02/10/2010

EPDM, Sustainability, and the Environment

EPDM has advantages over other elastomers

By Richard L. Fricklas

Fully adhered membranes are suitable for many roof conditions.

What material can support a vehicle going 120 mph through a steaming desert and still be flexible at -45 degrees C. (-49 degrees F.)? For roofing applications, materials must also have a high degree of weatherability – especially resistance to water, pollutants, UV rays, and impact and general traffic resistance.

Materials that meet these requirements are called *elastomers*. *ASTM D-1079* defines an elastomer as “a macromolecular material that returns rapidly to its approximate initial dimensions and shape after substantial deformation by a weak stress and subsequent release of that stress.”
EPDM has advantages over other elastomers in that its weathering resistance is extraordinary and its raw materials are highly cost effective. Presently, EPDM dominates the elastomeric roofing market, outselling all other materials combined. Among the single-ply roofing systems, EPDM offers building owners the roofing industry’s longest average service life, with more than 40 years of field performance, representing more than 20 billion square feet installed.
Because EPDM polymer doesn’t contain halogens within the polymer chain and isn’t inherently fire resistant, fire ratings can be achieved through two different avenues: the addition of an external fire retardant or via ballasted roof systems that obviate the need for membrane fire resistance. (Rocks don’t burn!)
While compounding of rubber is very complex, the following comments on ingredients may be useful:

- The EPDM polymer itself (provides the waterproofing and elastic properties)
- Oil extenders (permit higher filler loads to reduce costs)
- Processing aids (needed during manufacture)
- Accelerator activators (assist the vulcanization process)
- Antioxidants (for weather resistance)
- Antiozonants (for ozone resistance)
- Softeners (to improve pliability)
- Reinforcing fillers (dramatically increase modulus of elasticity and toughness)
- Non-reinforcing fillers (reduce costs)
- Fire retardants (as needed to meet building codes)

For roofing applications, two ingredients deserve further comment. One is the absolute need for carbon black to maximize the physical properties of the EPDM compound. If other fillers could match the performance of black rubber, we would see automobile tires in colors other than black. The carbon black is an excellent UV screening agent and reinforcing substance.

This explains why EPDM is generally furnished as a black material even though it's not as reflective as light-colored membranes. However, it's been documented that ballasted roof systems meet the intent of cool roofing design through the thermal inertia provided by the ballast, plus adequate thermal insulation in the system. Some manufacturers provide a white-on-black EPDM sheet. As the white side of the sheet weathers away, the exposed black rubber continues to protect the building. Reflective coatings have also been successful in elevating black EPDM's reflectivity to meet ENERGY STAR requirements. At the higher levels of thermal insulation now prescribed by *ASHRAE 90.1*, there's little difference in energy demand between black and white roofs except in the hotter climates, such as the desert southwest.

The extending oil and high filler concentrations also make EPDM vulnerable to attacks by oils, greases, etc. In a sense, an optimum amount of oil and filler have already been added to the EPDM sheets, and the sheet will accept more oil if it's present on the roof. EPDM manufacturers offer alternative membranes for those sections of a roof where such exposure occurs.

Hail and Traffic Resistance
When combined with cover boards, such as gypsum board, EPDM membranes can resist impact from 2-inch diameter hailstones or greater. Use of thicker membranes (e.g. 90 mil or roof walkways, or both) will improve durability for heavily trafficked areas.

LEED
EPDM has proven to be extremely durable and maintainable. Warranties have recently been increased to 30 years in many cases; with proper maintenance, life can be extended even longer. Single-ply membranes are thinner than BUR and modified bituminous membranes (45 to 90 mils compared to one-quarter inch or more) so, at the ultimate end of life, there is less volume headed to the landfills. The ballast is recyclable, whereas roofing gravel is embedded in asphalt and can't be reused (except with great difficulty). From a transportation point of view, ballast and pavers can be produced locally while shipping of large EPDM rolls from the few U.S. factories is not overly burdensome. There has been some success in recycling the rubber membranes, with more than 5 million square feet of membrane recycled in the past 3 years. So far, recyclers will only accept un-adhered membrane – the adhesives and attached insulation facers are too difficult to process.
Elastomeric membranes can't be heat welded to form watertight seams. Several generations of ways to achieve durable seams include volatile cleaner/primers, solvent-based adhesives (first based upon neoprene, then butyl rubber), and solvent-free butyl tapes. Some of the sheets are also free of talc or have side-lap tape factory-applied to reduce field cleaning. An additional benefit is that the tape is at a prescribed thickness, not subject to the variability of field application by brush or sponge.

Durable Accessories
Flashings are the most vulnerable part of any roof system. Prefabricated witches' hats are as durable as the roof membrane, whereas experience with bituminous pitch-pockets indicates that they must be frequently serviced to remain watertight. Roof edge details take advantage of the flexibility of the rubber membrane by carrying the membrane down the fascia at the building edge, so any water that gets under the metal edging is deflected down outside the building itself. Bituminous membranes can't effectively be bent into a 90-degree angle.

Sustainability and Maintainability
Many years can be added to an EPDM membrane by placing "target" pieces of fresh membrane at "tee-joints," inside and outside corners of flashings, curbs, etc. Such retrofitting may qualify the membrane for an extended warranty.

Attachment Options
EPDM membranes can be loose-laid and ballasted or, depending upon the substrate, fully adhered or mechanically fastened. Membranes can be non-reinforced, internally reinforced, or fleece-backed.