

OPEN-CELL SPRAY FOAM & WHAT EVERY CONTRACTOR SHOULD KNOW

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OVERVIEW

Open-cell or Closed-cell?

The age old question that many stumped - from industry bloggers to homeowners - is whether to choose open-cell or closed-cell spray foam insulation. Open-cell foam often gets pegged as having 'sponge like' qualities or as being under qualified as an air barrier. Well, if you've seen one, you haven't seen them all.

Homeowners often consult builders for the answer on this one; and a wrong answer can jeopardize their safety and well-being, not to mention the builder's reputation.

FIVE WHOLE TRUTHS *(that tell half the story)*

The spray foam selection process is usually dependent on the product characteristics that follow. Some contractors are quick to rule out open-cell foam without knowing the whole story. The truth is; low-density, open-cell foam is vapor permeable. But is that really a bad thing? There are a few more questions that need to be answered before making the decision about which cell structure is right for the project.

Truth #1 Air Permeance

The misconception is that open-cell foam requires 5.5" thickness to achieve air barrier status; whereas closed-cell foam is classified as an air barrier at about 1" thickness. The authoritative and required standard that verifies a product's performance as an air barrier is test ASTM E 283 as listed in section R806.4.2 of the 2006 IRC (International Residential Code). The manufacturer's ESR Report is a resourceful document that will state whether the insulation has been tested in accordance with ASTM E 283. Most will show that open-cell foams were tested as an air barrier at thicknesses between 3" and 3.5".

Open-cell foam that is in accordance with ASTM E 283 minimizes air leakage as effectively as closed-cell foam and likely does so without the use of HFCs. By contrast, most closed-cell products still use HFCs as blowing agents.

Using open-cell foam that meets air barrier requirements and uses water as the only blowing agent (no co-agent such as HFC-245fa) is a good way to increase sustainability in building.

FIVE WHOLE TRUTHS *(that tell half the story)*

Truth #2 Water Absorption

Open-cell foam can absorb more water than a closed-cell product when submerged (although some open-cell foams absorb much less water than others). It should be noted that submergence testing does not reflect a real life scenario. Apart from this point, water absorption is not the only factor that determines insulation performance. The spray foam selection process should also take into account the material's drying potential and performance afterward.

When spraying the underside of a roof deck in hot/humid climates, for instance, a key advantage of applying air-impermeable, open-cell insulation is that it does not hold onto water. In the event of a roof leak, water drains straight through the insulation by gravity rather than being trapped against the roof sheathing where it could contribute to roof rot.

Upon drying, some open-cell products return to their original state without warping or distortion, and the effectiveness of the insulation is fully restored¹. This is not possible with closed-cell.

Truth #3 Structural Strength

Open-cell foam doesn't offer the structural strength that is delivered when using a more rigid (closed-cell) product. While the application of closed-cell foam may provide compressive resistance and increased racking loads, structures must meet structural code requirements without relying on the type of foam.

In fact, applying an open-cell, flexible foam versus a rigid product delivers a key advantage to enhancing structural integrity. Open-cell foam cures soft and stays flexible so that when the framing members expand and contract with temperature and humidity changes, open-cell foam will flex with the substrate to help ensure a reliable air-seal.

In contrast, rigid closed-cell foam may develop cracks because it is not able to flex enough. This compromises the air-seal and results in air leakage.

FIVE WHOLE TRUTHS *(that tell half the story)*

Truth #4 R-Value

Open-cell foam doesn't deliver high R-Value. While R-Value has been the standard for comparing the energy efficiency of insulation, building science experts tell us we can take performance beyond R-Value.

In fact, an insulation that works to air-seal the building envelope can outperform products that deliver higher R-Value. While both open-cell and closed-cell foams deliver optimal R-Value and air-sealing, the blowing agents used in closed-cell insulation can cause some thermal degradation over time. As the closed-cell foam

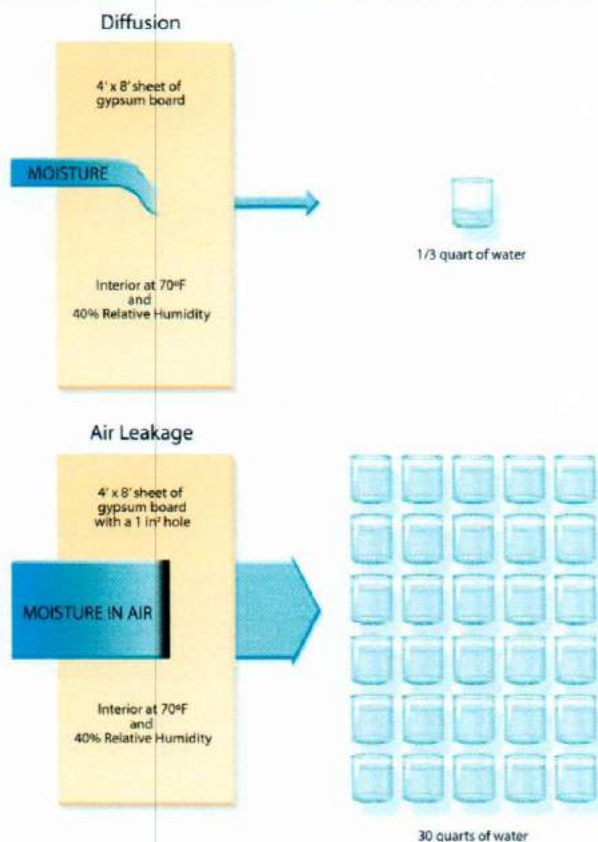
off-gases, the R-Value is diminished and performance is reduced.

