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Modified Bitumen Can Both Look Good and Be "Cool"

By Karl Schaack, RRC, PE

The Cool Roof Rating Council, Title 24, reflectivity, emissivity, and cool roofs are all "hot topics" related to current roofing materials and/or systems—particularly in warmer climates and geographic areas implementing related ordinances. The color of roof surfaces and their solar reflectance characteristics have become important components in the material selection of roof coverings and systems. Traditionally, white-colored single-ply membranes and liquid-applied white-colored elastomeric coatings have been the primary options for specifiers, designers, and installers to achieve the required solar reflectance values for low-sloped roofing. However, the manufacturers of bituminous material (i.e., modified-bitumen membranes) have developed products to achieve similar results. These products offer different options for end users who may be more comfortable using multi-ply bituminous-based assemblies without the need for full coverage of field-applied coatings to achieve the required reflectivity.

Currently available modified-bitumen products utilize several different technologies to achieve a certain level of reflectivity. These technologies include white-colored granules, pre-applied coatings, or proprietary films that are applied to the top surface of the finish ply sheet.

The use of white-colored granules applied on the top of the sheet in the traditional manufacturing process is a more widespread option in today's market. These products have thermal reflectivity values that typically range from 0.68 to 0.74 (*Figure 1*).

Modified-bitumen sheets can have a white-colored, acrylic-based coating that is either applied over the granule surfacing during the manufacturing process of the sheet or is baked onto the top bituminous surfacing in place of granules. This application is performed in the factory to achieve a relatively homogenous monolithic appearance at a desired coverage rate. One product that is available utilizes a clear coating applied over the colored granules in an attempt to maintain uniform color and protect the granules from secondary staining. These products typically have thermal reflectivity values that range from 0.75 to 0.85 (*Figure 2*).

Figure 2 – Close-up of pre-coated granule-surfaced cap sheet.

Figure 1 – Close-up of granules on "cool" cap sheet with white-colored granules.

Figure 3 – "Cool" roof cap sheet applied in hot asphalt.

The third product option consists of a modified-bitumen sheet with a white-colored proprietary film (either polymeric or aluminum foil) applied on the top surface of the sheet during the manufacturing process that results in a relatively smooth-surfaced sheet. These products typically have greater thermal reflectivity values (due to their smoother surfaces) that can range from 0.78 to 0.86.

Each of these products has its own unique issues related to the installation process in order to maintain a monolithic white-colored roof. Sheets with pre-coated granules can be applied with torching or heat-fusing techniques, bituminous-based cold adhesives, hot asphalt, or can be self-adhered. One obvious concern is maintaining cleanliness of the top surfacing sheet during the installation of the roofing materials and related components.

Proper planning, phasing, and protective measures by the contractor are essential in achieving an optimum monolithic white-colored roof. The traditional phasing sequencing process of material installation involving the initial application of the surfacing sheet at the furthermost point on the roof away from the access/staging area is critical in minimizing foot traffic across the finished sheet. Utilizing protective methods during the application of base flashing top ply and sheet metal flashings that will occur on top of the finish ply is also critical. Using sacrificial pieces of the top ply (placed the surfacing side down), insulation board, or some other independent protective layer placed under mop carts, material pails, and other equipment within the subject area can prevent soiling of the cap sheet and is a prudent method to maintain cleanliness.

The type of application method utilized for adhering the top ply flashing can have a significant impact on the finish of the cap sheet (*Figure 3*). Cold-process adhesive or hot asphalt that is mistakenly or carelessly deposited onto the cap sheet will soil the finish and require additional repairs. Placing a bituminous sheet with bitumen surfacing in contact with the top surface of the installed finish ply can result in staining of the white surfacing. Placement of protective material under plastic or metallic pails commonly used for fasteners or adhesives, fire extinguishers, etc., will also prevent circular-shaped ring indentions in the top sheet and corrosion stains from metallic pails on the top sheet.

Sheet metal mechanics performing their related work can impact the finished

Figure 6 – Typical view of coating applied on asphalt bleed-out.

Figure 4 – Corrosion stains from sheet metal storage on cap sheet.

