

Laboratory Versus In-Situ Test Methodology

STANDARDIZED TEST METHODS

The most common laboratory test methods to evaluate moisture absorption call for partial or full submersion conditions that do not replicate exposure in field applications. Standardized laboratory submersion test methods are typically conducted with 1-inch thick samples that are submerged for 24 or 96 hours. These basic laboratory test methods were not developed for predicting in-situ performance, but are intended for use in specifications as a means of product quality control.

Building insulations are subjected to a wide range of conditions and must maintain their performance over extended periods of time. In this context the value of in-situ test data is crucial and more important than basic laboratory test methods.

IN-SITU XPS TEST METHODOLOGY

To investigate the in-situ performance of extruded polystyrene (XPS) insulation, an independent laboratory was commissioned to evaluate the field performance for various applications being used in different climates.

The XPS samples were excavated under the supervision of the independent laboratory to conduct R-value and water absorption measurements. Samples from four different locations and applications were selected for testing. Two specimens were evaluated from each location. The R-value retention and moisture absorption percent for the individual samples were analyzed.

Specimens were tested for thermal resistance using ASTM C518 "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Apparatus" immediately after excavation. Moisture content was determined by measuring the sample weight at the time of removal and again after being oven dried.

*In-Situ XPS R-Value Retention
Diminished When Exposed To
Moisture*

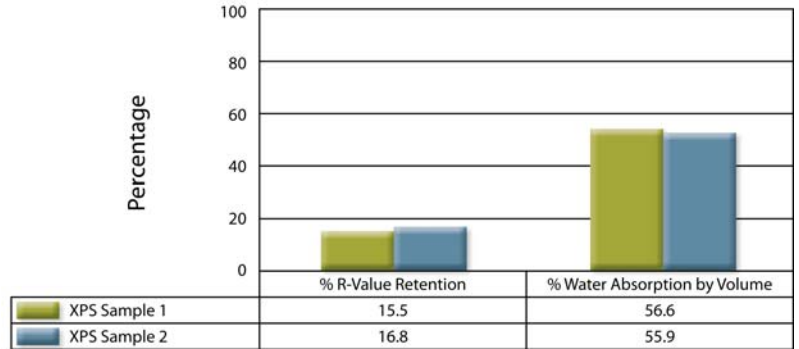


*Standardized Laboratory Water
Absorption Test Methods DO
NOT Predict Long-Term R-value
Performance*

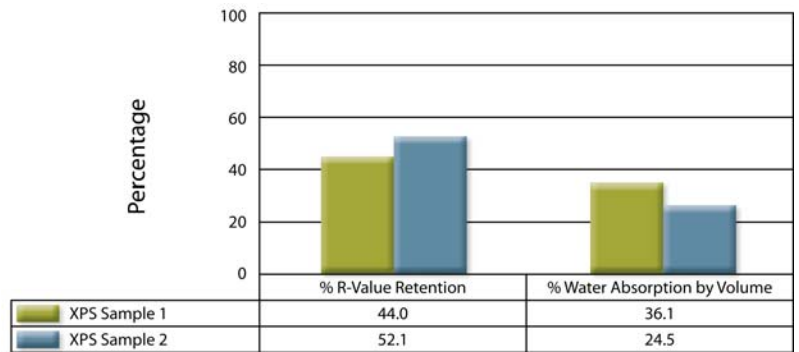
XPS Moisture & R-value Retention Percentages