Open-cell foam that uses water as the only blowing agent delivers stabilized R-Values because there is no off-gassing. One hundred percent waterblown, open-cell foam will deliver optimal and consistent energy and environmental performance for the life of the building. A 100% water-blown closed-cell, medium-density product like ProSeal Eco can also help achieve such a result.

Truth #5 Moisture Permeability

Open-cell foam is described as being vapor permeable. By contrast, closed-cell foam is said to be vapor impermeable. While some water vapor can move through open-cell foam under the right conditions, if the material is classed as an air barrier, then it is effective in controlling the primary moisture transfer mechanism through the building envelope which is convective (airborne) moisture flow.

In Figure 1, as much as 30 quarts of water is carried through air leakage via a 1 in2 hole in a 4x8 sheet of gypsum board. Only 1/3 quart of water moves through the gypsum board via diffusion (movement of water vapor from an area of higher concentration to an area of lower concentration). The tiny air pockets of open-cell insulation promote quick drying time of the small amount of moisture that is carried by diffusion. In extreme cold climates (Zones 6 and higher), a vapor retarder is used to restrict diffused moisture flow.



Right: Figure 1 - Moisture Transport via Diffusion vs. Air Leakage
Source: www.eeba.org

ACTION PLAN

Improve Building Performance with Open-Cell Foam

Open-cell foam can be used successfully to deliver sustainable, high-performance results. Incorporating open-cell foam in sustainable buildings can have the greatest impact on helping to achieve these key sustainable strategies: energy efficiency, moisture management, and whole building design.

Contractors can reference manufacturer's test results to select the most effective open-cell option.

Energy Efficiency

Air leakage can account for up to 40% of a home's heating and cooling costs². To avoid air leakage and excessive loss of energy, the U.S. Department of Energy recommends the use of an effective, continuous air barrier, as well as insulation. Both open-cell and closed-cell products can help reduce heating and cooling costs by as much as 50%. Open-cell foam has the added benefit of longevity in that 100% water-blown foam does not release emissions that would degrade the material and, ultimately, its performance. Open-cell foam is the permanent solution to minimizing operating costs and related greenhouse gas emissions. Selecting products that provide longevity can eliminate the need for re-installation of additional material in the future. Another benefit of using open-cell insulation/air barrier is that it cures soft and stays flexible to expand and contract with the substrate, helping to ensure a reliable air-seal. While more rigid material may pull away from the substrate, the flexibility of open-cell foam maintains the integrity of the air-seal for the life of the building.

Look for testing: *ASTM E 283 (rate of air leakage), ASTM E 2178-03 (air permeance)*

Moisture Management

When it comes to addressing moisture, open-cell foam is better suited for use against building materials that can be damaged by water build-up. When applied against these types of materials (i.e. exterior wood sheathing), particularly in hot/humid climates, insulation should allow moisture diffusion to occur, just enough to let adjacent building materials breathe in order to prevent moisture entrapment. Open-cell foam delivers this 'breathability' and allows building materials to dry, minimizing moisture build-up and related problems such as mold. If a closed-cell is used inside exterior sheathing and the sheathing gets wet, it may not dry fast enough to the interior to prevent problems. The sheathing could rot before any water issues become apparent.

Look for testing: *ASTM E 96-80 (vapor permeance), ASTM D 2842-69 (water absorption)*

ACTION PLAN

Whole Building Design

Optimizing building envelope performance considers how all building components interact. Following the principles of whole building design, the end result is a structure that is more durable and operates more efficiently. Air, heat and moisture flow are critical considerations for successful implementation of the whole building approach. This is where insulation comes into play.

More specifically, this is where certain open-cell foams can work to the contractor's advantage. For instance, when applied to the underside of the roof deck to create an unvented attic assembly, air-impermeable open-cell foam increases the efficiency of attic-located HVAC equipment, reducing energy consumption and related greenhouse gas emissions. More efficient operation of the HVAC system also results in advanced moisture management.

Look for testing: ASTM E 283 Under the 2012 IRC Section 806.5 and 2009 IRC Section 806.4, the use of air-impermeable insulation in unvented attic assemblies is outlined.

End Notes

¹ Consult manufacturer's reports as not all open-cell foam maintains original dimensions and performance upon drying

² U.S. Department of Energy

Open-cell insulation, when qualified as an air barrier, is an effective solution to maximizing air control and minimizing related problems.

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