

# Research Report



9931 S. 136th Street  
Suite 100  
Omaha, NE 68138-3936  
402-592-7077  
Toll-Free 800-468-6344  
Fax 402-592-7969  
www.rewardwalls.com

## How Moisture Affects EPS Insulation

- EPS insulation is a moisture-resistant material with low absorption
- EPS will shed water when placed behind brick or other exterior finish materials
- If inadvertently wetted, EPS will dry to either the outside or inside of the Reward building
- Moisture in EPS will not cause deterioration in a finished Reward iForm™ wall if interior and exterior finishes are vented or vapor permeable

**Expanded polystyrene insulation (EPS)** provides the majority of the thermal resistance (R-value) of the Reward iForm wall system. The EPS also acts as formwork and contains fresh concrete until it gains adequate strength.

**Weather-resistant barrier.** In the Reward iForm wall system, EPS on the outdoor side acts as a weather resistant membrane that sheds water that works its way behind a brick veneer or other exterior finish material. The EPS acts as a drainage plane and channels water to the bottom of the wall. Although a small amount of water may be absorbed by the EPS when wetted, the EPS will dry when the source of moisture is removed as long as the EPS is allowed to dry and its finishes are vented or vapor permeable. The addition of another weather resistant barrier, such as Tyvek®, is not necessary.

Research also indicates that EPS boards butted together will not allow water to reach the backside of the insulation.<sup>1</sup> Similarly, EPS in the Reward iForms is fit tightly together and will not readily allow moisture to penetrate. In areas where the EPS is damaged or not flush with the rest of the wall, a water resistant barrier material can be used to cover the gap. This will provide a continuous drainage plane on the side of the wall.

Even if a small amount of moisture is able to work its way to the concrete layer of the iForm, it will be stopped by the concrete, and will tend to dry to the outside. The drying will continue until the concrete reaches an equilibrium moisture content with the EPS insulation and the outdoor air.

**Moisture Resistant.** EPS is not damaged by moisture. EPS will not rot, does not promote the growth of fungus or bacteria, and has no food value for animals. EPS does not degrade due to age, thermal cycling or weathering in the anticipated service temperature range.<sup>2</sup> EPS has low absorption and coated EPS<sup>3,4</sup> is used to float structures, buildings, and even small islands. The green of the 14<sup>th</sup> hole of the Coeur d'Alene Golf Course in Coeur d'Alene Idaho floats on EPS as do the homes in Canoe Pass Village in Vancouver, BC.<sup>5</sup>

1 "Performance of Expanded Polystyrene Below Grade," EPS Newslines, EPS Molders Association, Crofton, MD, Vol. 7, Spring 2004. [www.epsmolders.org](http://www.epsmolders.org)

2 Bourne, J.G., et al, Building Insulation Materials Compilation, Civil Engineering Laboratory, Naval Construction Battalion Center, Report No. CR 80.001, Port Hueneme, California, 1979.

3 The coatings protect the floating EPS from conditions not found in buildings: deterioration due to sunlight, petroleum products floating on water, and wake and ice damage.

4 EPS Just Makes Sense, CD, EPS Molders Association, Crofton, MD. [www.EPSmolders.com](http://www.EPSmolders.com)

5 [www.coeurdalene.org](http://www.coeurdalene.org) and [www.floatinghomes.com](http://www.floatinghomes.com)



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**Absorption Testing.** Studies of buildings have found that EPS on exterior of basement walls and other building applications have long-term absorption rates of less than 1% by volume<sup>6</sup>.

The standard test for measuring absorption of EPS is by immersing 1 x 12 x 12 in. samples in water for 24 hours according to ASTM C272.<sup>7</sup> Using this method, the maximum absorption of EPS in Reward iForm is 2% by volume.<sup>8</sup> For comparison, the maximum absorption of wood fiberboard, traditional normal weight concrete, and medium weight block are 10,<sup>9</sup> 12, and 27% by volume. These are maximums under severe conditions and not applicable to typical building applications. Also, absorption test methods vary by material.

