Selecting correct coatings—part 2

by Reed Hitchcock

Editor's note: Following is part two of a two-part series about selecting roof coatings. "Selecting correct coatings—part 1" was published in the November issue, page 32.

In November, I provided basic information about roof coatings—such as coating technologies and the importance of establishing a coating's intended purpose and function to help you select proper coatings for roof systems.

After you establish what function you want a coating to serve, you must consider the type of roof system being coated. The following information provides some insight regarding coating requirements for specific roof systems.

BUR

The roofing industry's workhorse is the built-up roof (BUR) system. Coatings commonly used on BUR systems include solvent- and water-borne asphalt coatings; solvent- and water-borne aluminized asphalt coatings; and water-borne white elastomeric coatings (generally acrylics).

BUR systems can have several surface finishes—they can have bare or glaze-coated top sheets; be flood-coated with mopping asphalt; have a mineral (granulated) cap sheet as a top layer; or have a finish layer of gravel embedded in hot asphalt.

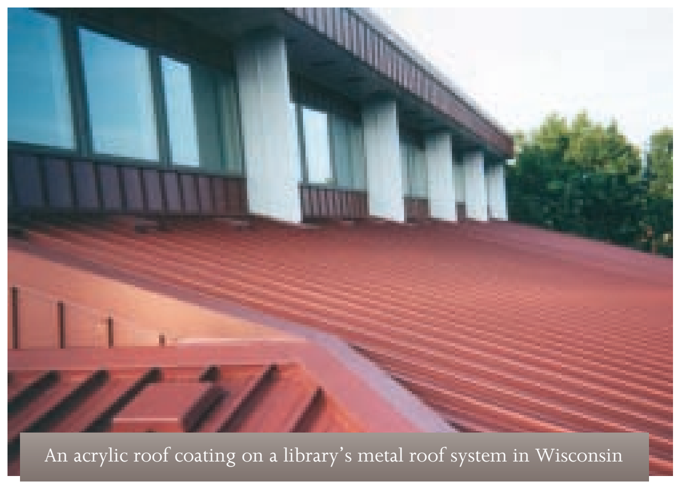
A mineral cap sheet generally is the easiest surface to coat because its small texture allows most coatings to achieve a strong mechanical grip. These minerals also block asphalt bleed. Smooth BUR systems are readily coated with solvent-borne asphalt coatings; they require careful preparation and base coats to accept water-borne coatings. Gravel-covered roofs generally are impractical to coat without removing the gravel, which will affect a roof system's fire rating.

Asphalt coatings, long recognized as effective for prolonging life cycles and restoring aging BUR systems, are applied after a BUR system's initial installation and at regular intervals during the BUR system's life cycle as part of a regular maintenance program.

Traditional solvent-borne bituminous roof coatings are made from cutback bitumen. To make cutback bitumen, distillate bitumen residue is refined to various specific physical properties through vacuum distillation or oxidation. This refined asphalt then is blended with a petroleum solvent, such as mineral spirits. This blend of bituminous resin and solvent is combined with special clay fillers or fibers to create a gel coating. These components' proportions ultimately determine a coating's consistency and properties.

For the past 60 years, water-borne asphalt coatings have been developed and used as alternatives to solvent-borne coatings. The mixture of bitumen, water and bentonite (clay) is referred to as asphalt emulsion because the microscopic asphalt particles are held in suspension by a clay coating.

Irving, Texas-based Texas Stadium, the home of the National Football League's Dallas Cowboys, features a metal roof system coated with a 100 percent acrylic coating system.
Photos courtesy of United Coatings, Spokane Valley, Wash.



An acrylic roof coating on a library's metal roof system in Wisconsin

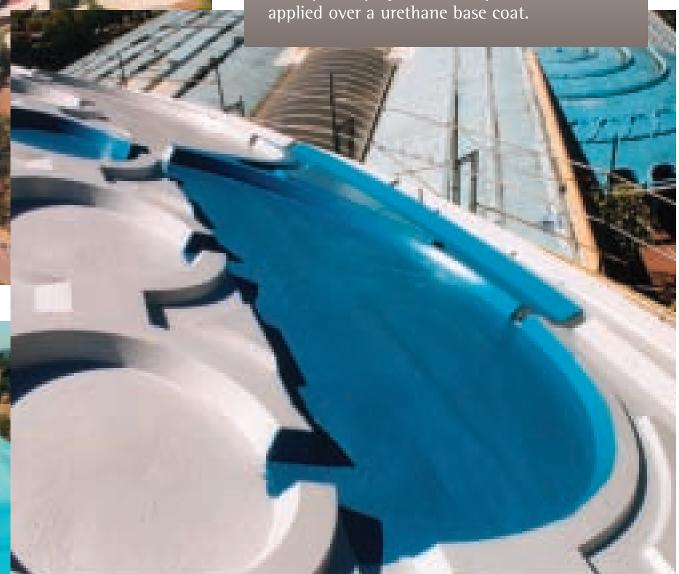
In an ongoing, independent coating durability test program conducted by the Midwest Roofing Contractors Association it was observed that solvent- and water-borne coatings in all climates perform better on all types of smooth roof surfaces when applied over an asphalt emulsion base coat. One advantage of asphalt emulsions is they generally meet fire ratings of original asphalt BUR systems.

