

A roof consultant takes the industry to task for dirty roofs

by Tom Hutchinson, AIA

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There are many reasons building owners clean their roof systems—aesthetic preference, functional use, and to assist in roof system inspection and maintenance. But the idea of cleaning a roof system to allow a roof membrane to perform one of its intended functions—reflecting the sun's rays—generally has been ignored in the roofing industry.

Although the "cool" roofing movement was unknown a few years ago, it is gaining momentum because of the concept that roof surfaces can provide energy savings. There are numerous points of discussion regarding this concept, but one that remains seemingly unaddressed by many manufacturers, code bodies, associations and the research community is that roof systems get dirty. What has been circulated to government agencies, code bodies, and the design and roofing communities is the hypothesis that white roofs will save energy, but the issue of cleaning roof surfaces to maintain reflectivity rarely is brought into discussion. In fact, some manufacturers have gone to the extent of declaring they never promised a roof would stay white.

Following are my thoughts and opinions regarding the means, methods, effects, consequences and realities of cleaning soiled roof surfaces to maintain roof reflectivity.

Ignoring the issue

Research conducted during the late 1990s by the Lawrence Berkeley National Laboratory (LBNL), Berkeley, Calif., suggested a light-colored roof may provide savings when cooling a building while reducing the urban heat island effect. (For more information, see "[Cool systems for hot cities](#)," October 1998 issue, page 32.)



Photos courtesy of Hutchinson Design Group Ltd., Barrington, Ill.

Quality aluminum coatings, such as the one used on the Louisiana Superdome pictured here, that are installed on relatively steep surfaces have maintained a great degree of their initial reflectances.

LBNL suggests northern cities such as Chicago and New York would achieve energy savings if they turned all their roofs white (though it is a physical impossibility). But cleaning soiled roofs to maintain any suggested energy performance is, unfortunately, absent from the data report.

In 2001, Chicago instituted a new Energy Conservation Code in which all low-slope roof systems constructed were to have minimal thermal resistance and roof reflectivity. No mention is made of maintaining roof reflectance through cleaning.

Interestingly, roofs sometimes are cleaned when researchers and government agencies attempt to support purported energy savings. To facilitate the accountability of roof membrane surface reflectivity values, the Cool Roof Rating Council was established. It will publish "aged" reflectance values for products in 2007 in which membranes will not be permitted to be cleaned, and testing currently is ongoing. But the Environmental Protection Agency's (EPA's) ENERGY STAR® program allows cleaning of test samples to take place before testing. Any testing of aged membranes or coatings in which cleaning takes place first is erroneous information to promote without proper clarification and caveats as to what is being reported.

There is one study that acknowledges the benefits cleaning roof membranes has on reflectivity. In 1998, SPRI and the Oak Ridge National Laboratory (ORNL) undertook a study to determine the effect of long-term exposures on sheet membrane reflectances. The results were reported at the 2004 Roof

Consultants Institute International Convention and indicated all membranes lost reflectivity over time—some up to 50 percent; the report also found that with cleaning the membranes' reflectance could be returned.

Building owner issues

Most building owners, facility managers and roof system designers expect roofs to perform after installation without much maintenance. Their expectation of white membranes and coatings is that they will stay white. A recent walk through the Chicago Roofing Contractors Association trade show found not one membrane or coating manufacturer promoting "cool" roofing that offered the caveat "you have to clean it."

It is important to relay to building owners who purchase roof systems based on providing energy savings that they not only will have to clean roofs to maintain energy savings but also repetitive cleaning may or may not shorten a roof system's service life. The discussion also would not be complete without talking about how cleaning affects a warranty.

The warranty issue is an interesting topic and one that has not been addressed at all by manufacturers. I asked no fewer than eight manufacturers about their written policies on warranty coverage for roof membranes potentially damaged, eroded away and/or

chemically altered by "required" cleaning to maintain potential energy savings. My inquiries drew many, "good question, let me get back to you," responses. I also inquired whether they provided any roof cleaning training and licensing. The answers were negative.

Promoting products that are based on cool roofing and then not having answers to these questions is acumen to telling only half the truth. I'm awaiting a lawyer's view regarding when energy-savings performance is below what is anticipated (or perhaps implied).

So should an owner be expected to clean his roof annually? At this time, there are no cleaning-cycle recommendations from anyone, which is leading to questionable practices.

Currently, a number of agriculturally based production facilities and breweries clean their roofs of deposited debris that escapes the ventilation systems. This cleaning takes place to prevent roof system deterioration. In-house maintenance crews often perform this work, and it appears cleaning often is performed without proper Occupational Safety and Health Administration- (OSHA-) required protection and appropriate insurance. These crews also are unfamiliar with roofing and the correct means and methods of cleaning roof surfaces.

But even if a roofing contractor were contacted, he may not be of much help. A survey I conducted in January of 10 of the largest roofing contractors in Chicago found that none were organized to provide cleaning as a maintenance service.

