Bayer MaterialScience

FOAM BOOK

ALL ABOUT SPRAY POLYURETHANE FOAM BOOK 1

INSIDE | WHY SPRAY POLYURETHANE FOAM INSULATION?

SUSTAIN THROUGH KNOWLEDGE

BOOK 1: WHY SPRAY POLYURETHANE FOAM INSULATION

BOOK 2: SPF & THERMAL BARRIER • SPF & SAFETY • PERSONAL PROTECTIVE EQUIPMENT

BOOK 3: A HIGH PERFORMANCE SPF ROOFING SYSTEM

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At Bayer MaterialScience, we've created this series of books to help you learn more about the benefits and advantages of Spray Polyurethane Foam. We're here to help you every step of the way.

Bayer MaterialScience manufactures spray polyurethane foam (SPF) insulation and a full line of specialty coatings that are used for thermal and moisture protection, roofing, waterproofing, abrasion resistance, and other applications. Bayer MaterialScience products enhance the total building envelope to help provide sustainability, durability, energy efficiency, and improved occupant comfort.

For more information go to **polyurethanes.bayer.com**

Why Spray Polyurethane Foam? (SPF)

Answer: Insulating with Spray Polyurethane Foam (SPF) for commercial and residential buildings helps reduce air and moisture intrusion, cuts energy bills*, strengthens the structure, and protects the internal air from outside airborne pollutants and allergens.

*Savings vary. Find out why in the seller's fact sheet on R-values. Higher R-values mean greater insulating power. Actual savings may vary depending on type of home, weather conditions, occupant lifestyle, energy prices and other factors. No specific guaranty or warranty of energy or costs savings is being given and all such guaranties or warranties are expressly disclaimed.

Bayseal® Spray polyurethane foam insulation helps provide a continuous, protective air barrier that helps minimize air leakage, a leading cause of building energy waste.

OFFER A HIGH INSULATION R-VALUE

PROVIDE A SEAMLESS AIR BARRIER

RESTRICT MOISTURE TRANSMISSION

SPRAY POLYURETHANE FOAM INSULATION CAN

ADD STRUCTURAL STRENGTH

MINIMIZE SOUND TRANSMISSION

PROMOTE BETTER INDOOR AIR QUALITY

Racking strength studies* show spray polyurethane foam can add significant structural strength to walls and roof decks.

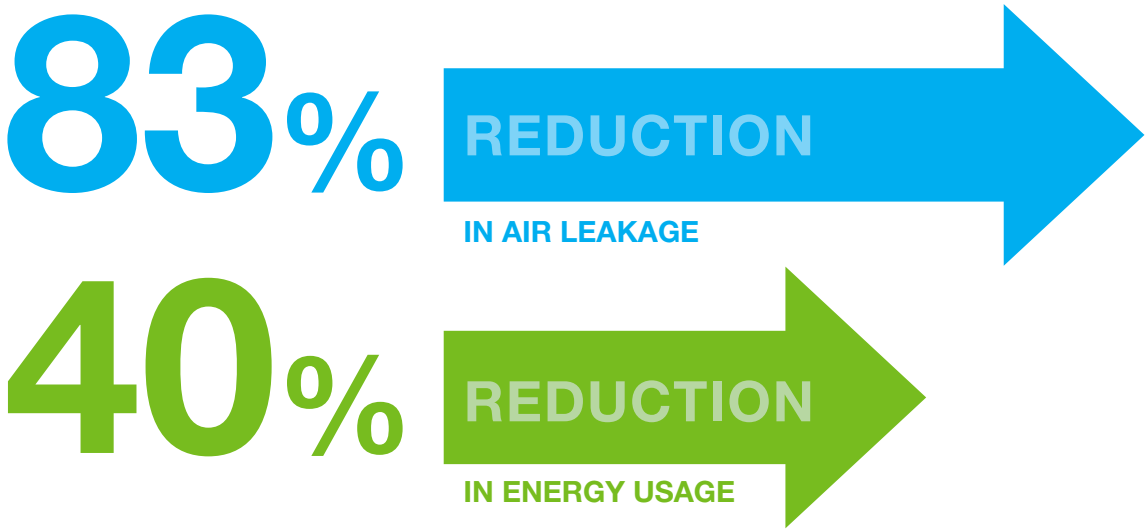
CLOSED-CELL SPF IN WALL CAVITY APPLICATIONS HAS INCREASED RACKING STRENGTH TO 330 - 400% IN NAHB TESTS

