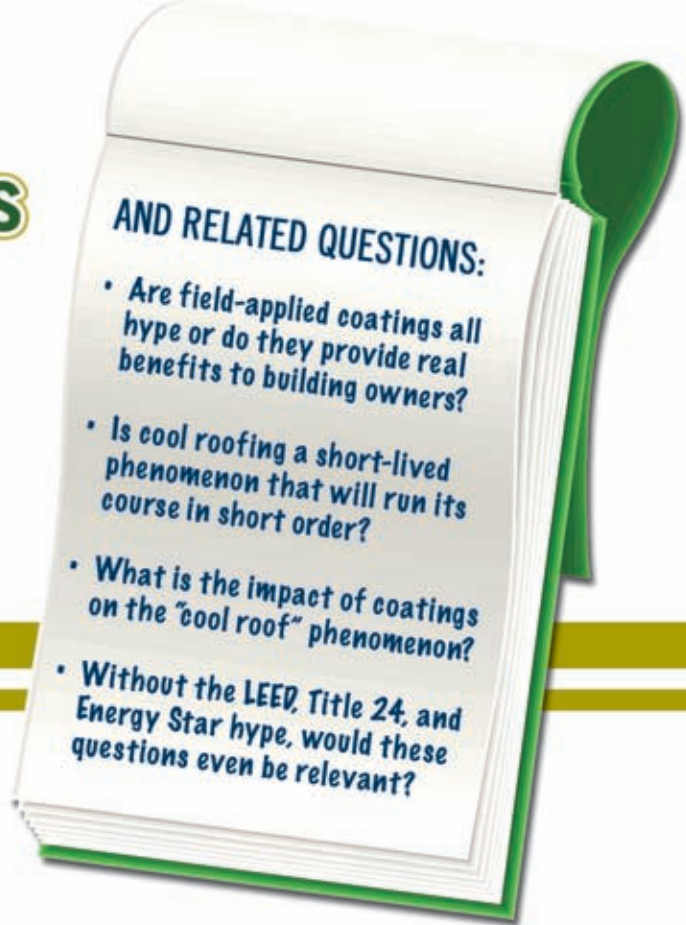


What Roof Consultants Need to Know About Field-Applied Roof Coatings...



By Bill Kirn, RRC, and Jim Leonard

Many articles have been written that explore these cool roof issues, such as:

- The value of white-coated surfaces providing solar reflectance versus the value of insulation and the need for R-value.
- The value of cool roof systems versus the value of proactive maintenance programs.
- The value of good roof design versus LEED/EnergyStar/Title 24 guidelines.
- The value of government and utility incentives to promote change versus roofing as it has been institutionalized.

In all of these cases, the discussions are presented as issues, alternatives, or options. Which will provide greatest and fastest return on investment? Which can save the most energy? Which will have the greatest impact on the environment? Often, a bias based on what is being sold becomes obvious.

In reality, it does not have to be "either/or." Good roof design needs

to incorporate factors beyond "the roof," such as LEED guidelines, and account for government and utility incentives. Roofs need to have sufficient insulation and cool surfaces. Proactive maintenance pays dividends on all roofs, including cool ones.

Without federal, state, and local governmental initiatives such as Energy Star, Title

24, and LEED, would this be a topic for discussion? Definitely! The primary benefit of roof coatings in extending the life of various systems and reducing maintenance costs has been well known for years. But the roofing industry has traditionally been first- and low-cost driven, and field-applied coatings have served a small niche within the



Modified-bitumen roof in the process of being coated.

industry. It has only been with the introduction of the energy and environmental issues into roofing and the recognized role of field-applied white coatings to increase the solar reflectance of dark surfaces that coatings have become a greater part of the arsenal of reflectivity and longevity solutions within the roofing community.

The energy and environmental issues related to roofing are significant and a reality for roof consultants to deal with in the future. Energy dollars saved with a white reflective cool roof may be small by comparison to the cost of poor design, inadequate maintenance, and shortened roof life. With all that being said, white reflective coatings have a place in the developing cool roof marketplace.

