MODIFIED BITUMEN: TOP CHOICE FOR RESIDENTIAL FLAT ROOFS

Just peel off the release paper and stick down the membane. This ease of installation makes self-adhering bitumen roofing very attractive to residential contractors.

It's self-flashing, can be self-adhering, and is probably long-lasting, but product quality needs better controls

by William Rose

If there is one characteristic that separates commercial builders from residential, it's roofing systems. Residential tradesmen have never taken a liking to flat roofs. The key difference is that sloped-roofing products shed water, whereas low-slope roofing products must be *waterproof.* But as remodeling continues to grow and because many room additions would be so much simpler with flat roofs, it's time to look seriously at low-slope roofing products for residential construction, and at modified bitumens, in particular.

Of all the low-slope roofing products on the market, modified bitumen may be the best for residential work. You'll find out why by the end of the article—first, a little background.

Bitumen is the generic name for black, semi-liquid materials with a base of petroleum or coal. Petroleum-based bitumen, usually a by-product of oil refining, is called asphalt. Coal-based bitumen, a by-product of coke production, is called coal-tar pitch. Both products have been used in building construction since ancient times.

Bitumen alone is not a good roofing surface. It becomes brittle in cold weather and it melts and runs in hot weather. It requires a reinforcement (felt, fiberglass, etc.) to help it maintain a uniform thickness, and to remain pliable in the cold and stable in the heat. The felt sheets in built-up roofs (BURs) were an appropriate matrix. However, BURs age quickly (15 to 20 years); the bitumen separates from the felt reinforcement (alligatoring), and the roofing blisters and peels. In an attempt to overcome these well-publicized deficiencies in BURs, research and development during the 1960s and 1970s was focused on producing roofing in the form of easy-to-apply sheet goods — so-called single-ply roofing.

Any cheap, gooey manufacturing by-product quickly becomes a roofing material. So it was with coal-tar pitch and asphalt (together generically named "bitumen"). So it is with atactic polypropylene (APP) and styrene-butadiene-styrene (SBS), which were added to the bitumen to improve it. In fact, the first *modified-bitumen* roofing was produced in Italy in 1963 with APP left over from the manufacture of tool-handle plastic (isotactic polypropylene), which had been invented in Italy nine years earlier. The name "modified bitumen" was given to roofing products where asphalt or coal tar are blended with polymers into a single sheet.

Manufacture

The bitumen arrives at the manufacturing plant via pipeline or tank car, at a temperature above its melting point. It is heated from 350 to 390°F in tanks containing mechanical arms for mixing and scraping. Modifying agents are added in "measured" amounts. The hot APP is mixed and blended for three to five hours; the mixing and blending time for SBS is much longer.

The reinforcing material (nonwoven polyester or woven fiberglass) comes in long rolls, usually a meter wide. The reinforcing material is dipped into several vats of molten bitumen. The material is then drawn through stationary plates which compress the bitumen into the reinforcement and scrape away any excess, leaving a relatively smooth and shiny surface. After this process, called *calendaring,* surface granules are added before bath time.

After the modified-bitumen material is formed, it is floated on a bed of water to cool evenly. Talc is placed on one side, and the seam marks are painted on. The material is cut into sheets, usually 33 feet long (so each roll covers one square), and the rolls are wrapped for transport. The production line is not any longer than a bowling alley, and is about as straightforward.

So how can you tell if the product is good or bad? Unfortunately, we do not know which product characteristics are the best indicators of service life. One promising test examines *asphalt dispersion* under a microscope. Under fluorescent illumination, at 100x magnification, the membrane shows up as tiny globules of black asphalt in a matrix of green polymer. If you heat the sample, you see the globules gather together forming fewer, but bigger, bubbles of asphalt. If you continue heating, the asphalt will coagulate so much that it leaves the polymer matrix and falls on the floor of the oven. Similarly, heat degradation in the field is probably the principal factor that determines performance and service life. This makes sense as you watch the globules grow under the microscope.

Most building products are manufactured to standards accepted, and often set, by industry members. Standards have been developed for most roofing products to determine the tensile strength, fire resistance, thickness, flexibility at cold temperatures, etc. Since the properties of modified bitumen depend on the chemical composition, one would expect standards to govern the composition—high volume of the good stuff, low volume of the bad stuff. But "standards for modified bitumen" is still somewhat of a joke to the manufacturers. The only attempts to write modified bitumen standards, so far, have been made by the Canadian General Standards Board and a proposal by the Midwest Roofing Contractors Association. Remember, manufacturers like standards, but they have to work.

While some chemicals are purchased by weight in clean containers with USP contents clearly labeled, APP is not one of them. The U.S. stockpile of APP is sitting out in giant mounds, covering acres of reclaimed land near

A worker uses a flat broom to force down the self-adhering membrane to get a good bond to the substrate.