**Testing and Adoption of Spray Polyurethane Foam for Wood Frame Building Construction*; prepared by NAHB Research Center for The Society of the Plastics Industry/Polyurethane Foam Contractors Division

The Structural Advantages of SPF

When it comes to protection against natural disasters, spray polyurethane foam roof and wall systems have shown remarkable resistance to high wind uplift and blow-off; a characteristic attributed to spray polyurethane foam's strong adhesion, lack of fasteners, and absence of joints or edges.

SPF MAY BE USED FOR CODE-PLUS WIND RESISTANCE IN NEW CONSTRUCTION, OR FOR ENHANCING THE WIND UPLIFT RESISTANCE ON EXISTING STRUCTURES.



According to a 2005 National Institute of Standards and Technology (NIST) study*, incorporating specific air-leakage prevention measures into design and construction can reduce air leakage by up to 83% and energy consumption by up to 40%.

**Investigation of the Impact of Commercial Building Envelope Airtightness on HVAC Energy Use*, Authors: S. J. Emmerich; T. McDowell; W. Anis.

SPF and AIR LEAKS

Air leakage can worsen problems with moisture, noise, dust, pollutants, insects, and rodents. Air leakage can account for 25-40% of the energy used to heat and cool a typical home. Spray polyurethane foam helps seal the building envelope to create an optimal energy-efficient environment.

Be sure to reference the ASHRAE 90.1 standard for the minimum energy efficiency requirement for your new or renovated building project.

SPF & MOISTURE

Moisture management is a critical concern in energy-efficient building design and construction. According to Building Science Corporation, the unique characteristics of closed-cell spray polyurethane foam (ccSPF) set it apart from all other insulation and waterproofing materials, delivering high R-value per inch, airtightness, low permeability, good material strength, and good “liquid water holdout,” or rain control. These unique characteristics create a significant competitive advantage when specifying ccSPF.

Only closed-cell spray polyurethane foam is classified as an “acceptable flood resistant material” by FEMA. “Flood-resistant Material” is defined as a building material capable of withstanding direct and prolonged contact with floodwater without sustaining significant damage. Closed-cell foam is the only wall and ceiling insulation material classified as “acceptable.”


Reduces
WIND
Uplift

An unvented attic with closed-cell spray polyurethane foam resists roof uplift during high wind events.

"During high wind events, vented soffit collapse leads to building pressurization and window blowout and roof loss due to increased uplift. Unvented roofs – principally due to the robustness of their soffit construction – outperform vented roofs during hurricanes – they are safer."

Lstiburek, "Understand Attic Ventilation"
Building Science Corporation, 2003

When properly installed, spray-applied foam helps reduce air leaks and greatly reduces noise transmissions through walls.

Reduces Sound Transmission

Insulation in the attic and walls of a house can be part of a home solution that achieves lower than acceptable indoor noise limits, and exceeds noise attenuation standards when required by the local building code.

Green Building CERTIFICATIONS

The Building Science Corporation believes that insulation products capable of achieving green building standards need to control moisture, air movement and temperature in one material. SPF is a product that can control all three.

[1] MOISTURE

[2] AIR MOVEMENT

[3] TEMPERATURE

Bayseal® spray polyurethane foam

helps reduce air leakage, thereby limiting the likelihood of condensation within the envelope. Spray polyurethane foam helps minimize water vapor transported by leaked air from entering the building envelope.

Improving indoor air quality

Spray polyurethane foam improves indoor air quality by limiting the transport of dust and pollen from outside. Spray polyurethane foam reduces drafts and air movement.