Figure 5 – Bleed-out along laps of cap sheet treated with coating.

appearance of the roof. Keeping metallic items such as carbon-steel fasteners, shavings from cutting or drilling sheet metal, and other similar items contained and not stored on the roof surface will minimize the possibility of corrosive stains occurring on the finish ply (*Figure 4*). Obviously, delaying the installation of the cap sheet until other ancillary work can be completed—such as installation of saw-cut reglets in masonry work (which results in masonry-colored dust deposits); sheet metal flashing installation; mechanical-, electrical-, and plumbing-related rooftop work, etc.—will pay dividends toward achieving a clean finish ply. The use of disposable "booties" on workers' shoes can also aid in maintaining cleanliness of the finish ply.

While most manufacturers do not require (though several do recommend) the application of a supplemental finish material on the bituminous bleed-out that occurs along the edges of side and end laps, the author believes addressing the bleed-out achieves the optimum monolithic surfacing and best long-term performance. Manufacturers of the pre-coated sheets and film-surfaced sheets typically provide a coating product that can be applied on the bleed-out or other blemished areas of the surfacing. However, applying coatings directly over bleed-out on a pre-coated granule-surfaced sheet results in a slick or smooth surface and visually appears different from the pre-coated granulated sheet (*Figure 5*).

To achieve a similar appearance as the cap sheet, the author recommends broadcasting or embedding loose granules (of any color) into the bleed-out (while hot/molten or softened) similar to traditional modified-bitumen applications. After embedding granules, liquid-applied coating can then be applied over the new granules, resulting in a more similar appearance to the cap sheet. In addition, the author has found that asphalt bleed-out that extends beyond the ends/sides of the sheet and has been covered with a liquid coating most often will experience shrinkage and resultant crazing or cracking after exposure to weathering elements (*Figure 6*). The author also believes that embedding granules into the bleed-out provides an additional stabilizer protection and will delay the aging and formation of cracks in the bleed-out.

For sheets with white-colored granules, a similar-colored granule should be used to broadcast and embed into the bleed-out, a practice similarly used with traditional cap sheets. The process used for applying the coating on bleed-out can also have varying results. The author has observed contractors using narrow napped rollers (2 to 4 inches) to apply coating over the bleed-out—commonly for improved production purposes; however, the new coating typically has a significantly brighter white color than the cap sheet and can result in visually obvious "stripes" on the finished product. While some in the industry indicate that the field-applied coating for lap dressing will fade to match the color of the cap sheet, it has been observed that an accumulation of dirt/silt on the surface would have greater impact in "concealing" the varying surface colors.

Perhaps considered tedious, applying the coating with a hand-held brush only onto the new granules embedded into the bleed-out, and not onto the sheet, can result in the most uniform appearance. Additionally, contractors who are diligent

Figure 8 – Rounded corner of cap sheet and granules embedded in bleed-out.

Figure 7 – Torch application of white-colored granule-surfaced cap sheet.

during the application process and minimize the bituminous bleed-out along the lap seams, have fewer issues to address, leading to an aesthetically pleasing end product. Some argue that treatment of bleed-out is "just an aesthetic issue," which in part is true, but when requiring and specifying a white reflective roof finish, this treatment is helpful in achieving the desired result. Furthermore, cracks that develop in bleed-out can and quite often do propagate and extend under the sheet and can allow moisture to migrate under the cap sheet with potential for detrimental side effects.

Using proper torching techniques and application procedures during installation helps to maintain a uniform color to the finish ply (*Figure 7*). As the torch is drawn across the width of the sheet and beyond the side of the sheet (to accomplish fusing the side laps), the flame can cause "scorching" of the surfacing of a previously installed adjacent sheet. Although these "scorch" marks will most likely diminish with time after exposure and weathering, they will be evident at the time of completion and during the final walk-through performed by project personnel. This condition most likely will be considered unacceptable and aesthetically displeasing—especially because the white-colored finish is the desired end product. A torching technique of directing the flame toward the subject sheet (i.e., extending the arm/torch over the adjacent sheet and pointing back at the subject sheet to melt the back coating), can achieve a properly fused sheet without scorching of in-place sheets.

Another item for consideration is performing repairs to the cap sheet. If the cap sheet surfacing becomes soiled, marred, and/or damaged, applying an approved coating over the subject area is a commonly accepted method; however, the resulting appearance will be markedly different than the surrounding cap sheet. The author recommends applying an additional cut section or layer of the cap sheet over the subject area. Regardless of the size of the area to be repaired, the repair piece (patch) should be cut to match the full width of the sheet and to extend longitudinally 4 to 6 inches beyond the affected area. Rounding corners of the cut section of cap sheet repair also aids in a more pleasing finish and can avoid "dog-eared" corners (*Figure 8*). Treating of the bleed-out around these repairs should be performed in similar fashion as during the installation of the cap sheet and as previously discussed herein.