If an original roof system was applied in hot asphalt, an asphalt emulsion coating generally can be applied relatively soon, but if the original roof was cold-applied with an adhesive, it usually is necessary to wait about 30 days before applying an asphalt emulsion.

Aluminum pigments can be used to formulate solvent- and water-borne asphalt coatings to protect against ultraviolet (UV) radiation and provide significant reflectivity. These coatings have small flakes of aluminum pigment dispersed in them. They typically have solar reflectivity values between 0.40 and 0.50 though premium formulations have demonstrated initial solar reflectivities in excess of 70 percent.

Highly reflective white top coats have become more common during the past several years as a means to reduce peak roof surface temperatures. This minimizes peak electrical demand for air conditioning in many buildings and provides ultimate reduction in diurnal temperature cycles, which can stress and fatigue roof systems.

The Marin Civic Center in San Rafael, Calif., features a mixed-substrate roof system coated with a urethane and polyurea waterproofing system and top coated with an aliphatic urethane.



An aliphatic polyurethane top coat was applied over a urethane base coat.

Polyurethane can provide waterproofing and lasting color in a fluid-applied roof coating system.

A majority of these white coatings are water-borne acrylic coatings. Because of the range of physical and chemical properties available within the general acrylic category, a particular coating's suitability for a given substrate should be verified with the coating's manufacturer. Most white acrylic coatings intended for use on asphalt roof systems can be applied directly to mineral cap sheets after appropriate surface cleaning (some don't require a barrier layer); smooth asphalt surfaces normally require a specified primer or base coat designed specifically to stop asphalt from bleeding into the top coat.

Asphalt typically contains light oils called exudates, which rise to a membrane's surface soon after application. Exudates often wash off roof systems after a rainstorm. Nevertheless, any exudate that remains on a roof system before coating application should be thoroughly removed. Exudates can cause staining or even debonding of a coating.

An optional coating for a gravel-surfaced BUR system is spray polyurethane foam (SPF). This effectively changes a substrate from gravel-surfaced BUR to SPF. An advantage of this approach is the layer of insulation above the BUR keeps the BUR from being subjected to extreme heat. A white coating over an SPF roof system can result in additional energy savings. Typical coatings for SPF are acrylic, polyurethane and silicone.

Whitening of the existing base of a commercial BUR system is important. Although BUR systems are among the most durable roof systems available, it is possible to extend their life cycles even more with coatings.

Polymer-modified bitumen

Polymer-modified bitumen roofing is a subset of asphalt roofing. Before these roofing sheets are formed, asphalt is heavily modified with APP or SBS rubber. These two technologies provide products with significantly different properties. SBS materials can be installed in moppings of hot asphalt, with cold adhesive or torch-applied. They may be used as hybrid systems and typically are finished with a mineral-surfaced cap sheet. A thick APP base sheet often is used with granulated SBS sheet on top, and, in most parts of the U.S., it is torch-applied rather than adhered with hot asphalt or adhesives. APP most commonly is available as a smooth-surfaced material though granule surfaces also are available.

Recently, some manufacturers have introduced white polymer-modified bitumen cap sheets that may be used to cap traditional BUR systems. If they provide reflectance values above 0.70, the roof systems qualify for an exemption from California's Title 24.

Various protective and reflective coatings also can be applied to polymer-modified bitumen substrates in the field.

Much of what applies to BUR systems also applies to polymer-modified bitumen roof systems. Polymer-modified bitumen roof systems generally are compatible with coatings developed for conventional BUR systems; aluminum and white coatings commonly are used. Elastomeric acrylic coatings can be applied to smooth polymer-modified bitumen and mineral-surfaced cap sheets to turn their black surfaces white and extend roof system life cycles while lowering energy costs.

Elastomeric acrylic coatings featuring nonbleed formulas recently were introduced. These coatings provide asphaltic substrates with a cool, bright white, protective seal. These specially formulated coatings maintain their bright white surfaces for long-term performance.

