XPSA
EXTRUDED POLYSTYRENE FOAM ASSOCIATION

Technical INSIGHTS

Winter-Spring 2021

Simple Experiments Demonstrate How Water Moves More Freely through EPS than XPS

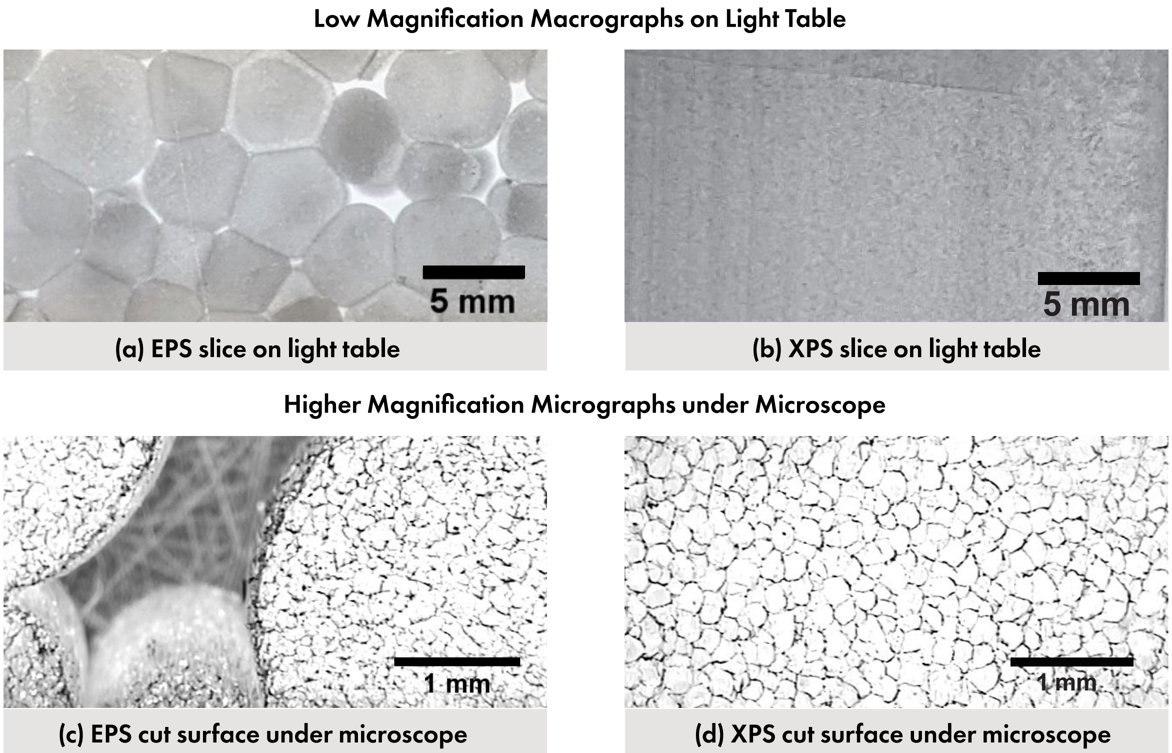


Figure 1 – Micrographs of EPS (ASTM C578 Type XIV) and XPS (ASTM C578 Type IV) foam samples at two magnification levels: (a) Channels between foamed polystyrene domains are seen in this construction-grade EPS slice; (b) XPS foam is uniformly continuous, no voids are present; (c) Higher magnification image of EPS shows voids between domains of closed cell foam, similar in size to domains themselves; (d) Only the continuous closed cell foam structure is evident in XPS insulation.

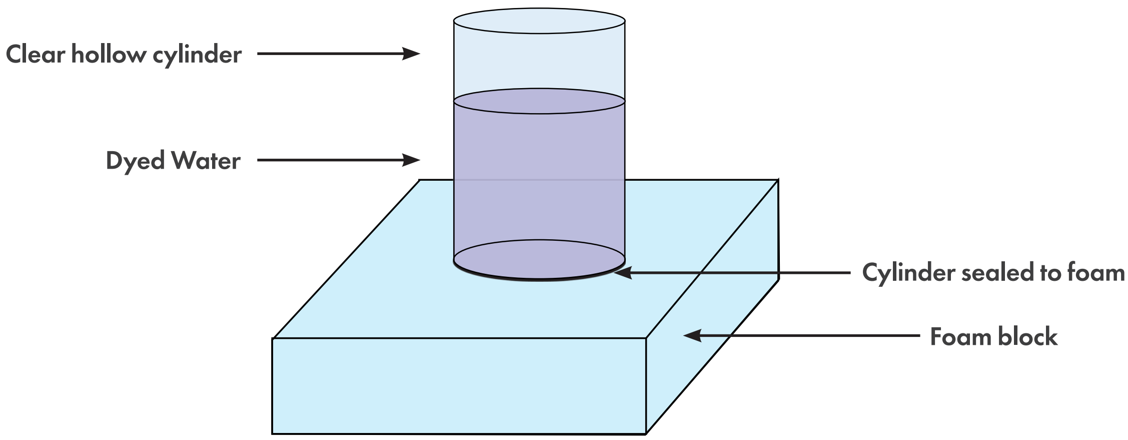
When exposed to water, foam insulations made from extruded polystyrene (XPS) behave differently than foam insulations made from expanded polystyrene (EPS). A few simple experiments illustrate the added value of XPS over EPS.