If all else fails or the previously mentioned processes cannot be effectively achieved, then the application of a field-applied coating over the entire surface of the roof may be the best option for achieving the optimum uniform color, particularly with pre-coated sheets. However, this option obviously involves the greater costs associated with the respective sheets.

The application of a supplemental coating on a modified-bitumen cap sheet creates additional challenges when performing repairs in the future—whether part of a maintenance program or due to changes in building operations. When new materials are to be applied on top of a pre-coated sheet, the coating has to be removed via applying heat with a torch or hot-air gun. The process typically consists of demarcating the area of the cap sheet to receive the new material, scoring the perimeter of the demarcated area with a razor knife, heating the subject area, then scraping the coating and underlying granules off of the sheet to reveal a bituminous surface suitable to receive the new material. This process

Figure 9 – Stained cap sheet from water draining across sheet.

should also be used for modified-bitumen sheets with a film surfacing.

A similar process is followed with sheets that have white-colored granules, except after heating the subject area, the granules can be pressed down into the heated bituminous top coating to achieve a bituminous surface. The granules can also be scraped off after heating, if so desired. This process is commonly called "degranulating." An accessory that attaches to the head of a torch, aiding in this degranulating process, is available.

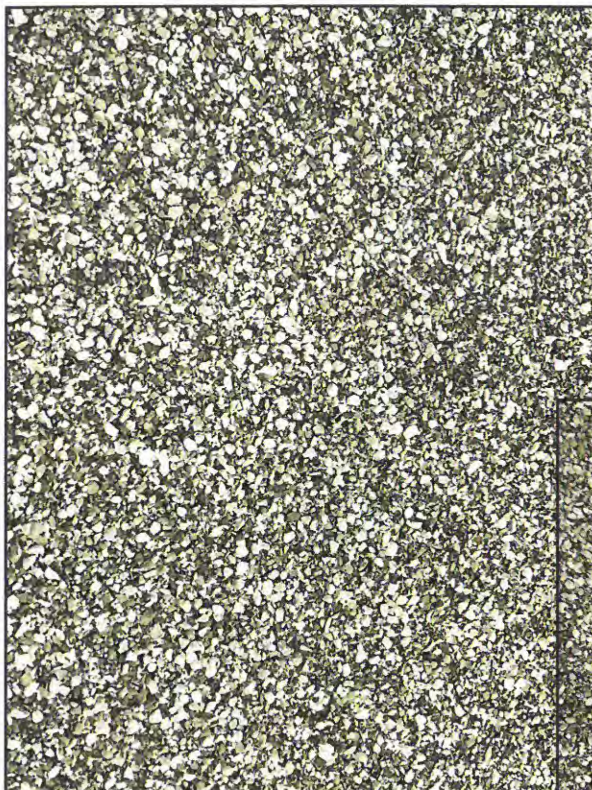

Figure 10 – Close-up of stained white-colored granules of cap sheet.

Figure 11 – Close-up comparison of stained granules vs. non-stained.

Another concern or condition that can cause staining of the cap sheet involves properly sequencing and coordinating roofing work to minimize trafficking and storage of materials on a newly installed white cap sheet, which could lead to significant staining and marring of the finish. Additionally, water or morning dew draining or running across a previously installed smooth-surfaced modified-bitumen base ply from an adjacent or higher roof and discharging onto a newly installed cap sheet can result in staining (*Figure 9*). The light oils contained in the top surfacing of a base ply can be captured by the moisture, and as the moisture travels across a cap sheet, the light oils are deposited onto the top surfacing, leaving bituminous stains, often called "tobacco juicing"[1] (due to its light brown appearance).

A similar condition has also been observed on these white-colored granule-surfaced sheets when visible brown-colored stains are found on the white granules on products that have been removed from manufacturers' wrapping upon delivery to a job site in preparation for application (*Figure 10*). This staining is very prevalent and widespread throughout the sheet. Manufacturers have indicated that the staining is due to light oils from the bitumen migrating from within the sheet and depositing on the granules during storage of the materials—commonly within unconditioned spaces/warehouses or job sites where elevated temperatures can cause the light oil migration (*Figure 11*).