Roof systems with asphaltic substrates must be aged at least 90 days before white elastomeric acrylic coatings can be applied. If a substrate previously was coated with an unknown coating, an adhesion test must be performed. After a successful adhesion test, all loose existing coatings and debris must be removed and the roof surface power washed with water. Excessively soiled or greasy surfaces—common on smooth APP—may require additional cleaning with a stiff-bristle broom or scrub brush.

Mineral-surfaced cap sheets are perhaps the easiest to coat in the field. These surfaces are rough enough to provide excellent adhesion but not so rough as to require a large volume of coating material. Mineral-surfaced cap sheets have a surface roughness of 30 to 50 mils. An initial coating of 10 mils with asphalt emulsion tends to fill in the voids and serve as a good substrate for a white coating.

A smooth polymer-modified bitumen roof system also can be coated with an asphalt emulsion coating and topped with a compatible white acrylic coating depending on the target reflectivity value.

An SPF roof system in Spokane, Wash., is coated with a self-flashing, 100 percent acrylic roof coating.

Thermoset membranes

Fully adhered and mechanically attached EPDM and Hypalon® roof systems are single-ply applications that benefit from the application of white elastomeric acrylic coatings. Because these membranes are thermoset, coatings will adhere to them only if the membranes' surfaces are treated with a specially formulated wash-primer.

EPDM roof systems include carbon black in their compositions to block UV radiation and are made from an inert material similar to tire rubber. Attempts to factory-coat EPDM have not succeeded; however, much can be gained from coating an EPDM roof system in the field with a white coating.

Hypalon is a chlorosulfonated polyethylene. When Hypalon is 15 to 20 years old, it should be coated directly to help extend its useful service life. It can be coated with a white coating provided a roof system's surface is properly prepared with a manufacturer-approved primer. Most manufacturers use a wash-primer for the best adhesion.

Because of their difficulty in adhering to a rubber surface, until recently the only coatings available for rubber roof systems were solvent-borne rubber coatings, which typically were used for repairs and reinforcement rather than whole-surface coating because of their costs.

Wash-primers have been introduced in recent years that effectively prepare the surfaces of EPDM and Hypalon roof systems for strong adhesion to specific water-borne acrylic coatings. These wash-primers change a membrane's surface to allow elastomeric coatings to effectively adhere to a membrane and offer the same long-term performance that these coatings provide to other roof membrane types.

An EPDM or Hypalon membrane must be cleared of all debris, such as leaves, branches and stones. Then, an air blower or stiff-bristle broom should be used to remove all loose dirt and other impediments. Next, the membrane must be repaired using compatible products; this includes tightening or resecuring all terminations and caulking termination bars and flashings. A specially formulated wash-primer then should be applied using an agricultural sprayer or airless spray equipment. The membrane should be dry before priming or the wash-primer will be diluted, reducing its effectiveness. A wash-primer normally is allowed to remain on a membrane for five minutes and then power-rinsed off with water. When an EPDM membrane


A tan acrylic coating on an EPDM roof system

is properly cleaned, it will become jet black. A roof surface should be allowed to dry completely before finish elastomeric acrylic coatings are applied.

TPO and PVC

TPO is a single-ply roofing material that can be manufactured in bright white; there is not an urgent need to coat a newly installed TPO roof system. However, there is a demand for coatings that will extend TPO roof systems' life cycles.

Unfortunately, TPO roof systems' smooth, inert surfaces present a significant adhesion challenge to coatings. For TPO roof systems, manufacturer-approved primers are available, allowing for an elastomeric white top coat, such as water-based acrylic. Suffice to say this is not a common application and is an area of ongoing research.

PVC also is smooth, chemically resistant, water-resistant and not easily coated—special primers are required to coat these roof systems. PVC's high levels of liquid plasticizer seem to present a bigger challenge than its slick surface. The polymer's chemical resistance also inhibits the development of suitable primers. PVC gets its white color from pigments added to the polymer during the manufacturing stage.

It's worth mentioning that TPO and PVC membranes easily can be misidentified in the field. Because they require different primers and coatings, examining a test patch is a prudent caution before coating an unidentified white membrane.

SPF

SPF roof systems usually are coated the same day foam is applied to protect the urethane from UV rays. The broad range of products used by SPF manufacturers includes one- and two-part urethanes, polyureas, silicones and water-borne acrylics. Similar products are available for recoating applications. Recoating a silicone roof coating is a special case—typically, only silicone sticks to silicone. Surface scarification often is employed if other coating types are used.

Manufacturers often require adhesion tests on a roof membrane sample and recommend the appropriate primer to help ensure the new coating's proper attachment. Silicone, as well as polyurea and aliphatic urethane coatings, resist recoating; you should contact roof coatings manufacturers for instructions.

