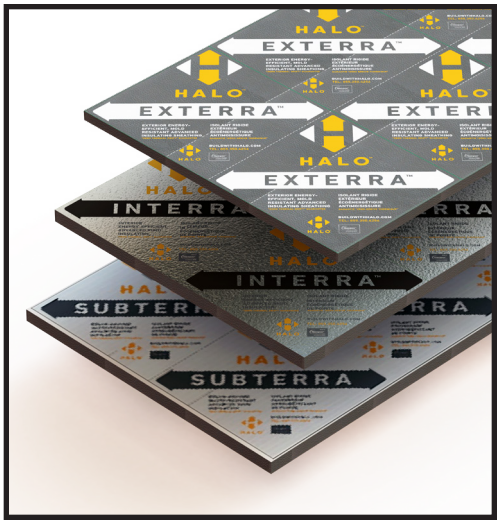
TECHNICAL BULLETIN
No.3 - 082916
REV1 - 100523

EPS VS XPS RIGID INSULATION - WATER ABSORPTION



Halo rigid insulation products are made of graphite polystyrene (GPS).

The insulation in a building is the biggest contributor to increasing energy efficiency - the higher the R-value of the insulation the greater the energy savings that can be expected. Over time, insulation can be exposed to moisture, especially below-grade, which can result in a reduction in R-value, and subsequent reduction in energy savings. So it's critical that the insulation chosen can retain its R-value even after long term exposure to moisture.

XPS and EPS are the main types of rigid insulation used for insulating the exterior of a building, including roofs, below slabs, crawl spaces and foundation walls. Both offer high R-values but differ in water absorption rates. Based on standards test methods[1], XPS absorbs less water than EPS. Because XPS absorbs less water than EPS one would expect XPS to retain a higher R-value. However, the standard test methods do not tell the whole story.

The standard test method requires a small sample size of 1" or 2" thick, 12"x12". The samples are submerged in water for up to 96 hours. Afterwards, the samples are measured for water absorption by volume. The test may indicate short term water absorption, but there is no test standard that accounts for long term water absorption and its effect on R-value – real end-use product performance.

As the standards note, these test methods are meant as a means to specify product performance, product evaluations and quality control – but not meant as a good indication for end-use product performance. Hence, the effect on R-value due to long term exposure to moisture should be considered.

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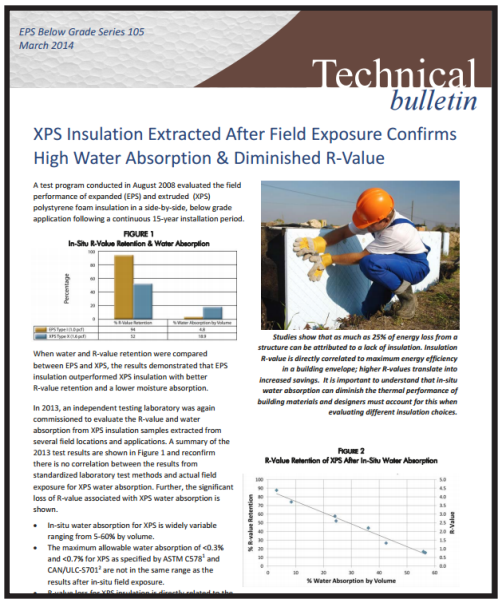
EPS Below Grade Series 105
March 2014

Technical bulletin

XPS Insulation Extracted After Field Exposure Confirms High Water Absorption & Diminished R-Value

A test program conducted in August 2008 evaluated the field performance of expanded (EPS) and extruded (XPS) polystyrene foam insulation in a side-by-side, below grade application following a continuous 15-year installation period.

FIGURE 1
In-Situ R-Value Retention & Water Absorption

When water and R-value retention were compared between EPS and XPS, the results demonstrated that EPS insulation outperformed XPS insulation with better R-value retention and a lower moisture absorption.

