Comparing SBS and SEBS Polymers — Factual Statements Can Still Be Misleading

By Philip D. Dregger, PE, RRC, FRCI

DIFFERENCES IN THE PHYSICAL PROPERTIES between styrene-butadiene-styrene (SBS) and styrene-ethylene/butylene-styrene (SEBS) modified asphalts are often used to promote one product containing modified asphalt over another. The differences are also sometimes used as a rationale for barring consideration of otherwise similar built-up roof or modified bitumen roof products as alternative "equal" products when project specifications call for products containing either one of the modifiers.

SBS and SEBS are in fact two distinctly different styrenic block copolymers and they impart noticeably different physical properties to asphalt. However, it is not so clear that these physical property differences translate into meaningful differences in anticipated performance of the final roof covering.

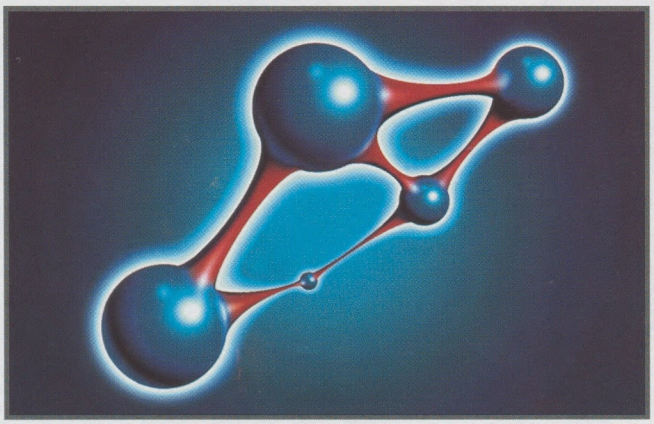
The purpose of this article is to identify potentially misleading aspects of otherwise factual statements sometimes put forth regarding the selection of SBS or SEBS modified roof products in low-sloped roof installations. This article will not address whether certain products containing SBS or SEBS modified asphalt are "equal" or whether modified asphalt products are "equal" to more conventional non-modified asphalt products.

This article will focus on two thermoplastic polymers used for asphalt modification and manufactured by Shell Chemical Company—Kraton® G, an SEBS polymer and Kraton® D, an SBS polymer utilized in the manufacture of rolled roofing products. Information about Kraton® polymers can be obtained online at the Shell Chemical web site at http://www.shellchemical.com.

Confirm How Modified Asphalt is Used

Exactly how and where the modified asphalt is incorporated into the roof covering is the heart of the issue. Confusion about this issue can lead to misleading claims. SBS and SEBS modifiers can be incorporated into roof covering systems in different ways. Some examples of the rather diverse usage of modified asphalts include:

- Use of SBS or SEBS modified asphalt as the "mopping" asphalt to adhere together otherwise conventional fiberglass ply sheets, organic felts, or polyester mats.
- Use of SBS or SEBS modified asphalt as the coating asphalt during manufacture of otherwise conventional fiberglass ply sheets.
- Use of SBS or SEBS modified asphalt in the manufacture of heavyweight, polyester or fiberglass-reinforced modified bitumen base, cap, or flashing sheets.



Shell Chemical's Kraton™ polymers are used for asphalt modificaton in the manufacture of rolled roofing products. (Courtesy Shell Chemical)

Shell literature explains that SEBS modified asphalts better resist extended periods of heating at the high temperatures of asphalt kettles more effectively than SBS modified asphalts.

This is an important consideration for roof coverings adhered with modified asphalt. Mopping asphalt is heated in kettles to temperatures between 400 and 500 degrees Fahrenheit for varying (and often extended) periods of time. In addition, an unjacketed kettle has heat exchanger tubes that could reach 1500°F. Especially during startup, (but even when running uniformly), there's little convection to keep localized overheating from occurring. This is one of the reasons one manufacturer requires a special double-jacketed, oil bath kettle with mechanical agitation for heating of its rubberized asphalt waterproofing membrane material.

However, this is a far less important consideration for roof coverings where the only use of modified asphalt is as a coating material for otherwise conventional fiberglass ply sheets. During roof installation, a modified asphalt present as a coating material on a ply sheet, experiences temperatures in the range of 400 to 500 degrees for only a matter of minutes. According to Shell literature, "thermal degradation" of SBS modified asphalt does not begin until the modified asphalt experiences temperatures greater than 380 degrees F for more than 2 hours. (Note: The modified asphalt "coating" material is also heated to elevated temperatures as part of the ply sheet

manufacturing process. However, the manufacturing environment allows a greater degree of control over temperatures and heating durations than is allowed by most asphalt kettle and mopping operations.)

Shell literature states that SEBS modified asphalt resists UV degradation better then SBS modified asphalt.

This is an important consideration when the modified asphalt material is likely to be exposed to sunlight. The use of plastic roof cements and flashing compounds containing modified asphalt often involves exposing portions of the materials to sunlight. On the other hand, modified asphalts used in the construction of built-up or modified bitumen roof coverings surfaced with conventional hot asphalt and aggregate would not be exposed to sunlight after installation.