Wilmington, Del. No one really knows how much is out there. It is shipped in and out by railroad car. A fellow in a polyester suit drops in on a manufacturer at 4 p.m. on Friday carrying an oversized gumdrop with the heft of a football and the look and feel of week-old oysters. He says he's got a railroad car of the stuff coming by next Wednesday, and he names his price. He says that the stockpile is about depleted, but they say that every 28 months just to keep the price up. You can buy the carload from him or you can wait until the next load comes by; but you do not ask the guy for affidavits attesting to the purity of the sample. That's the market in by-product chemicals. If you think APP is low-class merchandise, you ought to see the asphalt. (So don't ask how they make modified bitumen, sausage, or state and federal legislation.)

Preparation

There are no good roofs over poor decks. Every spacing requirement of the wood panel manufacturer must be followed closely. Any oversize cracks between roofing panels can be real weak spots in the membrane. No single-ply membranes are designed to bridge cracks. Raw decks are usually covered with a base sheet (either organic felt or fiberglass) which is mechanically fastened to the deck or, sometimes, hot mopped in place. Modified bitumen can be installed over rigid insulation (glass fiber, composite roof board, perlite, polyurethane foam board, etc.), provided there is a compatibility claim by *both* the roof system supplier *and* the insulation manufacturer! Very often a mechanically fastened base sheet is used to separate insulation from the roofing membrane.

Where an existing BUR has gone bad, the insulation beneath is usually wet. When the insulation is wet, the roof should be tom off. If you're convinced that the insulation is good, this isn't necessary. Instead, either cover with a mechanically fastened rigid panel, or flood the remaining gravel with hot asphalt to produce a smooth surface. Then the membrane can be applied.

Methods of Application

There are three major ways that modified bitumen is applied to the roof—hot mopping, torch fusing, and self-adhering. There are a few oddball systems too. HeyDi (which is out of business) used to be applied with screw fasteners. There are also cold-mopping products such as Awaplan 170 (Tamko Asphalt Products, Inc., P.O. Box 1404, Joplin, MO 64802; 417-624-6644). Modified bitumen may be ballasted, and may be ballasted with heavy insulation, making the IRMA or upside-down roof with the insulation on top.

Applying modified bitumen with a hand-held torch demands care and safety precautions. The applicator must heat the membrane until it just turns shiny but before it begins to run.

Hot-mopped. At first, modified bitumen sheets were applied very much like cover sheets on a built-up roof; they were simply mopped in place. In Europe, applicators used two thicknesses of sheets, and tagged any single-ply application as "the American method." Mopping in place, however, misses the principle advantage of single-ply systems—the reduction in equipment and the cleanliness of the installation.

In this system, hot asphalt is mopped to the surface and the membrane is set into it. Lap joints and flashings are also sealed with hot asphalt. The system requires an asphalt kettle on site and close monitoring of the asphalt temperature, which must be at or above 400°F at the point of application. The membrane must be applied immediately after the hot asphalt to ensure proper adhesion. Once the asphalt is cooled, it is no longer a good adhesive. If the asphalt which appears at the seams is judged unsightly, the "mop-n-flop" system may be used. Here, a membrane is placed upside-down next to its intended location, and the substrate and membrane are both mopped. Then the membrane is flopped over with the two mopped edges in line.

This system is fairly forgiving where small errors and terminations are concerned. Terminations are generally finished using the same membrane and asphalt for adhesion. Because the technology is similar to that of built-up roofing, those trained in BUR will easily make the transition to hot-asphalt modified-bitumen systems.

Disadvantages:

- Heavy equipment necessary on site.
- Hot, dirty conditions during application may affect quality control.

Advantages:

- Installation techniques are based on familiar BUR techniques.
- Slop in liquid bitumen can seal small holes.

Self-adhering. SBS is sticky stuff; among other things, it's the adhesive in masking tape. In self-adhering systems, the modifier is its own fastening system. This seems like a good approach, although presently we're down to two self-adhering modified bitumen products: W.R. Grace's GRM membrane (W.R. Grace & Co., 62 Whittemore Ave., Cambridge, MA 02140; 617/876-1400) and Flexshield Mark 3 (Flexshield Corp., P.O. Box 200, Gilbert, AZ 85234; 602/892-9320).

The sheet comes with a release paper on back. You roll out the sheet, allow it to relax. Reroll one half (standing on the other half). Slit the release paper and pull straight. The exposed sticky surface can be rolled down with a linoleum roller. (Hopefully, the workman has not walked backwards off the roof with the release paper in his hand.)