The Basics

Let's examine some of these issues in more critical detail. Roof coatings are by definition a monolithic, single-ply, fully adhered membrane formed in situ on an existing roof membrane. Typical coating dry film thicknesses exceed 20 dry mils. This means the coating actually becomes the top ply of the composite roofing membrane and underlying system. As such, the coating is the first echelon of protection for the membrane, receiving the full impact of sunlight (both IR and UV), rain, hail, and physical damage due to impact. A properly formulated coating is designed to reflect both the IR and UV portions of sunlight, thus protecting the underlying membrane from the damaging effects of the sun. When the coating is light in color, it not only reduces the summertime air conditioning demand, but, equally important, also reduces the stress on the membrane caused by heat. The effects of "thermal shock," where the roof is subjected to summertime heat followed by the rapid cooling of an afternoon thunder-shower, are also reduced.

Additional features can be built into the coatings. Often, these coatings contain fire-retardant components that enhance the Factory Mutual and United Laboratories fire rating of the entire system. Increased mildew and algal protection can be impart-



PVC coated roof.

ed to the coating to protect the roof in hot, moist climates.

The following are some common questions often asked about reflective roof coatings.

the IR portion of the solar spectrum. The application of a white coating is a maintenance practice rather than the installation of a new or recover roof. This is an important distinction, as the coating does not add significant additional "dead load" or weight

What coatings should be used over different roof substrates?

It is important to follow the manufacturer's directions and cautions when applying any roof coating. Typically, the product data sheet will list the appropriate substrate and recommended film thickness for approved substrates.

Which is better: a white roof coating or a white membrane roof?

Neither is better: they are different with advantages and disadvantages for each. Either will reduce the cooling load on the building by reflecting



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Reinforced coating system over BUR capsheet.

to the roof. Thus, if the roof includes two roofs – the original and a recover – then, the coating can be applied while still complying with the appropriate building code.

There are also tax advantages and financial implications that may favor a roof coating over a new white roof. By contrast, the white roof is a true “roof,” acting as the primary waterproofing. The coating is usually not the primary waterproofing, but rather acts as the first echelon of protection, keeping water out and shielding the membrane. Remember that with any type or color of roof, a coating can be applied to prolong the roof life.

If a roof starts out white, doesn't it get dirty, thus reducing the solar reflectance? How much loss in reflectance can be expected?

The roof will collect dirt during its life and will have lower solar reflectance or albedo. Studies conducted by Lawrence Berkeley Laboratory and reinforced by field studies conducted by ERSsystems, have shown that the solar reflectance drops to about 80 percent of its original value. Of course, this is critically dependent on the “micro climate” – i.e., how dirty the locale is. Actual experimental data is now becoming available on the Cool Roof Rating Council (CRRCC) Web site, which lists three-year aged

reflectance of listed roofing materials. Early results show that a properly formulated white coating can retain more than 88 percent of its original solar reflectance.

I'm using a primer with my roof coating. Do I need to clean the roof?

Definitely. A primer is not a replacement for thorough cleaning. Remember, the primer is designed to adhere to “structurally sound” (read: dirt-free) substrate. With-

out precleaning, the primer will not make the needed contact with the roof substrate. Any chemical reaction to promote adhesion that may normally take place will be impeded by the presence of dirt and degraded roofing material.

On the job site, how can I tell if the roof is satisfactorily cleaned?

Here's an easy qualitative method: When the roof has been cleaned and dried, press a 3- to 4-inch long piece of 2-inch wide masking tape to the roof using hand pressure. Then, peel the tape off. If it comes off easily or is laden with dirt, degraded roofing material, and/or other particulates, the roof is not satisfactorily clean. Reclean and dry the roof and repeat this test. This

test should be conducted in several areas of the roof, especially in dirty areas or those that collect ponded water.

Is there a more quantitative method for determining the adhesion of a coating to a roofing substrate?