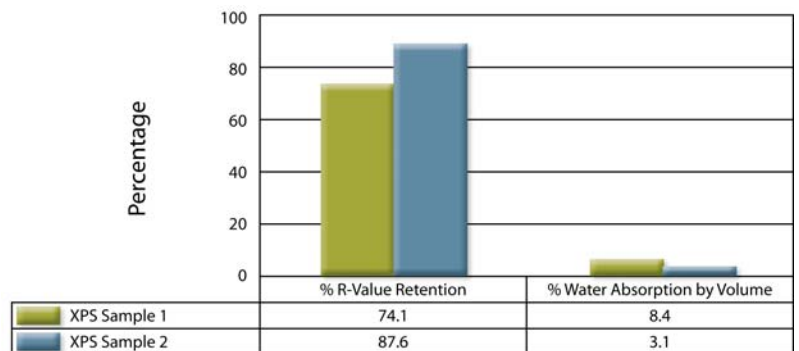
**Below Grade Insulation
St. Paul, MN**



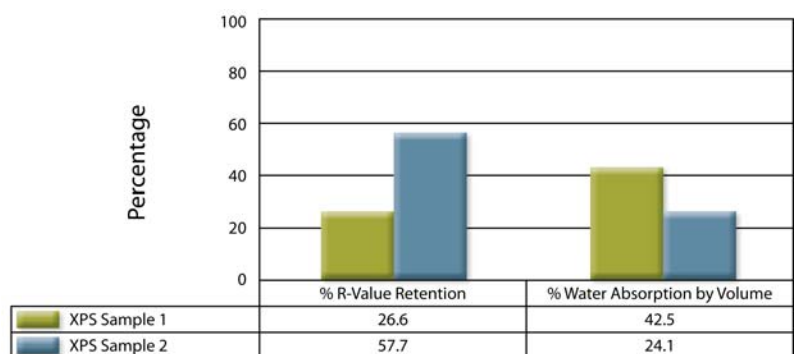
**Roadway Insulation
Minneapolis, MN**



**Roof A
Wasilla, AK**



**Roof B
Wasilla, AK**



Polystyrene Foam Below Grade

BEST PRACTICES

It is important to recognize that the successful use of polystyrene foam insulation depends upon its correct installation using good building practice. In below grade applications the success of the overall system depends, to a large extent, upon provision for adequate drainage of water away from the foundation system. The following design considerations should be taken into account for below grade applications:

Direct Water Away From The Foundation

- Provide a slope at grade away from the foundation of at least 6" in 10 feet.
- Direct down spouts to drain at least 3 feet away from the building.
- Avoid landscaping that requires excessive watering in the vicinity of the foundation wall.

Ensure There Is Adequate Subgrade Drainage

- Wrap a geotextile filter fabric around the drain tile at the base of the foundation or place over the granular fill material over the drain tile.
- Ensure the drain tile has adequate slope to the outflow point.
- Use well-graded backfill or other appropriate drainage medium to ensure sufficient sub-grade drainage adjacent to the foundation wall.

Use Details To Minimize Leakage Potential

- Seal and flash top edge of exterior foundation insulation.
- Embed lower edge of exterior insulation layer at least 6" into perimeter stone over drain tile.
- Keep level of perimeter drain tile below the basement floor level.
- Seal tie rod holes and control joints.
- Place vapor barrier on inside face of wall (on the interior of the insulated wall).

CONCLUSION

The long-term application of XPS insulation below grade results in a higher water retention and greater loss of R-value than reported when using standardized laboratory test methods. Water absorption results for XPS using ASTM C272³ cannot be correlated to the in-service performance of extruded polystyrene foam insulation.

Material specifications such as ASTM C578 and CAN/ULC-S701 cannot provide all of the answers that a designer may need. These specifications provide physical property requirements for the various EPS and XPS insulation types most commonly used. In many cases, end use applications require unique physical properties and manufacturers have products to meet these needs; designers should consult with manufacturers when a particular application requires specific material properties.

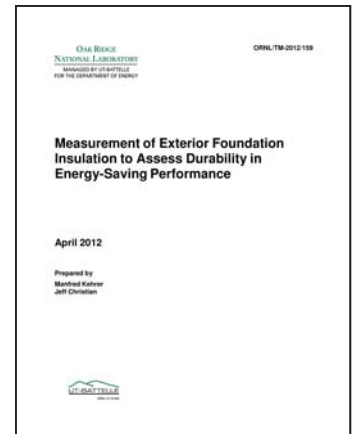
REFERENCES

¹ ASTM C578 "Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation"

² CAN/ULC-S701 "Standard for Thermal Insulation, Polystyrene, Boards & Pipe Covering"

³ ASTM C272 "Standard test Method for Water Absorption of Core Materials for Structural Sandwich Materials"

ADDITIONAL RESEARCH



Third-party research published by Oak Ridge National Laboratory in April 2012 further validates the findings of Table 1, indicating XPS below grade systems can experience a 10-44% loss of energy savings performance when subjected to moisture accumulation in the range of 8% - 16%. This study, Measurement of Exterior Foundation Insulation To Assess Durability in Energy Saving Performance, evaluated six exterior insulation systems spanning installation periods of 9 months to 15 years.