Honeywell

Closed-Cell Spray Polyurethane Foam Insulation

A cost-effective solution for today's industry demands

With the demand for improved energy efficiency, increasingly stringent code requirements and rigorous consumer expectations, the overall performance of building enclosures has received a surge of industry focus. One of the components receiving elevated attention in design is the selection of insulation materials.

Installed Insulation Costs Don't Tell the Whole Story

In selecting a product, there can be a tendency to place too high of an emphasis on the "first" or "installed" costs. This is understandable given defined budget limitations for most projects. However, installed costs don't tell the whole story. When selecting an insulation product, one should consider not only how its attributes impact performance, but also the cost benefits that multiple functionality has on a project. Often, this multiple functionality can offset much of the initial product cost difference. As we transition thinking to whole system design, a comparison of cost and performance of systems rather than individual components provides a clearer cost picture. This can also help determine which product is better suited for a specific project.

Spray Polyurethane Foam - Growing in Popularity

With an emphasis on "whole system design," spray polyurethane foam (SPF) insulation use continues to grow in popularity. This is an indication that awareness about the benefits of spray foam, and often associated cost savings, has started to take root. This is largely due to its versatility and the performance that it provides relative to more traditional insulation products, such as fiberglass and cellulose.

Spray foam insulation is commonly recognized as providing higher performance and insulation value over more traditional products. Because it expands to fill the cavity, SPF better accommodates irregularities in materials and conforms around piping, outlet boxes and other wall penetrations. As the foam quickly expands, it fills cracks and gaps that normally occur in a wall system. Because of its excellent adhesion properties, SPF does not settle in wall systems like cellulose and fiberglass. Also, it does not compress in the cavity like fiberglass, which reduces thermal performance.

Because it conforms to the cavity and adheres to the surfaces, SPF is not subject to convective air loops that further reduce wall system performance. These performance benefits should be considered when selecting insulation for a project.

There are generally two different types of spray polyurethane foam insulation used in the market. These are commonly known as open-cell SPF or closed-cell SPF. Alternatively, they are also known as low or medium density foams respectively. Both are easily installed through the use of qualified and trained contractors.

TABLE OF CONTENTS

Closed-cell foam

Open-cell foam

Comparing Closed-cell to Open-cell SPF:

Closed-cell spray polyurethane foam (ccSPF) is more rigid, denser, and provides a higher level of insulation performance for a given thickness. In addition, it is water resistant, provides vapor control, is an air barrier material and can enhance the structural integrity of a building. These ccSPF attributes provide for added flexibility in design because it can be used in interior cavity and exterior applications. In fact, ccSPF is one of only a few products available that can be used to meet the continuous insulation requirements in the code. In addition, it can be used on the exterior as a roofing system that provides moisture protection, air sealing and insulation performance. Alternatively, open-cell spray polyurethane foam (ocSPF) is spongy in nature, can absorb water and has a lower insulating value, similar to traditional fiberglass and cellulose products.

CcSPF is more rigid, denser, and provides a higher level of insulation performance for a given thickness

When selecting insulation products, ccSPF is among the most thermally efficient and highest performance insulation systems available on the market. This alone can provide significant flexibility in the design of a wall system. When further consideration is made for the air sealing performance, air barrier properties, moisture control and structural enhancements attributed to its use, one may realize cost savings[1] in other areas that help offset the “first” or “installed costs” of the product. This contributes to a more informed product selection. Here are a few cost saving considerations when selecting ccSPF in a design:

Higher Insulation Performance

Although wall systems are designed to a specified total R-Value required, the higher insulating performance of ccSPF offers design flexibility, in particular where space restrictions apply. With higher insulation requirements in the code, ccSPF can help you achieve and/or exceed the higher insulation values (R-19) with 2x4 framing rather than the required 2x6 framing for fiberglass, cellulose and ocSPF.[1] In fact, some ccSPF products can achieve as high as R-24[2] within a 2x4 cavity space. The reduction in lumber costs can provide significant cost savings for a builder in the framing package, as well as the trim package required for windows and door penetrations. The builder may even realize 40-50 additional square feet of usable area in the home. This alone can significantly offset any insulation cost difference if livable space is created.