Yes. One easy method is to apply the roof coating to the prepared roof surface and while still wet, embed a 1-inch wide cloth strip. The strip should be approxi-



SPF roofing and restoration coating over BUR capsheet.

mately 12 inches long, but embed only about six inches of the strip. Allow this to dry. If wet adhesion properties are needed, adhere a 12-inch diameter by 2-inch, sheet-metal cylinder to the substrate using a caulk. When the caulk is dry, fill the area with water and wait for one week. After the dry/immersion period, attach a small fish scale (the kind used by sport fisherman, available at sporting goods stores) to the free end of the cloth strip. Carefully, cut the 1-inch wide sides of the strip that is embedded in the coating, being careful not to cut into the substrate. Pull slowly on the fish scale, pulling the 1-inch wide cloth strip away from the substrate at an angle of 180° from the sample. Read the weight (force) required as the cloth strip is pulled away. This method is similar to the ASTM C-794 adhesion test. ASTM specifications for different coating types list minimum adhesion values. An acrylic coating could reasonably expect adhesion in excess of 1.5 pli.

Coating data sheets typically describe mechanical properties, permeance, and swelling. How important is film thickness in these tests?

If the tests were conducted in accordance with ASTM D-6083, then the samples

should have been prepared at 20-dry-mil thicknesses. Obviously, the results of these tests will be different if the same product is tested at 30 instead of 20 dry mils.

Coating product data sheets list values for adhesion. Are these numbers different from actual (in the field) numbers?

Sometimes, yes. Experience has shown that adhesion values actually increase for waterborne coatings after weathering. This is because the coating, which contains some low levels of water-sensitive components necessary to maintain stability in the drum, leach out when exposed to the rain. These water-sensitive components have a slightly negative effect on adhesion. When they are removed from the coating – and, specifically, at the coating-to-substrate interface – the adhesion values increase.

Do membrane “release agents” – such as talc on EPDM and sand on modified bitumen – have an effect on adhesion?

Yes, the release agents can interfere with adhesion. Since they are not embedded into the membrane, the coating adhesion will not be as good as it would if the release agents had been removed prior to coating.

Proper cleaning of the existing substrate will provide the best adhesion.

If you could briefly describe adhesion in a very concise way, what would you say?

Adhesion, one material sticking to another, is best described as “an interfacial property.” That is, the quality of adhesion has as much to do with the coating or adhesive as it does with the substrate. Think about applying an epoxy adhesive to a Teflon® frying pan. Chances are the adhesive will not work well. Why is that? Is it because the epoxy is not a good adhesive, or because the Teflon surface of the fry pan is not clean? Neither. It is not because the adhesive is not “good,” but rather that the chemistry of the substrate and the chemistry of the adhesive (coating) are not suitable for nor compatible with one another.

How much weight does a coating add to the dead load of the roof?

If a typical reflective roof coating having a solid weight of 67% at 12.0 pounds per gallon is applied at 3 gallons per square, it would add approximately 24 pounds per square to the weight of the roof. So the weight would increase by 0.24 pounds per



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square foot. If a scrim is embedded into the coating, that would also be factored in.

Are all aged roofs suitable for coating? When is the roof too badly deteriorated to benefit from coating? When is the appropriate time to coat the roof?

The obvious answer is, "While it is still possible for the coating to be effective." If the roof has significant water entrapped below the membrane, the prudent decision would be to tear off that section and replace it with new membrane. However, if the mechanical and structural integrity of the membrane are viable, then the roof is a suitable candidate for coating.

The mechanical and structural integrity of the roof membrane refer to the membrane's ability to tolerate the mechanical stresses associated with that particular roof under those specific design and environmental factors. If the reinforcing mat or scrim in a single ply has deteriorated substantially due to excessive weathering, an unreinforced coating cannot be expected to have the tensile strength required to maintain the roofing membrane. Similarly, if the glass or polyester mat of a conventional built-up or modified bitumen roof has deteriorated significantly, the roof may not be suitable for coating. Without scrim reinforcement, today's coatings are not capable of providing the tensile strength normally provided by glass and polyester mats. Coatings are designed to have sufficient elongation and tensile strength to protect and reinforce the substrate over which they are applied, but they do not add significantly to the mechanical properties of the substrate.