The reality

Even if a building owner desires a clean roof and finds a contractor to perform such a service, there is a complete lack of information available in the industry.

From the viewpoint of a roof system designer, one of the first parameters of cleaning I would undertake is that of a cleaning solution's type, strength, application method, etc. Roofing professionals must realize codes restrict what can be sent down a roof drain and into storm drainage systems or retention ponds. The current industry mindset is to use detergent solutions ranging from products available at a convenient store to solvents, and of all the manufacturers interviewed for this article, no two product recommendations were the same.

I am unaware of any discussion about how roofs will be cleaned in areas of the United States in which water use is restricted. For example, in the Midwest, the use of water for car washing and lawn care often is restricted. The Southwest is particularly water-deprived. It is incongruous to suggest owners clean roof surfaces to maintain anticipated energy savings when the use of water in such volumes and waste may not be permitted.

That said, it is evident the current industry state of affairs with regard to cleaning roof surfaces is one of confusion. No recommended procedures, materials, or means and methods appear to exist. Contractors are not set up to provide the service, and if and when they do, the effects of that cleaning on the roof surface integrity are unknown. Considering the importance placed on a roof surface's potential ability to provide energy savings, this level of flux is unacceptable.

The type of roof surface will affect the amount of soiling and results of cleaning, as will roof slope. Low-slope roofs have a tendency to pond water, accumulate debris and drastically alter any potential for energy savings, as shown in Photo 1. According to some manufacturers, certain cleaning solutions may promote biomass growth, and some solvent-based cleaners may deteriorate a membrane's surface as they clean. Without clearly written recommendations, contractors will try a variety of products at risk.



Photo 2: This photo shows the reality of a white roof surface membrane used in areas of heavy agricultural activity. The soil atop the membrane certainly has robbed the roof of its potential energy savings. Rather than trying to repeatedly clean the roof surface, using ballast would have been a better design choice in this situation.

Another issue is the method of washing. For example, does a contractor use a power washer, hosed water and a broom, scrubbing machine or hose spray nozzle? Many in the public domain seem to believe power washing is an advantageous method of cleaning fairly quickly and effectively. Unfortunately, the pressure to be used is unknown, and the angle of application, even if provided, would change as a crew faces fatigue during the operation. How flashings and seams are to be treated with a pressure washer also are unknown. I have seen seams of modified bitumen opened and coatings peeled off effectively by errant positioning of a pressure tip. One manufacturer even indicated it was leery of recommending the use of power washers on its products because the power washers may pull out plasticizers. If a scrubbing machine is to be used, what coarseness of pad should be used and what type of safety precautions are necessary?

Sometimes, practicality itself is reality. A great many facilities cover more than 100,000 square feet (9290 m²) of area. Bringing water and electricity to roofs of this size is impractical.

Contractors who look into providing cleaning services will need to consider the costs of procuring the appropriate insurance, complying with OSHA, training and safety, which certainly will push the cost of cleaning upward.

Cleaning recommendations

Even though the practicality of cleaning a roof surface is low and repeated cleaning unrealistic, there are those who will undertake this endeavor. Therefore, a methodology needs to exist.

The first question to ask is why a roof is being cleaned. Is it to return the roof's surface reflectivity near its initial value? Is the soiling an accumulation of airborne particulate, soil, debris, biomass and/or mold? The cleaning means and methods will need to be customized to the roof in question. Following are a series of questions and protocol statements a contractor or designer may wish to consider when involved with cleaning a roof surface:

- Review with the owner his project goals.
- Document and provide written confirmation of the goals.
- Determine the roof surface composition—its membrane and/or coating type.
- Determine the roof's texture.
- Determine whether the roof surface is under warranty. Are there any disclaimers in the warranty with regard to cleaning?
- Determine the roof surface substrate.
- Identify the type of roof and site access available.
- Identify the electrical connections, and determine whether the amperage and wattage are adequate for the machinery intended to be used.
- Find the water connections.
- Are there any adjacent sites and building components that overspray may contact?
- Are there any site restrictions with regard to performing the cleaning?
- Are there any restrictions on water use?
- Verify the roof does not leak. If it does, provide repairs before introducing great quantities of water onto the roof.
- What is the roof drainage system, and is it able to handle the volume of water anticipated to be used during the cleaning operations? Determine whether drains are functioning properly.
- Is there any rooftop mechanical equipment that would be adversely affected by the spraying of water?
- Is there electrical conduit or other rooftop piping that may pose safety conditions?
- Determine conditions that may compromise safety, such as skylights, and include them in a safety plan.
- Determine the type of sheet-metal finish (painted, pre-finished, etc.) being used on a project and whether it will be affected by the cleaning procedures. For example, paint on field-painted metal may be removed when hit with a pressure washer.
- Determine whether any materials that may become dislodged by the cleaning operation are hazardous, such as lead paint and asbestos-containing materials or coatings.
- Contact the membrane and/or coating manufacturer's representative and review his thoughts about cleaning, and request written cleaning recommendations. Discuss issues such as pressure volume or scrub pad coarseness and warranty concerns. Confirm everything discussed in writing.
- Determine with the manufacturer the type of cleaning solution required, if any. Review with the cleaning solution manufacturer the appropriateness of its cleaning product on the type of roof surface being considered, and request environmental data. Inquire about the appropriate concentration mix and whether it will emulsify the soiling at low temperatures. Verify that it is environmentally safe for plants and animals. (One apparently environmentally friendly cleaning solution is EnviroWash by ERSystems Inc., Rockford, Minn.)
- Verify what type of odor the cleaning solution and/or cleaning process may have.