Air Tightness

The 2012 codes require all buildings to be air sealed and introduces air tightness testing. A typical wall system can have miles of cracks and gaps that reduce the air tightness of the building. Air tight buildings perform better because they enable insulation to perform as designed, but also translate to better air quality control, comfort and temperature regulation. Both types of SPF insulations provide enhanced air sealing by expanding during installation into the various cracks and crevices within a wall system. However, ccSPF is the only insulation recognized as an air barrier material at 1" thickness.[3] It has stronger adhesion properties which can translate to higher performance of the air barrier system. In fact, a thermal metric study[4] indicated that SPF sprayed walls provided superior air sealing over traditional materials like fiberglass and cellulose. In this study, ccSPF walls were found to reduce air infiltration by as much as 96% over traditional materials. In addition to air sealing, the tighter nature of SPF designs may enable the size of the HVAC system to be reduced.

Vapor Control

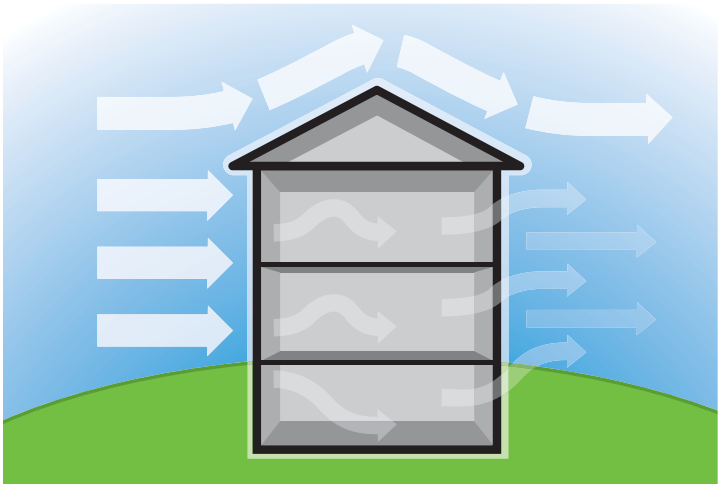
Vapor control is an essential part of moisture mitigation and impacts building durability. CcSPF meets ICC code requirements for a Class II vapor retarder.[5] Traditional vapor control layers, such as 4-6 mil poly, are installed on the "warm in winter" side of the insulation. In climate zones 5 and above, vapor control measures are required under the ICC model codes, and for the most part, optional in zones 4 and below. The problem with vapor control layers in a mixed or warm climate is that they are on the wrong side of the wall for much of the year and therefore, are listed as optional. This doesn't mean vapor control is not needed – just that it is difficult to design properly in zones 4 and below. Because vapor control is inherent to ccSPF, it can be effective in all climate zones and is never on the wrong side of the insulation (when properly installed). When using ccSPF, no additional vapor control is required. This offers savings by eliminating the need for additional vapor control layer materials and the labor required for installation.

Moisture Control

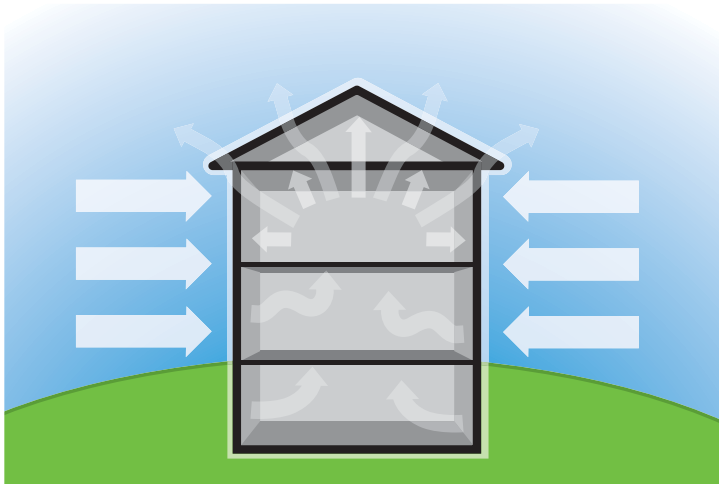
CcSPF is inherently moisture resistant. This makes it uniquely suited for flood prone areas or as a secondary moisture control layer. For crawl space applications, ccSPF offers the best balance of properties for an insulation layer due to its thermal performance and moisture control benefits. In fact, ccSPF is the only FEMA approved insulation material for extended moisture contact.[6] In areas prone to flooding, storm surges or other forms of severe weather, ccSPF may improve the moisture resistance of a building. This can translate to reduced moisture problems and even reduced insurance premiums.

Structural Enhancements

As mentioned, ccSPF cures as a rigid foam product that provides enhanced structural properties to a building. In fact, studies reveal that using ccSPF in a framed wall system can increase the structural integrity of a building by as much as 200%.[7] Likewise, a study at the University of Florida revealed that use of ccSPF in roofing systems enhanced the structural integrity of the roof during a severe weather or wind event. Protecting the roof system during a hurricane or other severe weather is essential not only to safeguard building contents, but most importantly, its occupants. This can often translate to reduced insurance premiums.