Are all roofs maintainable with coatings?


This question can be answered with the statement, "Yes, if the coating provides some performance property inherent in the roofing membrane that has deteriorated as a course of normal weathering." For example, the original, factory-applied OEM coating on a metal roof may erode during weathering and can be recoated using the appropriate maintenance coating. Even uncoated metal subject to galvanic corrosion can be coated with a corrosion-inhibiting coating to prolong roof life. Built-up and modified bitumen roofs subject to surface degradation can be coated with coatings that provide additional protection in the form of high film thickness over the weathered and worn areas. If the coating has additional reflective properties, as in the case of white

reflective coatings, the roof membrane temperature can be reduced and the life extended. As single-ply roofs weather, causing chalking, crazing, and checking, they too can be maintained with coatings. This type of coating would be specifically formulated to adhere to the membrane, tolerate the dynamics associated with the membrane installation method (i.e., fully adhered or mechanically attached), and have excellent weathering characteristics equal or superior to the membrane chemistry.

Summary

Reflective coatings have proven to be a useful and complementary tool in maintaining and sustaining roofs. Today's high-performance, reflective, elastomeric coatings not only protect the underlying membrane, but also provide air conditioning energy

savings through solar reflectivity. These coatings have demonstrated significant "added value" to the building owner in actual life cycle cost studies. Moreover, coatings are actually more weather-resistant than some roof membranes they protect. Ideally, in the future, only the original roof will be required, and it can be coated easily and periodically, just as floors or walls are painted and repainted. "Sustainable roofing" exists today through the use of reflective coatings.

The roofing professional and the building owner can incorporate the criteria described in this paper to make a prudent and cost-effective coating selection. Improved understanding of the roof's physical and dynamic requirements will ensure a successful coating selection and installation. 

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Bill Kirn is technical director and key accounts manager of National Coatings Corporation. He was previously employed by Rohm and Haas Company, most recently as market manager for roof coatings. Prior to moving into marketing, Kirn spent 22 years in research, developing acrylic products for construction applications. He holds four U.S. patents for a wide range of chemical applications. He has been a featured speaker at RCI conventions and facilities engineering and maintenance expositions. Bill is an RRC and was on the faculty of the Roofing Industry Educational Institute. He has been a recipient of the Richard Horowitz Award for writing excellence in *Interface* journal. He is active in the Polymeric Materials Subcommittee of ASTM D-08 (Roofing and Waterproofing) and E-06 (Building Performance). Bill currently chairs the technical committee and is on the board of directors of the Cool Roof Rating Council (CRRC) and is a member of the Construction Specification Institute. He is president of the Reflective Roof Coating Institute (RRCI) and serves on the board of the Energy Coordinating Agency, a non-profit organization that assists low income seniors with energy-related needs in Philadelphia, Pennsylvania. Bill holds a bachelor's degree in chemistry from Temple University, a master's in organic chemistry from St. Joseph's University, and an MBA from Temple University.



Jim Leonard

Jim Leonard received degrees in chemistry from the University of Wisconsin and the University of South Dakota. He taught college chemistry for ten years. Jim has over 30 years experience in development and marketing of roof coatings and adhesives and holds two patents. In 1993, he founded Elastomeric Roofing Systems, Inc., and in 2004, was a co-founder of Prairie Technologies, Inc. Leonard is past president of the Reflective Roof Coatings Institute, and a member of NRCA, RCI, CSI, SPFA, and CRRC. He has written numerous articles for publication. ERSYSTEMS' manufacturing plant in Rockford, Minnesota, is built to LEED standards with a roof that serves research and demonstration functions for garden roofing, solar and wind study, and roof-mounted energy generation.