To me, a self-adhering modified-bitumen system is the ultimate no-hassle roofing: It can be used about anywhere, on any roof, and you may need no tools other than your hands and your teeth. Unfortunately, we do not have long track records for many of these products. Companies such as Apache SAM (Self-Adhering Membrane) went out of business. There may be a performance price which is paid for this ease of installation, but the self-adhering roofs I've seen seem to be holding up well. One potential problem is that adhesive strength lessens with time, so these products appear to have a finite shelf-life: If you wait too long, they might not stick.

Disadvantages:

- Careful substrate preparation is necessary. There may be too much dust after a tearoff to use a self-adhering system.
- Rain-lapped application is difficult on higher slopes.
- SBS needs excellent protection from ultraviolet radiation.

Advantages:

- Ease of installation.
- Minor adjustments of sheet placement are possible during application.

Torch Applied. The most common type of application is torch-applied. Unfortunately, applicators have burned down a whole lot of buildings using torches. Generally, torch application in the field is quite safe, and is done with a torching trolley or "draggin' wagon." The applicators who use hand torches without "deadman" safety triggers, or who keep the torch too long in a small spot, are the ones who bring out the claims adjusters. In the past, fiberboard cant strips have appeared to be especially vulnerable to careless torches. Many manufacturers no longer recommend cant strips, and those that do, recommend noncombustible strips. Deck materials can smolder for hours after application before breaking out in flames.

Many installers do a walking survey of the roof every night after the crew leaves. The inspector will typically carry an infrared heat detector (pyrometer). These devices cost from $600 up, but that's only a half day's bill for a lawyer.

To install without a draggin' wagon, the roll is laid out flat on the roof to "relax" it. One half is rolled up. A propane flame is applied to the coiled surface until it reaches 330°F and the heated surface of the roll develops a sheen. The flame is moved from side to side as the membrane is slowly unrolled and pressed into the substrate. The edges will show a small amount of flow, and they will be buttered using a small heated round-point trowel.

Disadvantages:

- Fire hazard from careless use of tools and possible combustion of flammable deck materials and cant strips.
- Client's insurance may not cover open flame application. Builder's insurance may not, either.
- Workman's judgement required for proper flow of heated surface.

Advantages:

- Permits low-temperature applications (perhaps 20°F outdoor temperature).
- Flashing penetrations and termina-

Outside corners—the hardest detail on flat roofs—are relatively easy with modified bitumen because it is self-flashing. Here a worker fits a patch of felt base-sheet around the corner of a curb.

tions is very simple.
- Good adherence and good seams with experienced application.

Residential Construction

So why use modified bitumen for residential construction?

Repairability. Of all the single-ply systems, this one is the most easily maintained and repaired. Repairs are almost intuitive. On PVC or EPDM roofs, the directions for repairs have to be followed very closely. If the spot isn't properly cleaned with the correct solvents, or if the patching material is not the same as the field material, then the patch can go bad. What's more, patches in rubber and plastic roofs don't stick very well, even when done properly.

Most roof repairs are done by the homeowner, with materials that are at hand. Anything that looks like it will repair modified bitumen probably will.

Size and handling. Rubber comes in a big roll, usually a whole roof-full on a roll. EPDM rolls are often 40 feet in length and some rolls are 60 feet. Most PVC comes in rolls 5 feet wide. The rolls are heavy enough that they must be hoisted on the roof with equipment. Of the available single-ply systems, only modified bitumen can be installed with a pickup truck and hand tools.

Compatibility. Neither EPDM nor PVC is compatible with asphalt in the long run. It does not appear that there is quick deterioration wherever these materials meet, but bitumen can indeed pull plasticizer out of PVC, and will make EPDM brittle. Most residential flat roofs occur either above or below shingled roof sections. Manufacturers of modified bitumens are the only ones who show details of how to achieve a shingle meeting a membrane.

The repairs and retrofits during the life of the roof will probably be done with plastic roof cement, regardless of what any of us say or do. Such repairs have a fighting chance with modified bitumen, but not with other systems.

Tools and skills. The method chosen for fastening down the roof system determines which tools are needed. Tools range from the whole BUR outfit for a hot mop-down to a utility knife for self-adhering modified bitumen.

Conclusions

All roofing manufacturers like to keep a measure of control over installers, using certification or franchising. But we probably are not far from the day when some of the single-ply membranes will be available as off-the-shelf products from the lumber yard. My guess is that, of all the new systems, the first material that deserves to be, and will be, in the hands of general contractors and remodelers, is modified bitumen.

We'll need another ten years of field performance results before we can really start talking about the track record of the material. Meanwhile, the modified bitumen does go down easily, and should find its place on a lot of low-slope house roofs. ■

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