The Material Compatibility Between Spray Foam Insulation and Henry Blueskin SA (Asphaltic-based Peel and Stick Air Barrier)

White Paper

Background

When designing exterior wall systems that include spray polyurethane foam insulation (SPF) applied to the exterior as continuous insulation, architects and engineers often inquire about the material compatibility of the SPF with common building product materials. Although direct substrate material compatibility alone rarely limits the application of SPF, secondary factors such as the response of dissimilar material types in dynamic environments may constrain product use. Asphaltic based weather-protection barriers and flashing materials such as Henry® Blueskin SA normally exhibits excellent adhesion, and no material compatibility issues with SPF. However, beginning in late 2022, in-field observations by both Henry Company technical service team personnel and SPF applicators documented significant peeling of the peel and stick air barrier from the polyethylene facer side of the membrane several days after SPF installation.

Purpose

This report summarizes a root cause analysis investigation into the reported SPF material compatibility complaints with Henry Blueskin SA (Asphaltic-based Peel and Stick Air Barrier).

Discussion

Henry Blueskin SA is a self-adhering membrane consisting of a Styrene-Butadiene-Styrene (SBS) rubberized asphalt compound laminated to a blue polyethylene film facer. Used along with SPF in continuous air barrier assemblies, Blueskin TWF is typically installed as through wall flashing (TWF) at the exterior base of a wall and Blueskin SA around penetrations such as pipes, windows and door frames. All spray foam insulation manufacturers permit the application of SPF to polyethylene faced membrane products like Blueskin SA. Carlisle Spray Foam Insulation (CSFI) includes the materials comprising Blueskin SA as well as specifically lists Henry Blueskin SA as an approved substrate material on the CSFI Material compatibility Sheet. This permission derives from in-house adhesion testing and real-world application and use information over several years.

In late 2022 both Henry Company technical service representatives and Carlisle Spray Foam Insulation representatives noticed a sudden rise in complaints from spray foam applicators across Canada. These complaints ranged from the residential sector to the commercial sector where installed spray foam was either: popping away from studs, curling sheet metal substrates, or causing Blueskin TWF or Blueskin SA to peel away from the substrate as well as a peeling from the polyethylene side of the membrane (Figure 1).

Figure 1. Shrinking foam causing Blueskin TWF to peel from exterior glass faced gypsum.

These complaints confirmed the same adhesion issue across Canada occurred with SPF products from several manufacturers. To isolate the root cause to either the SPF products or the Henry Blueskin SA, one SPF manufacturer in Canada tested their SPF product on multiple equivalent asphaltic membrane type products. This testing replicated the adhesion on all membranes

evaluated, suggesting that the root cause of the issue derived from the SPF product and not the membrane.

Despite the numerous complaints from SPF applicators to Henry Company representatives, Carlisle Spray Foam Insulation received zero similar complaints during this same period.

When Henry Company representatives notifed CSFI aboot the SPF issues, CSFI representatives contacted multiple applicators, who spray CSFI's SealTite One product in commercial construction projects where asphaltic peel and stick membranes are used with concrete masonry units (CMU) and fibreglass faced exterior grade gypsum. CSFI representatives inquired about any similar curling, warping, or peeling issues. The applicators installing SealTite One denied encountering the adhesion issues reported by applicators installaning other SPF products.

Hypothesis

The lack of any reported evidence of adhesion issues with the Blueskin SA alone to the substrate suggests that the SPF causes the Blueskin SA to peel. Since the peeling occurs several days after the SPF application and the initial application to Blueskin SA appears to have a strong bond, we hypothesize that the SPF is slowly contracting, thereby pulling the Blueskin SA off the substrate while still adhering to the SPF.