**Manufacture.** EPS is a closed-cell rigid foam plastic<sup>10</sup> manufactured from petrochemical by-products. EPS uses pentane, a blowing agent that is not harmful to the upper (stratospheric) ozone layer. EPS is odorless,<sup>11</sup> does not contribute to off-gassing, and is approximately 95% air. Also, the pentane within the foam dissipates during or shortly after the molding process, so the thermal resistance (R-value) of the foam is stable.<sup>12</sup> Some other rigid insulation materials use foaming agents that contribute to the R-value, but as these agents are released from the insulation, the R-value degrades.

**Precautions.** EPS should be protected against prolonged exposure to the ultra-violet rays in sunlight, which will cause a slight yellowing and surface dusting. This does not affect the EPS in a building after the siding or other exterior finish has been applied. On the inside surface, EPS generally needs to be covered with 1/2-in. gypsum wallboard or other applicable finish to meet building code requirements for fire protection. EPS is subject to attack by some petroleum-based solvents. Contact between these solvents and their vapors should be avoided. The maximum service temperature of EPS is 165°F.

6 "Performance of Expanded Polystyrene Below Grade," EPS Newsline, EPS Molders Association, Crofton, MD, Vol. 7, Spring 2004. www.epsmolders.org

7 ASTM C272-91 (1996), "Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions," ASTM, www.ASTM.org

8 *Reward Wall Systems Installation, Structural, and Technical Manual*, Reward Wall Systems, Inc., Omaha, NE, Release F, 2003.

9 Graham, M., "Properties of Rigid Roof Insulation," *Professional Roofing*, May 1999, www.ProfessionalRoofing.net

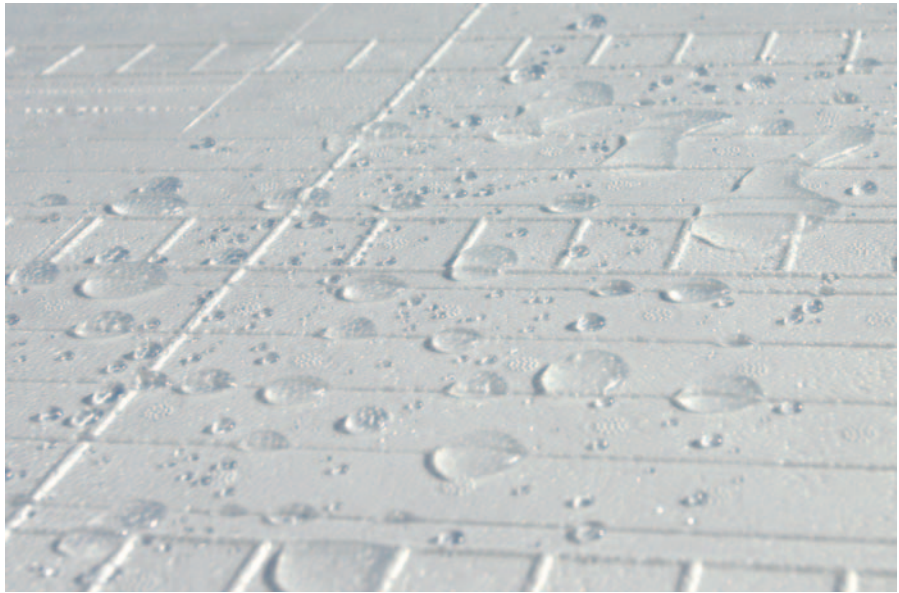
10 ASTM C578-03, "Standard Specification for Rigid, Cellular, Polystyrene Thermal Insulation," ASTM, www.ASTM.org

11 Bourne, J.G., et al, *Building Insulation Materials Compilation*, Civil Engineering Laboratory, Naval Construction Battalion Center, Report No. CR 80.001, Port Hueneme, California, 1979.

12 "All About EPS", *Permanent Buildings & Foundations Magazine*, R.W. Nielson Co., Provo, UT, May 15, 2003. www.pbf.org



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Water sprayed on EPS forms small droplets and is not readily absorbed.

Due to manufacturing processes, EPS thickness, EPS type and the uniqueness of the Reward iForm, this analysis, information and report is only to be used with Reward iForm and is not to be used with any other ICF system



Prepared by:  
Martha G. VanGeem, PE, LEED-AP  
Construction Technology Laboratories, Inc.  
5400 Old Orchard Road  
Skokie, IL 60077  
Phone: 847 965 7500  
[www.CTLgroup.com](http://www.CTLgroup.com)

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