

Drying Potential of Polystyrene Insulations Under Extreme Environmental Cycling Conditions

Moisture intrusion into building materials is sometimes unavoidable. It is important to evaluate material performance when exposed to long term environmental conditions. Insulation materials need to resist moisture intrusion, but just as importantly be able to exhibit drying potential to maintain long term thermal integrity.

The EPS Industry Alliance commissioned Intertek Testing Services NA Ltd., an independent test laboratory, to conduct tests on several types of polystyrene foam using ASTM C1512, **Standard Test Method for Characterizing the Effect of Exposure to Environmental Cycling on Thermal Performance of Insulation Products**; a rigorous environmental cycling laboratory test method.

The ASTM C1512 test method was developed to evaluate building insulation performance when exposed to moisture and freeze-thaw cycles. The tests were performed on 1" (25 mm) thick specimens of ASTM C578 Types I, II and IX expanded polystyrene (EPS) insulation (equivalent to CAN/ULC-S701, Types 1, 2 and 3) and Type X extruded polystyrene (XPS) insulation. This bulletin provides

detailed moisture results measured during the ASTM C1512 testing.

Pre-Conditioning

During the first stage of the ASTM C1512 test, specimens are pre-conditioned in a test chamber for 28 days. To replicate extreme field exposure conditions, the test samples are exposed to 75 °F (24°C) and 90% relative humidity on one side (warm side) and 5 °F (-15 °C) at ambient relative humidity on the opposite side (cold side). The intention of the extreme temperature and humidity gradient between the warm and cold side is to artificially accumulate moisture within the test specimens from vapor diffusion.

Cycling Stage

The next stage of the ASTM C1512 test subjects specimens to exposure conditions on the cold side of the test chamber cycling between 5 °F (-15 °C) and 59 °F (15 °C) at ambient relative humidity at 12 hour intervals for 20 days to simulate extreme field exposure conditions. The warm side of the test specimen stays at a constant 24 °C (75 °F) and 90 % relative humidity for the 20 day period. The cycling stage is where the

drying potential of the insulation under common field exposure conditions is measured.

Results

The test provides information on the wetting and drying performance of EPS and XPS insulation under severe conditions.

- All polystyrene foams retain a very low percentage of moisture by volume after environmental cycling.
- All EPS insulation types dried significantly during the cycling stage, demonstrating long-term drying potential.
- The XPS insulation *did not* exhibit drying potential in the cycling stage.

Conclusions

When exposed to the extreme conditions of the ASTM C1512 test, EPS insulation exhibited drying potential under severe exposure conditions while XPS, when exposed to the same conditions, *did not*. The drying potential for thermal insulation is critical to maintaining thermal resistance (R-value) under severe long term exposure conditions.

ASTM C1512 Environmental Cycling¹

Insulation Type	Moisture Accumulated During Pre-Conditioning	Moisture Remaining After Environmental Cycling	Moisture Lost During Environmental Cycling	Drying Potential Observed?
EPS Type I	4.7 %	2.7 %	2.0%	Yes
EPS Type II	3.2 %	1.7 %	1.5%	Yes
EPS Type IX	2.1 %	1.6 %	0.5%	Yes
XPS Type X	0.8 %	0.8 %	0.0%	NO

¹ Values in table are water % by volume