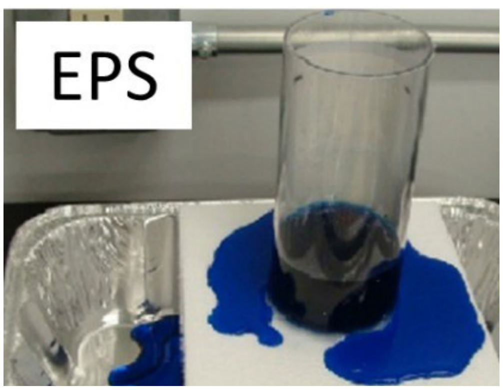
The closed-cell continuous structure of XPS does not allow liquid water to move through the foam. The open pathways between EPS particles allow liquid water to move through the EPS foam boards. When EPS is continuously exposed to liquid water, as is normally the case in below grade applications, it can absorb water rather quickly. This is important because thermal resistance of XPS and EPS insulation is reduced in proportion to the increase in moisture content.

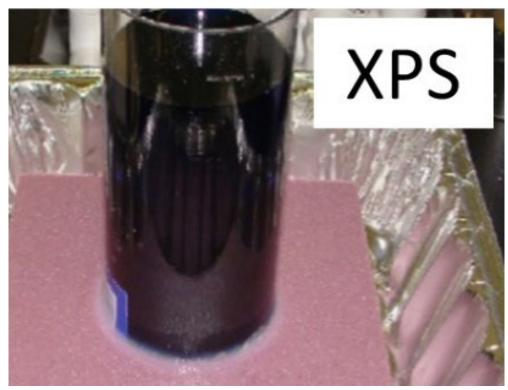
Why doesn't water (or coffee!) flow out of your expanded polystyrene foam cup? The EPS particles making up the foam cup are very small, and the voids between them are also small enough to resist the water pressure of the hydrostatic column of coffee. In comparison to the foam cups, construction-grade EPS foams commonly have sufficiently large voids so that even a couple of inches of standing water can breach the foam board.

Capillary Action Experiment #1

The extent of capillary action* in EPS is dramatically illustrated by a simple experiment that can be performed with unsophisticated equipment. A clear sturdy hollow cylinder, which is open on both ends, is sealed on one end to a construction grade (EPS or XPS) foam board using a silicone sealant. When the sealant sets, dyed water is added to the cylinder (dye is added purely for visualization of water passages). Liquid water easily finds and moves through the voids between partially fused discontinuous EPS particles in an EPS board by capillary action. It follows paths of least resistance and flows out. Conversely, no liquid water migrates through an XPS board by this mechanism because the microstructure of XPS has no such capillaries.

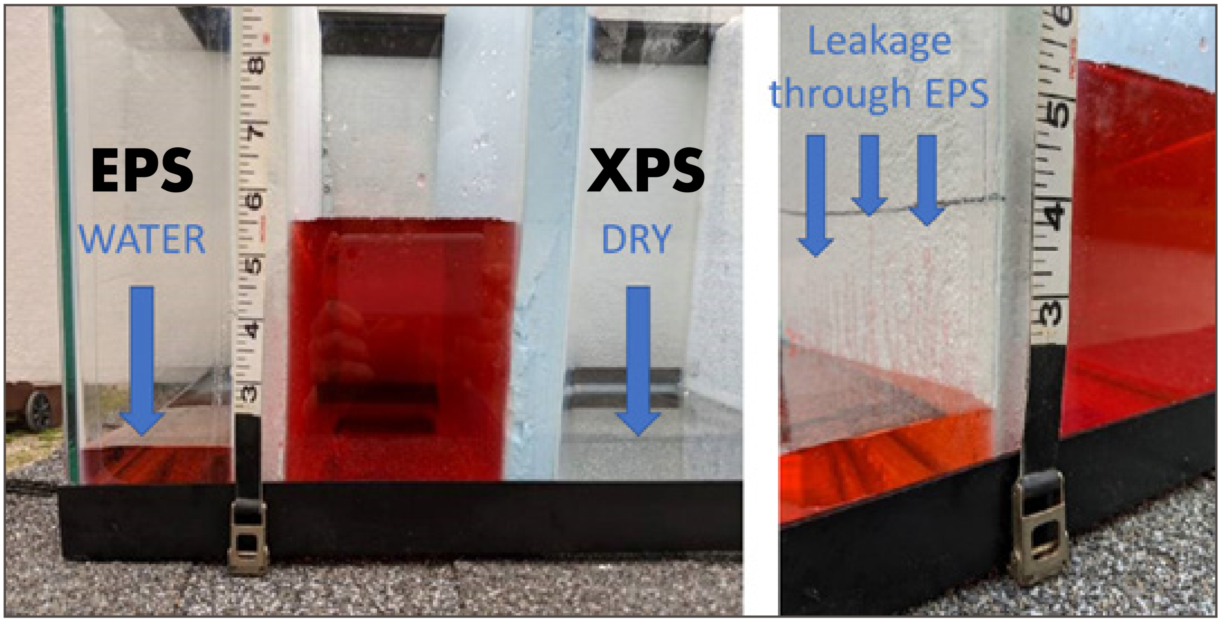






Capillary Action Experiment #2

In another simple experiment, a fish tank is set up with one-inch thick panels of construction-grade XPS and EPS, separating the tank into three sections. The panels are securely sealed to the walls of the tank using silicone sealant. The experiment is started by placing dyed water in the middle section. Water soon seeps through the EPS panel but no water seeps through the XPS panel (even after many days following the start of the experiment).



XPS efficiently resists liquid water penetration, as is readily demonstrated by these experiments. Construction-grade EPS allows liquid water penetration through the foam.**

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*For more about capillary action, see https://en.wikipedia.org/wiki/Capillary_action.

**Surface treatments such as facers can inhibit water penetration into EPS in the laboratory; in real world applications, these surface treatments are susceptible to physical damage and chemical deterioration. Water easily flows through bulk construction-grade EPS foam insulation once the surface is compromised. A major advantage of XPS is that it resists water flow throughout the entire thickness of the bulk material.