Permeable insulations, such as cellulose and fiberglass, are more susceptible to air infiltration and air leakage than ccSPF insulation.



CcSPF insulation reduces air infiltration and provides superior air sealing over traditional materials like fiberglass and cellulose.

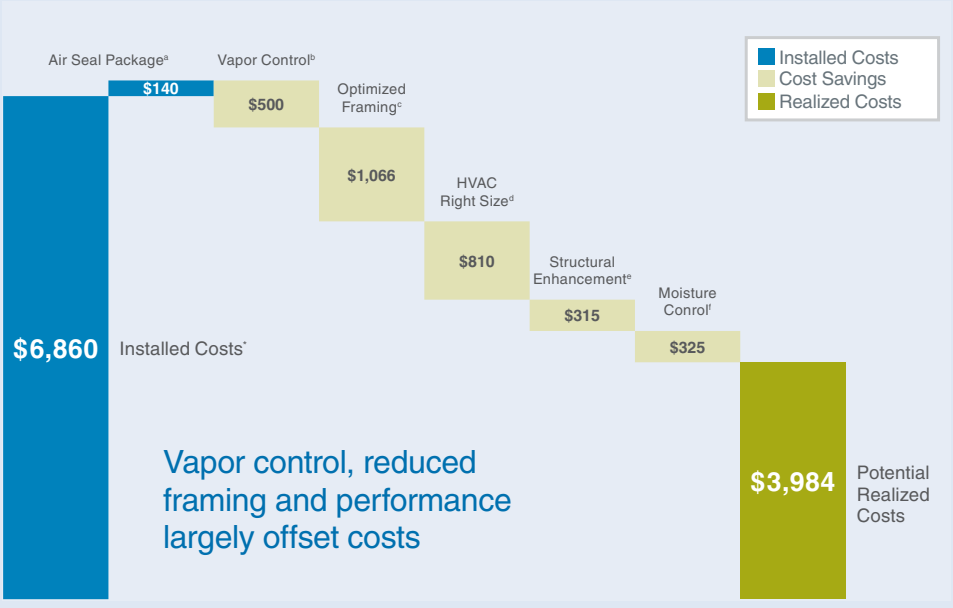
Considerations When Comparing Insulation Costs

In an attempt to assess "potential realized costs" of insulation products, the RSMeans database was used to compare national averages for various products commonly used in wall system design. Because local labor costs and design criteria can vary widely between regions, national averages were evaluated for the purpose of this assessment. We considered insulation, air infiltration control, framing, weather resistive barrier, structural sheathing and let-in bracing, and vapor control as part of the assessment, since these are essential to wall system performance.

Based on these considerations, the following charts (Figures 1-4) depict the impact of these benefits and present a comparison of the "installed" and the "potential realized" costs for insulation materials commonly used in wall systems. The assessment is based on a 2,800 square foot home and national averages.[8] It provides a platform for considering the potential benefits subject to local market and construction practices. Beginning with ccSPF, the following chart shows the potential savings that may be realized to offset the initial installed costs of this material.

Figure 1

Realized Cost of ccSPF (R-19)



*Based on RSMeans National Averages (2,800 sq. ft. area) *Installed costs calculated at $2.45/sq. ft. (2,800 sq. ft. area)*

a Based on RSMeans data, the typical air sealing package for the baseline home was estimated to cost $700. Because SPF inherently seals the various cavity penetrations and gaps when installed, it eliminates the need for further air sealing in this area. With an SPF installation, only minor air sealing is required i.e., around floor joists, windows and doors. Therefore, SPF air sealing costs are estimated to be 80% less than the typical air sealing package.

b Based on RSMeans and the base case considered, this cost savings for vapor control was determined to be $500 vs. a traditional insulation system.

c Based on RSMeans average lumber costs of 2x6= $0.475/ft, 2x4= $0.375/ft and labor costs of 2x6=$0.405/ft, 2x4=$0.335/ft, a cost benefit for the lumber package alone was determined to be $1066 based on national averages. Although a continuous insulated sheathing option enables maintaining a 2x4 framing system with traditional insulation materials, this option was not considered since the cost of installing the insulated sheathing alone exceeds the savings in framing lumber used.

d For larger homes, as much as a ton of capacity may be offset by the benefit of HVAC right sizing. For the purpose of the base case evaluation, a ½ ton reduction in the HVAC sizing was assumed representing a savings of $810 based on national averages and reducing the size of the HVAC equipment from a SEER 16 4T system to a SEER 16 3.5T system.

e For structural enhancement, a modest value of $315 was assigned representing a one year savings for a 21% premium reduction on a wind policy of $1500 under Florida OIR-B1-1655 for use of a qualifying system as a secondary water barrier (6%) and enhanced roof to wall connection (15%).

f For moisture control, a modest value of $325 was assigned for a 1 year policy savings representing a 30% contribution towards preferred NFIP rates on a $150K policy.