Spray Foam Insulation shares some similarities with baking a cake. Escaping gases in the foam cause the foam to rise. If the polymeric polyurethane network does not set or form properly, the SPF will slightly shrink like a cake pulled out of the oven too early. Internal chemical bond tension distorts the foam as the bonds orient themselves into a more favorable or relaxed energy state. Normally, these effects are minimized as the internal contracting forces are balanced with the adhesive strength to substrates spaced 16-inches or 24-inches apart as in wall and ceiling cavities. When installed uninterrupted across a wide surface area, a 0.5% change amounts to several inches of contraction.

The SPF industry widely acknowledges this effect, which led to the establishment of dimensional stability testing prior to SPF product certification (Table 1).

Table 1: Acceptance criteria for dimensional stability differences by country

	United States	Canada
Standard	ASTM D2126	
Sample Conditioning	73.4°F ± 3.6°F (23°C ± 2°C) 50% ± 10% R.H. 40 hours	73°F ± 2°F (23°C ± 1°C) 50% ± 4% R.H. 336 hours
Exposure Conditions (Total Volume Δ%)	158°F ± 4°F (70°C ± 2°C) 97% ± 3% R.H 168 hours (≤ 15)	1) -4°F ± 5°F (-20°C ± 3°C) Ambient Humidity 672 hours (≤ 5) [<0.5] for SealTite One 2) 175°F ± 5°F (80°C ± 3°C) Ambient Humidity 672 hours (≤ 8) [<0.5] 3) 160°F ± 5°F (70°C ± 3°C) 97% ± 3% R.H 672 hours (≤ 14) [<7]

Compared to the United States, Canada, through CAN/ULC-S705.1, sets rigorous dimensional stability standards due to the cold climate and its effects on SPF dimensional stability. However, though often difficult to achieve, these performances standards are industry minimums, and exceeding the standard provide additional assurance the foam will maintain physical properties in harsh environments.

Figure 2 below shows the impact of the foam's contracting forces exceeding the adhesive strength due to

compromised dimensional stability, and Figure 3 shows the secondary impact on the exterior cladding with a deleterious "oil can effect".

Figure 2.

Figure 3.

Method

CSFI constructed two identical block walls (Figures 4 & 5) with exterior gypsum to replicate typical real-world applications of asphaltic peel and stick membranes. Both walls were primed with Henry BAKOR Hi-Tac Adhesive 3.5L prior to the application of Blueskin SA. The walls were placed outside, exposed to the elements beginning May 27, 2023, until June 19, 2023, in Eastern Ontario, Canada. These walls experienced typical summer project site conditions for temperatures, day light, and rainfall. On June 19, 2023, the walls were sprayed with SealTite One.

Figure 4.

Figure 5.

Spray Foam Insulation Application

SealTite One was applied to the wall in a single 2-inch pass. Although not allowed in Canada, to replicate potential worst-case conditions, 4-inches of SealTite One was applied in a single pass to the interior corner where the CMU met the exterior gypsum. Higher lift thicknesses generate more heat which may have deleterious effects on the primer and adhesive. Additionally, higher lift thicknesses create elongated calls and a diminished dimensional stability.

SealTite One was applied to wall 2 in a one-half inch single pass. At the top of the wall, a strip of exterior gypsum was left exposed to replicate what is known as "zebra pattern" in the industry. After 30 minutes, a half inch was applied to the remaining exposed exterior gypsum and allowed to cure for 30 minutes. A

final 1.5-inch pass of SealTite One was applied to the entire mock wall.

To eliminate any forces that would prevent the foam from shrinking, CSFI cut off the edges of the foam which would have wrapped around the back side of the wall. The extra foam wrapped around could hold the foam in place by adhering to the back side of the gypsum and wood framing.

SealTite One was applied to both walls outside and remained exposed to the elements from June 19, 2023, until July 12, 2023. On July 12th, the walls were deconstructed to ascertain the adhesion of the foam to the membrane and the membrane to the substrate.

Batch Information

SealTite One Regular (B-side Resin)
Batch: 0833000RGW
Manufacturing Date: 05/03/2023

SealTite One Regular (A-side pMDI)
Batch: PA86002382

Figure 6. Day 1 SealTite One applied to test walls with sides trimmed

Figure 7. SealTite One with colour faded by UV exposure after approximately 3 weeks.

