Case Study

Chemical Engineering
Building Sciences
Materials Science
Polymer Science

Failure Analysis of Spray Polyurethane Foam (SPF) Insulation

Spray polyurethane foam (SPF) insulation is essentially manufactured in place when installed. Off-gassing of volatile organic compounds (VOCs) occurs as the foam cures, but it is important to link detected VOCs to the SPF as a source if the foam is to be implicated as the cause of alleged issues.

The Situation

Spray polyurethane foam (SPF) insulation is essentially manufactured in place when installed. Off-gassing of volatile organic compounds (VOCs) occurs as the foam cures, but it is important to link detected VOCs to the SPF as a source if the foam is to be implicated as the cause of alleged issues. ESi was contacted about a newly constructed residence that had SPF insulation installed. The homeowners visited the site during the construction process and complained of excessive odors they believed originated in the SPF and cited health code violations. Air samples were collected by the homeowner's expert, and allegations were made against the foam installer that the odors and VOCs detected came from the foam and that the foam had been improperly installed. ESi was retained on behalf of the foam installer and asked to inspect the residence and conduct testing to determine whether there was any indication of improper installation resulting in conditions that resulted in excessive odors and whether odors detected were related to the foam.

ESi Consultants:

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Services Utilized:

- Building Services
- Failure Analysis
- Materials Testing
- Lab & Inspection Services
- Product Design & Analysis

Our Approach

ESi collected air samples from various locations inside the residence. Four common organic solvents were detected in the air in all locations sampled following the EPA TO-15 standard method. These included acetone, pentane, methyl ethyl ketone (MEK), and tetrahydrofuran (THF), at low parts per billion (ppb) concentrations not considered to be health hazards. These solvents can be found in many different building materials and personal care products. Samples of the SPF were also collected from various locations. Emissions testing was conducted via ASTM D7706 Standard Practice for Rapid Screening of VOC Emissions from Products Using Micro-Scale Chambers. Other VOCs were detected in the foam emission testing, but because they were not detected in the air sampling, ESi reasoned that they were not contributing to the odor complaints.

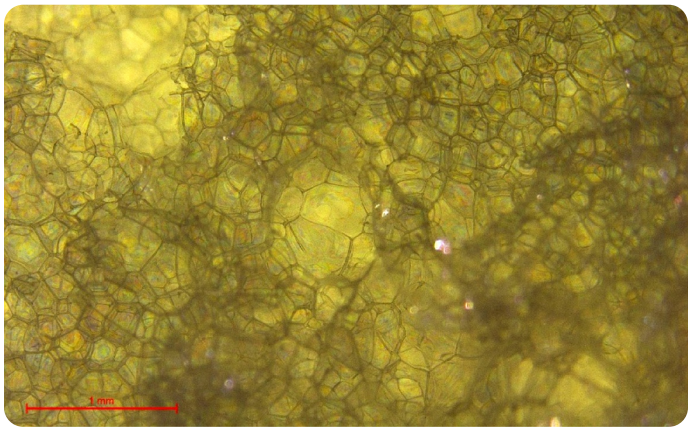
ESi also determined the foam density to compare to expected values, analyzed the foam pore structure via optical microscopy, and evaluated how well the foam had cured via differential scanning calorimetry (DSC) and Fourier transform infrared (FTIR) spectroscopy. The results of this suite of testing showed that the foam samples all exhibited characteristics typical for fully cured SPF insulation.

This, along with the foam emission testing, indicated that no evidence of improper installation could be found. Our team's report stressed the importance of finding a link between VOCs detected in the air that could be sources of odors and emissions from actual foam samples.

Unlike other types of insulation that need to be cut to shape or blown in as particulate matter, SPF is sprayed in place in liquid form where it expands in volume filling voids and conforming around complex shapes. SPF therefore acts as a highly efficient air barrier and tightly seals buildings to prevent air from entering, resulting in odors caused by VOCs from other sources within the structure to often be mistaken for smells originating from the SPF itself. Additional fresh air make-up in the HVAC system design can alleviate this issue, which is not related to improper SPF materials or installation.

The Outcome

As a result of the ESi team demonstrating the SPF insulation was installed properly and the VOCs detected that could be contributing to odors did not originate in the foam, the client was able to get a successful dismissal of the case. The end result was a classic case of correlation not equaling causation.



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