Figure 2

Realized Cost of ocSPF (R-19)

Based on RSMeans National Averages (2,800 sq. ft. area) **Installed costs calculated at $1.65/sq. ft. (2,800 sq. ft. area)*

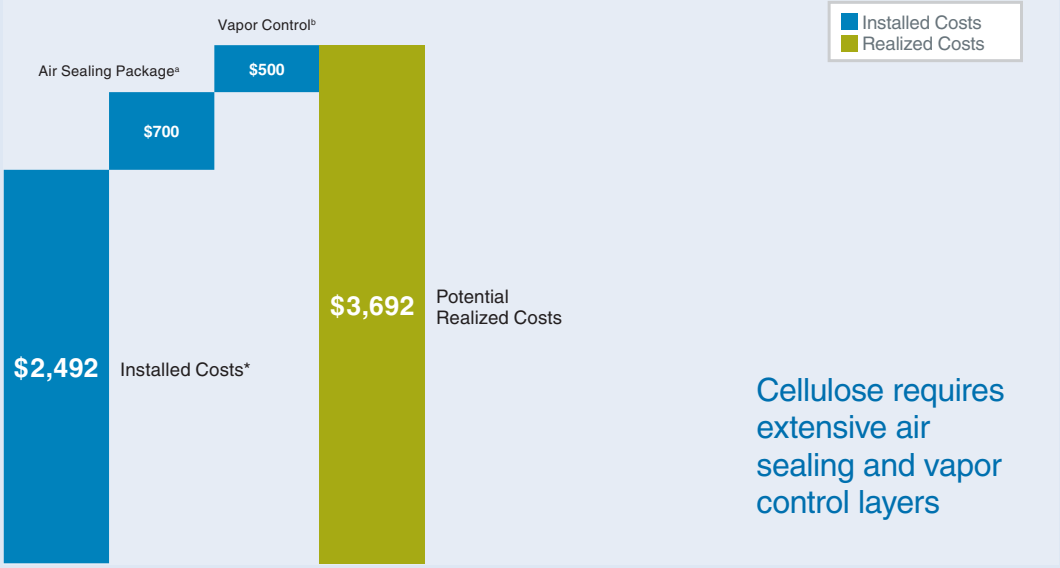
a Based on RSMeans data, the typical air sealing package for the baseline home was estimated to cost $700. Because SPF inherently seals the various cavity penetrations and gaps when installed, it eliminates the need for further air sealing in this area. With an SPF installation, only minor air sealing is required i.e., around floor joists, windows and doors. Therefore, SPF air sealing costs are estimated to be 80% less than the typical air sealing package.

b Based on RSMeans data, the typical vapor control package for the baseline home was estimated to cost $500.

c For larger homes, as much as a ton of capacity may be offset by the benefit of HVAC right sizing. For the purpose of the base case evaluation, a ½ ton reduction in the HVAC sizing was assumed representing a savings of $810 based on national averages and reducing the size of the HVAC equipment from a SEER 16 4T system to a SEER 16 3.5T system.

Figure 3

Realized Cost of Cellulose (R-19)



Based on RSMeans National Averages (2,800 sq. ft. area) **Installed costs calculated at $0.89/sq. ft. (2,800 sq. ft. area)*

a Based on RSMeans data, the typical air sealing package for the baseline home was estimated to cost $700.

b Based on RSMeans data, the typical vapor control package for the baseline home was estimated to cost $500.