Results

Figure 8 shows no observable gaps between the spray foam and Blueskin SA or gaps between Blueskin SA and the exterior gypsum substrarte. Attempting to separate the foam from the substrate with a prybar caused gypsum, to break apart indicting good adhesion of Blueskin SA to the gypsum (Figure 9).

Figure 8. First attempt to remove SealTite One from exterior glass faced gypsum. Prybar shows bitumen intact.

Figure 9. Serious efforts to separate or remove SealTite One from the substrate. Forces used caused gyspum to break.

Figure 10. Attempts to pull Blueskin SA away from the gypsum substrate shows excellent adhesion. Adhesion failure occurred between the fibreglass facer to the gypsum.

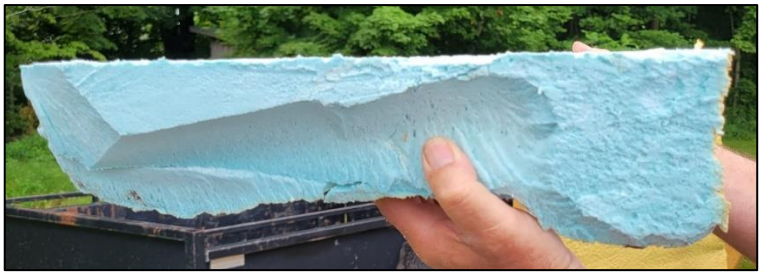

Figure 11. SealTite One when separated from the Blueskin SA substrate shows no evidence of shrinking, curling, or warping

Figure 12. No cupping, curling, or warping after 3 weeks. SealTite One is flat. Blueskin SA is well adhered to CMU.

Conclusion

Inadaequate dimensional stability of spray foam insulation causes costly repairs not just to remove and replace the foam insulation but potentially to repalace other building materials in direct contact with the foam such as the exterior cladding. SPF products applied to Blueksin SA and other asphaltic-based other peel and stick membrane have a long sccessful history across Canada. The unsatisifactory performance of some SPF products to Blueskin SA led those SPF manufacturers in Canada to incorectly assigned the root cause of recent material compatability issues to Henry Blueskin SA rather than to the curling and warping of the foam due to poor dimensional stability. The manufacturers of these products thereby prohibited the use of their SPF product to applications with Blueskin SA as a way to mitigate the compatability issues.

The information in this analysis demonstrates satisfactory material compatability of SealTite One to Henry Blueksin SA. SealTite One shows strong adhesion to the Blueskin SA as well as strong adhesion to of Blueskin SA to the gypsym substrate after SPF application revealing that there are no deleterous effects to the adhesive caused by the exothermic reaction from the SPF.

This report concludes that SPF products are compatible with Blueskin SA, however, since SPF adheres very well to the Blueskin SA, any curling, warping, or shrinking of the SPF similarly affects Blueskin SA. We attribute the recently reported issues across Canada to SPF products that exhibit inadequate dimensional stability and not an inherent material compatability problem bewteen SPF and Blueskin SA.

Since Canada sets strict spray foam insulation product physical property standards as well as spray application and installation requirements, we are surprised to see approved Canadian SPF products display inconsistent results with that of SealTite One. Reconciling the recently observed dimensional stability problem with the robust Canadian standards requires one to consider intentional product formulation modification explanations.

Carlisle Spray Foam Insulation is committed to providing the highest standard of quality in Canada. Our manufacturing facility, formulations and Quality Control records are audited annually by the Underwriters Laboratories of Canada ULC. ULC Evaluation Reports are intended to provide guidance in determining code compliance for products where the manufactuter requires data validation from a third party. SealTite One holds a ULC ER-39311-03. Since the inauguration of SealTite One our formula remains the same so that every batch and that every drum produces the same foam insulation.

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