SPF is especially useful as part of roof coating and rehabilitation projects. SPF is self-flashing and monolithic and can be used by a skilled applicator to address a host of drainage issues. SPF bonds to almost all roofing materials. It also adds extra insulation value by preventing heat from conducting through fasteners to the underlying roof deck.

Metal

Steel, aluminum and galvanized metal roof systems are good candidates for coatings. Uncoated metal roofing that has lost its galvanization and is starting to rust needs to be coated with a corrosion-inhibiting coating system. Many coatings are available in the marketplace for metal roofs, including water-borne acrylic coatings, solvent-borne aluminum coatings, rubberized aluminum coatings, solvent-borne SBS or styrene-ethylene-butylene-styrene white coatings, polyurethane coatings and other coatings typically identified by the primary resin they use.

Most metal roof systems feature factory-applied coatings, but these may degrade over time because of weathering. Therefore, aftermarket metal roof coatings are in demand. And because metal thermally expands and contracts more than other roofing materials, screw holes can elongate and seams can open. A coating system might be able to address these problems.

A primer generally is required before a surface coating can be applied to a metal roof system, regardless of the roof system's age. Special primers are made for aluminized asphalt and elastomeric coating applications over metal roofing.

Primer and coating combinations often are specific. For example, a solvent-borne zinc chromate primer recommended by one manufacturer may be incompatible with a similar top coat from another manufacturer. The use of a primer should not be substituted for removing corrosion on weathered metal roofing. Coatings manufacturers can provide guidance regarding preparing metal roof systems for surface coatings. A primer is followed by a flashing-grade sealant or tape over all fasteners and seams and around penetrations. Then, finish coats are applied.

Urethane coatings and, more recently, polyurea coatings, are two-component coatings that are well-suited to metal roofing. They provide good elongation and high tensile strength—about 1,500 pounds per square inch (psi) compared with 200 psi to 400 psi for other coatings. Polyurea also results in a harder surface than other types of coatings; rain will wash dirt off the hard surface relatively easily, making it easy to keep clean. These coatings typically are 100 percent solids so they offer the same advantages as water-based coatings in terms of volatile organic compound regulations and fire hazards but don't have the same cure rate limitations.

Another new technology is based on fluoropolymer coatings, such as Kynar,® which provide high reflectivity and durability and clean easily. These products may bridge the gap between solvent- and water-borne performance in terms of biological resistance and water resistance.

A lot is being done with SPF over metal roof systems. The foam is effective as a self-flashing waterproofing material and acts as an insulating layer, which reduces expansion and contraction. Standard SPF coatings then are applied on the foam.

Elastomeric acrylic coatings also are popular for metal roof system restoration. In recent years, new elastomeric acrylic systems have been specially designed for metal. For example, new coating systems for metal roofs use zinc-rich metal roof primers, which improve finish coatings' adhesions while encapsulating and inhibiting rust. Before coating a roof, loose old coatings, debris, heavy rust and any fresh roof cement must be removed, and repairs, such as replacing missing or loose fasteners, must be made.

Coating is spray-applied on a roof system.

For larger metal roof systems, an airless sprayer is preferred for power washing at 2,000 psi with a cleaner and also to apply the coatings. The first product applied is a metal roof primer with proper application thickness determined using a wet film gauge. Next, a tape or flashing-grade sealant is used to treat fasteners, penetrations, seams and lap joints. Depending on a project's size and nature, the sealant may be applied by any combination of a pump, roller, brush, or even a caulk gun or putty knife. Finally, the acrylic finish coating is applied using an airless spray gun. A wet film gauge is used to check for proper thickness. Proper coverage typically is achieved in two to three coats.

Although newer technologies such as polyurea and flouropolymer formulations have generated interest, traditional acrylic, rubber and polyurethane products provide time-tested performance and proven value. Regardless of the product chosen, it must possess a balance of strength, elasticity and weatherability to withstand the rigors of the environment to which it will be exposed.

A study

The late Carl G. Cash, former principal of Simpson, Gumpertz & Heger Inc., Waltham, Mass., attempted to account for the relationship between climate and roof system life cycle in "The Relative Durability of Low-Slope Roofing." He correlated life cycle with survey respondents' geographic locations. Although this study is an informal survey of roofing professionals' experience and perceptions, Cash's data suggest durability declines as temperature increases. Therefore, a reduction in peak roof temperatures through the use of reflective coatings can be expected to extend all roof systems' life cycles.

There is no doubt coatings prolong roof systems' life cycles. It may even be possible to extend certain roof systems' life cycles indefinitely by protecting substrates that age slowly and have long lives without the benefit of protective and reflective coatings. We currently are in the era of optimizing coatings for maximum life—in the meantime, stay tuned.

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