HEAT TRANSFER & SPF

Outside heat or cold can transfer from an exterior wall to an interior wall through six different methods of transference. Spray polyurethane foam insulation helps block all six transfer methods, helping to maintain a comfortable indoor temperature.

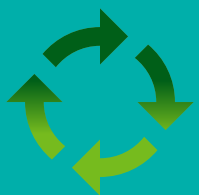
LOOKING BEYOND R-VALUE

Heat loss or gain can happen through any element of the building envelope (wall, floor, or roof/ceiling) by three primary mechanisms:

1

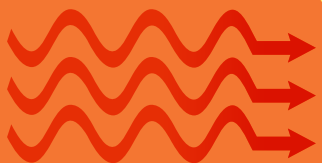
CONDUCTION

2



CONVECTION

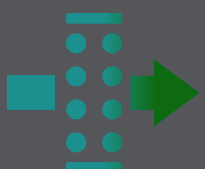
3



RADIATION

In addition, three secondary mechanisms can influence heat loss or gain:

4



AIR INFILTRATION

5

MOISTURE ACCUMULATION

6

AIR INTRUSION

R-value, the traditional measure of insulation effectiveness, measures only ONE of these mechanisms - conduction. Spray polyurethane foam can effectively prevent or block all heat transfer methods.

CONDUCTION

[Conduction] is the transfer of heat within an object or between two objects in contact.

The SPF Advantage: The predominant heat transfer mechanism is conduction. Because the polymer matrix and the gas contained within the cells are both poor conductors of heat, closed-cell spray polyurethane foam has a very high R-value and effectively blocks heat transfer by conduction.

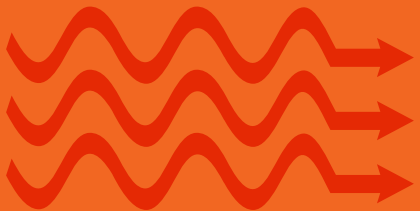
2

CONVECTION

[Convective] heat transfer occurs when air moves within the walls. Natural convection currents occur when temperature differences in different locations (for example, walls) create air movement that transfers heat.

THE SPF ADVANTAGE:

Both open-cell and closed-cell polyurethane spray foam helps reduce air movement within and through the walls, thereby reducing convection as a heat transfer mechanism within the insulation mass.



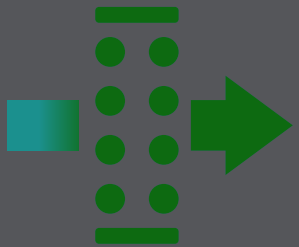
3

RADIATION

[Radiation] is the transfer of heat from one object to another by means of electromagnetic waves.

THE SPF ADVANTAGE:

Heat transfer by radiation is reduced by spray polyurethane foam because of the cell structure. Minimizing radiant heat loss/gain can lead to greater comfort.



4

5

AIR INFILTRATION

[Air Infiltration] transfers heat by the gross flow of air between the exterior and interior.

THE SPF ADVANTAGE:

SPF applied at a minimal thickness of 3/4" for closed-cell SPF[1] and 3.5" for open-cell SPF[2] is considered air-impermeable insulation based on testing in accordance with ASTM 283.

MOISTURE ACCUMULATION

[Moisture Accumulation] within insulation materials will reduce it's R-value, contributing to heat loss/gain.

THE SPF ADVANTAGE:

Closed-cell spray foam is a water-resistive barrier.* It also helps stop moisture accumulation due to air infiltration and air intrusion.

1: ICC-ES Evaluation Report 2072, 2013
2: ICC-ES Evaluation Report 1655, 2014

*Water-resistive barrier requirements prescribed in IBC Section 1404.2 and IRC Section R703.2, when installed on exterior walls. ICC-ES Evaluation Report 2072, 2013.

6

AIR INTRUSION

occurs when air enters the insulation from the exterior and exits back to the exterior.

Bayseal® closed-cell and open-cell spray polyurethane foam effectively reduces the three primary and three secondary mechanisms of heat transfer. The 2012 IECC requirement is ≤5 ACH@50 pascals for climate zones 1-2 and ≤3 ACH@50 pascals for climate zones 3-8.

