LABORATORY

Florida Solar Energy Center

Results of tests conducted by Florida Solar Energy Center for FPL showed that white painted galvanized metal roof saved the most energy. Other materials included dark gray shingles, white shingles, white flat tile, white tile, terra-cotta S-shaped tile. The results are being used to develop a program that will promote selection of white or light colored roofs for energy conservation.

The maximum attic temperature during the peak summer hours is 40°F higher than the ambient air temperature in the control home, but no higher than ambient with highly reflective roofing systems. Light colored shingles and terra cotta roofs show temperatures in between.

Average attic air temperatures over unoccupied period



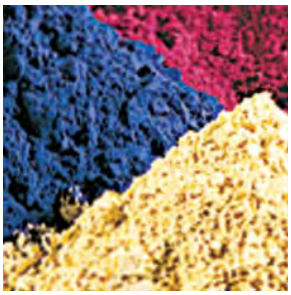
SOURCE: FLORIDA SOLAR ENERGY CENTER

Creating the right cool chemistry

Components of coatings

All coatings contain two primary ingredients – resin and pigment. The long-term performance of exterior coatings is dictated by resin strength and the correct choice of pigmentation. You simply cannot have one without the other. The right combination will insure a superdurable coating.

The resin's primary functions are to provide adhesion, flexibility, hardness, moisture and chemical resistance, and resistance to UV light. The pigment provides the color of the coating. The right pigment is critical in formulating a coating that resists fading, another important property of the pigment.



Differences in pigment types

Pigments used in exterior metal coatings fall into three classifications:

organic pigments: comprising a class of pigments that may have good — but usually not ultimate — durability. Just as the curtains in your living room can be expected to fade with time, so can the organic pigments used in coatings. It generally costs less to use organic pigments.

inorganic pigments: pigments that are synthetic or naturally occurring which do not contain carbon compounds. The majority of these colorants provide excellent long-term performance. The exception is carbon black, which can sometimes be considered an inorganic pigment. Their higher performance usually comes at a higher cost than organic colorants.

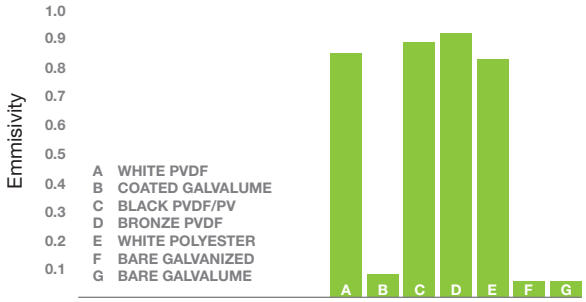
ceramic pigments: named after their original use in ceramic products, these complex inorganic pigments are made from mixed metal oxides synthesized at molten metal temperatures. The most color stable pigments available today, they offer unparalleled resistance to heat, light and chemical attack. These attributes make them ideal for use in the highest quality exterior coatings to assure long-term color retention even after decades of weathering. Higher cost is usually associated with their higher performance.

Greater reflectivity achieved through pigmentation

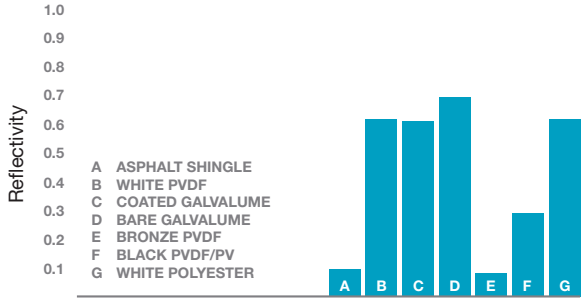
These pigments take solar reflectance a step higher than previously possible. Solar Reflective Pigments (SRP) have been altered, physically and chemically, to reflect infrared radiation while still absorbing the same amount of visible light, thus appearing as the same color as lesser reflecting pigments, yet staying much cooler.

It should be no secret – higher solar reflective coatings are possible through the use of select ceramic pigments and new SRP's.

Emmisivity is influenced by the coating



Reflectivity is influenced by pigmentation



We are leaders in cool roof coatings

The proof is in the performance

Long term durability needs to go hand-in-hand with solar reflectance. Many of the SRP's are mixed metal oxides (inorganic/ceramic) that have been around for years, and are typically used in high performance coatings such as TRINAR® and our CERAM-A-STAR® family of products.

The truly new SRP's now appearing in the marketplace are represented by a handful of colors, chemistries, and suppliers, for which only limited actual South Florida testing data is available.

Examples of "improved solar reflectance" appearing in the marketplace are quite often nothing more than the comparison between low-cost, organic pigmentation and the ceramic and select inorganic pigments which have been used for years in TRINAR® and our CERAM-A-STAR® product lines.

Many existing TRINAR® and CERAM-A-STAR® colors are, and have always been, formulated with SRP's because both systems use high quality pigmentation. The most notable exceptions are those colors using considerable amounts of black or brown traditional ceramic pigments. For these colors, improvements in TSR may be realized by using AkzoNobel's COOL CHEMISTRY® Series of coatings with ceramic pigments that have the highest level of infrared reflectance.

For years AkzoNobel has served its customers worldwide by creating the right chemistry with products such as TRINAR® and our CERAM-A-STAR® product lines. With our COOL CHEMISTRY® Series of coatings, we continue to offer the unparalleled durability of TRINAR® and CERAM-A-STAR® in formulations which reduce energy consumption in buildings, thus lowering costs while protecting natural resources and help reduce pollution.

"The selection of reflective roofing systems represents one of the most significant energy-saving options available to home owners and builders."

– Florida Solar Energy Center

Energy Star® program

The EPA believes that the energy savings possible from roofing products are so important that it has included them in its Energy Star® program. States and localities are using Energy Star® specifications to award tax rebates and incentives.

An Energy Star® compliant roof must have the following solar reflectance:

Steep-Slope	>= 0.25 initial	>= 0.15 after 3 years
Low-Slope	>= 0.65 initial	>= 0.50 after 3 years

Low-slope roofs are surfaces with a slope of 2:12 inches or less. (As defined in ASTM Standard E 1918-97).
Steep-slope roofs are surfaces with a slope greater than 2:12 inches.

For more information, please contact:

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AkzoNobel
Tomorrow's Answers Today

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We're the largest global paints and coatings company and a major producer of speciality chemicals. We supply industries worldwide with quality ingredients for life's essentials. We think about the future, but act in the present. We're passionate about developing sustainable answers for our customers. Based in Amsterdam, the Netherlands, we have 60,000 employees working in more than 80 countries - all committed to excellence and delivering Tomorrow's Answers Today™.

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CRRC COOL ROOF RATING COUNCIL

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