Figure 4 **Realized Cost of Fiberglass (R-19)**

Based on RSMeans National Averages (2,800 sq. ft. area) **Installed costs calculated at $0.84/sq. ft. (2,800 sq. ft. area)*

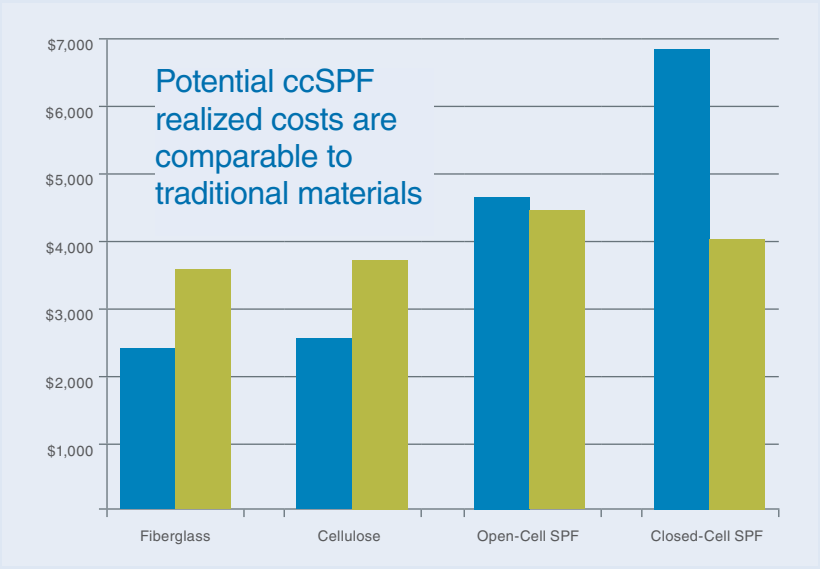
a Based on RSMeans data, the typical air sealing package for the baseline home was estimated to cost $700.
b Based on RSMeans data, the typical vapor control package for the baseline home was estimated to cost $500.

Using a Wall System Design Approach for Insulation Comparisons

If one bases a product decision simply on installed costs, it is not surprising that some would elect to use traditional insulation materials, such as fiberglass and cellulose. However, when one considers the "associated" costs incurred when designing a wall system with these products, the potential "realized" or "actual" cost difference may be quite small (Figure 5).

This is because permeable insulation such as fiberglass, cellulose and ocSPF may require additional wall components such as an air barrier and vapor retarder to ensure the wall system meets minimum code requirements. As we've seen in the charts, these additional product needs result in additional material and labor costs directly associated with selecting these products; yet we often overlook that fact during product selection.

Figure 5 **Installed vs. Realized Costs (R-19)**



Based on RSMeans National Averages (2,800 sq. ft. area)

Installed insulation costs don't tell the whole story.

When one considers wall design and the various components required to make insulation perform as intended, the initial costs of the insulation package become less significant. The more steps you have to take to achieve an effective wall design and the more trades you have to coordinate, the higher the risk that something can go wrong with the overall wall system performance. Because SPF, and in particular ccSPF, provides multiple benefits, it is the easy choice for today's performance driven requirements. As part of any wall system design, thermal performance, moisture control and air tightness remain the key areas requiring diligent consideration. CcSPF excels in these areas and its "all-in-one" functionality can far outweigh any initial "installed" cost premium.

Therefore, you may want to consider taking a system approach when making your insulation selection. Selecting the right insulation can have long lasting effects on the operational costs, comfort and sustainability of your home or building.

Sources:

1. Because building code requirements can differ by region, potential cost savings may vary. It is important to follow building codes and standards for your respective region
2. The higher the R-value, the greater the insulating power. Ask your seller for the fact sheet on R-values
3. When a minimum of 1" is applied, closed-cell SPF qualifies as an air barrier according to ASTM E-2178 which is the test used by the Air Barrier Association of America (ABAA) to define an air barrier
4. BSC Thermal Metric Summary Report 9/23/13 http://www.buildingscience.com/documents/special/content/thermal-metric/BSCThermalMetricSummaryReport_20131021.pdf
5. Two inches of closed-cell SPF qualifies as a 1 perm vapor retarder according to ASTM E-96. Perm ratings vary by manufacturer; please consult manufacturer literature
6. Closed-cell spray foam is the only insulation classified as an "acceptable flood resistant material" by FEMA. FEMA Technical Bulletin 2-93
7. NAHB Research Center for The Society of the Plastics Industry/Polyurethane Foam Contractors Division: Testing and Adoption of Spray Polyurethane Foam for Wood Frame Building Construction (May, 1992). www.sprayfoam.com/spps/ahpg.cfm?spgid=74.
8. Insulation installed costs- Based on RSMeans national averages. For this assessment, a typical new construction baseline two story home with approximately 2,800 square feet of wall area was used to evaluate a cost comparison. In addition, R-19 was used as the insulation requirement for the design and consistent with the 2012 IECC requirements

Responsible Care®
Our commitment to sustainability

Honeywell Performance Materials and Technologies
101 Columbia Road
Morristown, NJ 07962-1053
Phone: 1-800-631-8138
www.honeywell-blowingagents.com

Honeywell

May 2014 Printed in U.S.A.