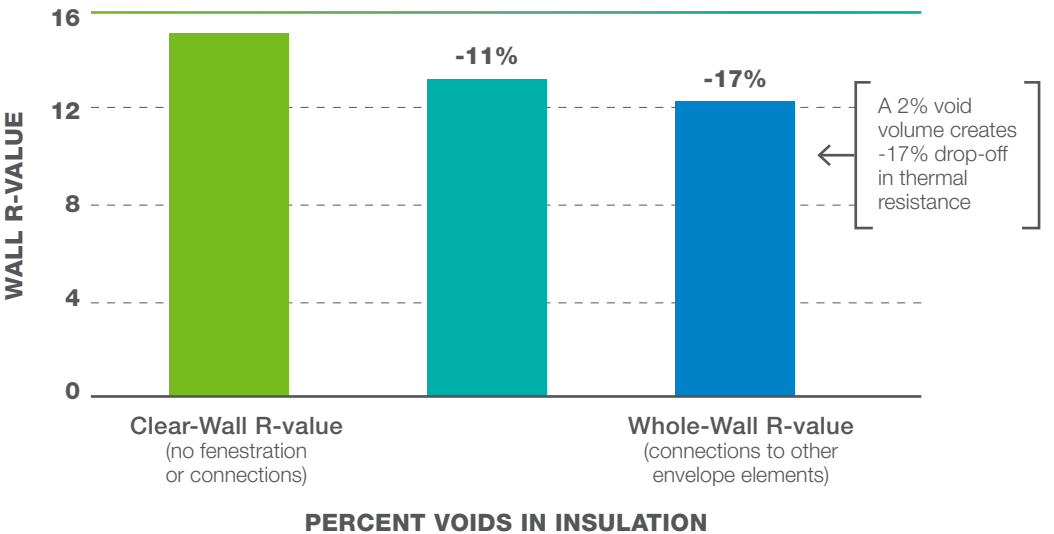
Contrary to popular belief, windows and doors are not the major sources of air leakage, contributing only 25%. Rather, joints between the main walls and floor system, electrical outlets on exterior walls, and ceiling penetrations for light fixtures, attic hatches, partition walls and plumbing fixtures constitute the major infiltration/exfiltration paths.

Geistbrecht and Proskiw, ASTM STP 904 *An Evaluation of the Effectiveness of Air Leakage Sealing,* Philadelphia, 1987, pp 312-322

SPF VS. FIBERGLASS

Gaps and voids are common during fiberglass installation

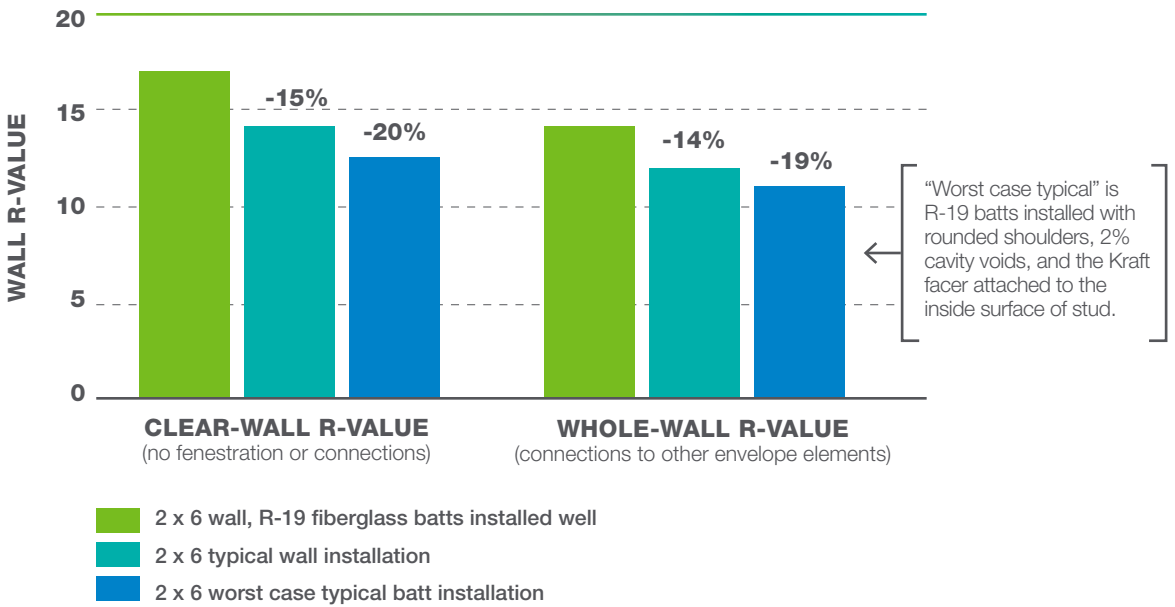
Air voids significantly detract from insulation performance