In 2013, an independent testing laboratory was again commissioned to evaluate the R-value and water absorption from XPS insulation samples extracted from several field locations and applications. A summary of the 2013 test results are shown in Figure 1 and reconfirm there is no correlation between the results from standardized laboratory test methods and actual field exposure for XPS water absorption. Further, the significant loss of R-value associated with XPS water absorption is shown.

- In-situ water absorption for XPS is widely variable ranging from 5-60% by volume.
- The maximum allowable water absorption of <0.3% and <0.7% for XPS as specified by ASTM C578[1] and CAN/ULC-S701[2] are not in the same range as the results after in-situ field exposure.

Studies show that as much as 25% of energy loss from a structure can be attributed to a lack of insulation. Insulation R-value is directly correlated to maximum energy efficiency in a building envelope; higher R-values translate into increased savings. It is important to understand that in-situ water absorption can diminish the thermal performance of building materials and designers must account for this when evaluating different insulation choices.

FIGURE 2
R-Value Retention of XPS After In-Situ Water Absorption

% R-value Retention

% Water Absorption by Volume

R-Value

Independent research[2] has shown that over time XPS will actually absorb and retain more moisture than EPS resulting in a significant decrease in R-value. One of the studies showed XPS retained 19% water absorption compared to 5% for EPS after being buried below grade for 15 years. As a result, the XPS samples only retained 52% of its initial R-value, whereas EPS retained 94% of its R-value. The reason for the higher R-value retention of EPS is likely due to the comparatively higher vapour permeance property, which allows moisture absorbed in the EPS to escape more readily than XPS – most of the moisture absorbed in XPS will be retained in the XPS reducing the R-value.


EPS Below Grade Series 103
November 2008

Technical bulletin

15-Year In-Situ Research Shows EPS Outperforms XPS in R-Value Retention

Studies show that as much as 25% of energy loss from a structure can be attributed to a lack of insulation on below-grade foundations, crawl spaces and under slabs. Insulation R-value is directly correlated to maximum energy efficiency in a building envelope; higher R-values translate into increased savings. In below grade applications, foam insulation is exposed to moisture and could lose R-value over time if this moisture is absorbed.

As shown in an independent, third-party test program expanded polystyrene (EPS) maintains its R-value even after long-term exposure in northern climates. A competing insulation material, extruded polystyrene (XPS), was shown to have lost R-value over time. The results of this test program demonstrate that EPS insulation is a perfect choice to reduce energy loss.

IN-SITU TEST RESULTS

In August 2008, independent testing evaluated the field performance of EPS and XPS insulation in a side-by-side, below grade application following a continuous 15-year installation period. EPS Type I and XPS Type X test samples were excavated from the exterior of a commercial building in St. Paul, MN at a depth of approximately 6 feet below grade.

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.

Excavation Site St. Paul, MN Climate Zone 1

Side-by-Side Installation

Ironically, a good demonstration of this is featured in an Owen Corning video "XPS vs EPS: Science Doesn't Lie." The video, available on Youtube, shows water injected into a sample of EPS and XPS. As expected, the EPS sample allowed the water to escape retaining its R-value, whereas the XPS sample showed little to no water escaping resulting in a reduction in R-value.

The XPS industry has long marketed XPS rigid insulation as having higher retained R-values than EPS because it has a lower water absorption property based on these standards. However, as these standards indicate, the water absorption properties do not reflect real end-use product performance. Just as the XPS insulation industry is required to provide long term thermal resistance values to consumers (due to its loss in R-value over time); it should also provide long term water absorption values, which also affects the long term R-value.

1. Minimum water absorption rates for XPS and EPS are set in accordance with ASTM C578, "Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation" and CAN/ULC S701, "Standard for Thermal Insulation, Polystyrene Boards and Pipe Covering".
2. EPS Industry Alliance, "15-Year In-situ Research Shows EPS Outperforms XPS in R-value Retention"
   EPS Industry Alliance, "XPS Insulation Extracted After Field Exposure Confirms High Water Absorption & Diminished R-value"