Modified cap sheets are manufactured with a layer of mineral granules for UV protection. However, if the mineral surfacing is lost in some areas during roof service, the modified asphalt could be exposed to sunlight and UV degradation.

In the case where "smooth" surfacing materials are specified over otherwise unsurfaced sheets containing modified asphalt, the better resistance of the SEBS polymer to UV degradation would be an important consideration since coatings deteriorate and need to be re-applied periodically.

According to Shell literature:

- SBS modified asphalt has more than twice the elongation of SEBS modified asphalt.
- SEBS modified asphalt has 50% more tensile strength than SBS modified asphalt.
- SBS modified asphalt has a softening point 10% higher than SEBS modified asphalt.

This type of information, however, has been used to argue in fairly broad terms that roof coverings constructed with products containing SBS or SEBS modified asphalt, respectively, are more resistant to splitting, damage from skateboards, and slippage.

Both the SBS and SEBS polymers impart improved tensile strength, elasticity, and recovery properties to asphalt. Yet, the two modified asphalts exhibit different physical properties when tested alone. However, it would be misleading to imply, on that basis alone, that the test "differences" for the two polymers would necessarily translate into similar differences in the tensile strength, elasticity, or recovery properties of the completed roof membrane. Accordingly, this author suggests that any comparisons made between SBS and SEBS modifiers include comparisons of test results obtained from tests conducted on the composite roof membrane.

Sometimes smooth or aggregate-surfaced built-up roofs are constructed with hot asphalt, and the only modified asphalt

Further Suggested Reading:

Brzozowski, Kenneth, "Asphalt vs. Coal Tar," *Interface*, October 1995, p. 10.

Hogan, Lyle, "The Province of Testing," *Interface*, March 1997, p. 10.

Loden, Tony, "Selection of SBS Modified Asphalt Membranes: A Comparison by Evaluation," *Interface*, June 1994, p. 4.

present is the thin coating applied to the ply sheets during manufacture. Here it is important to point out that the tensile strength, elasticity, and recovery properties of the completed roof membrane depend more on the type and strength of ply sheet reinforcement layers and on the properties of the mopping asphalt, than on the relatively thin coating of modified asphalt on the ply sheets.

Fiberglass ply sheets coated with SEBS modified asphalt do not exhibit tensile strengths 50% higher than similar weight fiberglass ply sheets coated with SBS modified asphalt.

It is equally misleading to imply that a built-up roof membrane constructed with ply sheets coated with SBS modified asphalt is less likely to slip due to its higher softening point than one constructed with ply sheets coated with SEBS modified asphalt. The overriding consideration in either case is the appropriateness of the hot asphalt used to adhere the ply sheets together (and, when slopes indicate the need, the implementation of back nailing).

Other important considerations not addressed in this article include the compatibility of the polymer with the asphalt being used, the percent of the polymer added, the amount of filler, fire retardant additives, and the nature of the dispersion process. While some polymer-modified products have been used for decades, ASTM standards for many of them are now just appearing. This author is not aware of an ASTM standard for modified mopping asphalt.

Draw Conclusions Carefully

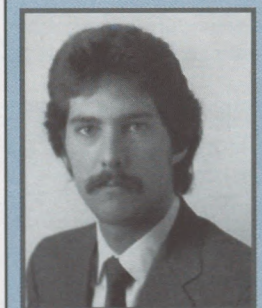
This author was asked to review a report commissioned to evaluate the acceptability of a roof membrane constructed of ply sheets coated with SBS modified asphalt proposed as an alternate to the specified roof membrane constructed of ply sheets coated with SEBS modified asphalt. Both the specified and the proposed alternate roof coverings included an SBS modified cap sheet and were to be adhered with conventional hot asphalt. The report stated, "We conclude from the data reviewed that the SEBS roof will last longer than an SBS roof."

Considering the references to "roof" and "last longer" in the statement, it appeared to this author that the concluding statement was intended as a judgement comparing the expected service life of two fully assembled roof membranes—not merely as a judgement comparing laboratory test results of two modified asphalts. The information presented, however, consisted primarily of contrasting the physical properties of SEBS and SBS modified asphalts. No information was presented contrasting the properties of the completed membranes or the expected longevity of SEBS or SBS modified asphalts at expected roof "service" temperatures. Accordingly, the basis of the conclusion was not clear. (Note: This author is not aware of any studies comparing the in-service longevity of built-up roofs constructed with ply sheets coated with SEBS, to built-up roofs constructed with ply sheets coated with SBS modified asphalt.)

Roof service life depends on many considerations, including roof installation, flashing details, slope, and maintenance. This author's experience has fostered caution about predicting roof service based on laboratory tests of roof materials alone. For example, a proven record of successful in-service performance is very important supplemental information. The roofing industry has suffered through several examples of highly-touted, technically "superior" products that tested well in the laboratory but did not perform as expected on the roof.

Roof professionals need to remember that making statements about laboratory test results is one thing, while drawing conclusions about expected roof service life is something quite different.

About The Author



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