Some manufacturers have indicated that staining will "bleach-out" after installation and exposure to sun and rain over some period of time (three to six months), depending on geographic location, time of year, and weather. While this event may occur, the author has found that the white color of the cap sheet upon completion of application and acceptance by the building owner is not of a level that could meet the initial solar reflectance requirements established for a cool roof (*Figure 12*). Even after the sheet experiences the bleaching-out following exposure, the resulting solar reflectivity may not meet the published initial solar reflectivity requirement as mandated by applicable codes or project requirements. The author has witnessed solar reflectance testing using a portable solar reflectometer (per ASTM C1549)[2] of installed cap sheets of various exposures that had exhibited initial discoloration of the white granules due to the noted bituminous

Figure 12 – Varying colors/shades of granules on white-colored granule-surfaced cap sheet.

Figure 13 – Reflectivity reading of 48 on cap sheet with stained granules.

Figure 14 – Reflectivity reading of 56 on cap sheet with stained granules after exposure.

"Dirt or other atmospheric deposits on the cap sheet can also diminish the solar reflectivity, but this condition can readily be rectified by appropriate cleaning methods."

staining. Testing of a newly installed stained cap sheet revealed solar reflectance values on the order of 0.40 to 0.50, and testing of previously installed sheets (in place for two to three months) revealed solar reflectance values on the order of 0.50 to 0.60, with neither value at the published value of 0.70 for the respective products (*Figures 13* and *14*).

Manufacturers have reported that actions taken to avoid this condition may include storing the product in conditioned warehouse space, manufacturing the specific product upon demand with direct shipment to the jobsite in anticipation of immediate installation, and avoiding storage in unconditioned spaces. It is unclear at this time if storage onsite can cause this phenomenon to occur or how long it takes it to occur.

One practice by one manufacturer that appears to be successful in maintaining the white color of the granules is the placement of a thin plastic film over the granule surfacing when the material is rolled up following completion of the manufacturing process (*Figure 15*).

Another factor of concern is the in-place reflectivity of these types of sheets. Maintaining a uniform granule embedment is critical for these sheets to provide the appropriate solar reflectance. Loss of granules and exposure of the underlying black-colored bitumen greatly diminishes the solar reflectivity characteristics. Manufacturers have experimented with several types of white-colored granules to achieve the desired reflectivity. Some of the granules looked similar to the traditional granules but appeared to

Figure 15 – Film on roll to prevent staining of granules.

Figure 17 – Overview of installed white-colored granule-surfaced cap sheet.

Figure 16 – Round-shaped granules.

be lighter in weight, and achieving proper embedment was more difficult with excessive granule loss occurring with in-place products. A similar condition occurred with a polymeric granule that looked like small-sized paint chips. A modified-bitumen sheet product that has recently been introduced utilizes small circular or ball-shaped granules, and the manufacturer believes, based on initial studies, that this will provide better long-term performance compared to conventional angular-shaped granules (*Figure 16*).

Obviously, dirt or other atmospheric deposits on the cap sheet can also diminish the solar reflectivity, but this condition can readily be rectified by appropriate cleaning methods. Cleaning a smooth-surfaced sheet is easier than cleaning a rough-surfaced or granule-surfaced sheet. The smooth-surfaced sheets are more slippery to walk on when surface moisture is present, so special care must be practiced when walking on these types of sheets if specific walk pads are not provided or present within the subject area.

In summary, these modified-bitumen sheet materials are specified and installed to achieve a desired end product and resulting finished surfacing for the building owner. By identifying the requirements within the scope of work or specifications and by implementing certain procedures and protocols during application, this can be reasonably achieved while meeting the expectations of the individual parties and the building owner associated with the project (*Figure 17*). IIBEC

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Karl A. Schaack is president of Price Consulting, Inc. in Houston, TX. He graduated from Clemson University with a BS in civil engineering and is a registered professional engineer. A building enclosure consultant since 1983, Schaack is an AWCI Certified Inspector of EIFS systems and has successfully completed the Tile Roof Institute's Certified Tile Installation program. He has been an active Consultant member of IIBEC since 1996 and is a current member of IIBEC's Technical Advisory and RRC Exam Committees. He has authored articles for IIBEC Interface *and other industry publications. In 2007 and 2015, Schaack was awarded the Richard Horowitz Award for excellence in writing for* Interface.

EagleView Wins $125 Million in Patent Infringement Case

A New Jersey jury has awarded EagleView, providers of aerial imagery and data analytics adopted to measure roofs, $125 million in damages from Verisk Analytics, Inc. and its subsidiary, Xactware Solutions, Inc. for willful patent infringement. The suit, filed in 2015, had claimed that the companies had used EagleView's innovations and technology for years.