- Review the appropriate rinsing requirements and whether the cleaning solution will leave a residue.
- Verify with local code bodies and EPA the use of the proposed cleaning solution and its deposit into the roof's drainage system. Determine whether water recapturing is required and where it may need to be disposed.
- Verify the weight of the cleaning equipment will not damage the substrate below the roof membrane's surface.
- Verify the cleaning process will not adversely affect the bond of the roof surface to the substrate.
- Use electrical cords of appropriate wire gauge.
- Review with the building owner the process to be undertaken, and schedule a cleaning plan so he can inform building occupants.
- Submit your safety and fall-protection plans to the owner.
- Photograph the roof and all questionable conditions before cleaning.
- If funds permit, document the roof's pre-cleaned reflectance value.
- Before beginning full-blown cleaning, test a small area. Review with the cleaning crews the appropriate pressure, action of the wand or scrubbing machine, responsibilities of each crew member, safety concerns and project goals.
- Monitor the cleaning, and make modifications as necessary to be effective.
- Have action plans in place for when hoses are damaged; electrical cords are cut; drains clog; water infiltration occurs; overspray contacts personnel, passersby and/or vehicles; and when the owner stops cleaning applications.
- Following the cleaning, review the work. Have any curb flashings been damaged because of rubbing cords and hoses? Has the roof membrane or coating been damaged in any way? If so, repair as necessary.
- After cleaning, have re-inspections by the warranty holder performed and obtain written confirmation that full warranty coverage is in effect.

Design recommendations

The topics of cool roofing and cleaning will be debated for years. In the interim, the manufacturing community will be working to improve membrane and coating performance. Roof system designers can assist in this endeavor by considering the following in their roof system designs:

- Providing easy access to all roof levels, using large double-door roof hatches and ship ladders or penthouse access
- Providing rooftop water connections across a roof every 400 feet (121.6 m), maximum, so the maximum length of hose required on a roof is 200 feet (60.8 m)
- Providing 110/220 ground fault interrupter outlets every 400 feet (121.6 m) maximum
- Providing roof edge davits so fall-protection equipment easily and repeatedly can be installed
- Providing fall protection at all skylights and roof hatches
- Providing rooftop emergency contact boxes
- Designing adequate slope to promote water movement across a roof and minimize the soiling that may occur.
- Using thicker membranes to better cope with the surface erosion that will occur with repeated cleanings
- Incorporating solid below-surface substrates that will resist deformation underfoot from repeated foot traffic and cleaning equipment
- Incorporating protection flashing courses at all roof curb corners to resist the rubbing of hoses and electrical cords that will occur

- Not relying on surface alone for potential energy savings and using adequate amounts of thermal insulation to achieve energy savings
- Designing roof systems using aged (soiled) reflectance values
- Considering incorporating a vapor retarder into roof system designs, especially those that are mechanically attached, to prevent the saturation of the insulation as a result of air flow meeting the dew-point temperature

Research is being conducted by SPRI and ORNL with regard to the role ballast may play in the cool roofing issue and potential energy savings. Preliminary results appear to confirm what I hypothesized in a letter to the city of Chicago when its new energy code was initially released, which required new roof construction to incorporate initial reflectance values of 0.65. I suggested ballast may in the end be the most environmental of all roof coverings. It's self-cleaning, and its roof surface shading attributes may provide benefits close to or even greater than white membrane surfaces only (see Photos 2 and 3).

Coming clean

Saving energy is a noble goal, but the pendulum has swung too far and resulted in mandates, code changes and false promises that are unattainable. Achieving a quality roof system is a great deal of hard work, and placing unrealistic performance expectations into the equation is unfair.

The cleaning of roofs, I suspect, will never become a widespread activity. For those few projects and facilities that will partake in roof surface cleaning, the same requirements that are needed to achieve a quality roof system apply: incorporate knowledgeable designers; excellent, knowledgeable and caring contractors; and quality materials, then budget accordingly.

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Photo 3: This ballasted roof system will provide greater benefits during its life than would a "cool" roof system that becomes soiled.