Infante et. Al., *Thermal Insulation, Materials and Systems for Energy Conservation, In the 80's*, p341

Fiberglass batts, as typically installed, lose 15-20% of R-value relative to a perfect installation.

Oak Ridge National Laboratory Study



Christian, Jeffery, et al. *The Whole Wall Thermal Performance Calculator – On the Net.* Proceedings, Thermal Performances of the Exterior Envelopes of Buildings VII, Atlanta, FA, ASHRAE, Dec., 1998

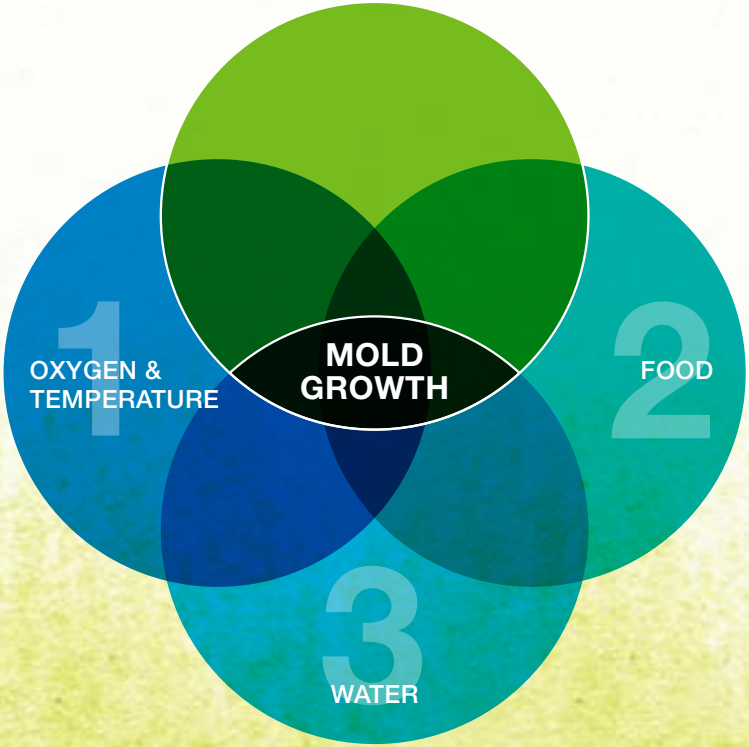
CONDITIONS FOR MOLD GROWTH

MOLD SPORES ARE ALWAYS IN THE AIR

Mold spores require THREE conditions to proliferate:

1. **Oxygen & Temperature**
2. **Food**
3. **Liquid Water**

Mold growth is prevented by removing one of the conditions



SPF functions as an air-impermeable* insulation limiting air supply to mold spores.

SPF is not a food source!

Most cc-SPF systems function as a Class II vapor retarder at >2", limiting the potential for condensation within walls.

*AIR-IMPERMEABLE INSULATION as defined by ICC Section R202: An insulation having an air permanence equal to or less than 0.02 L/s-m2 at 75 Pa pressure differential tested according to ASTM E 2178 or E 283.

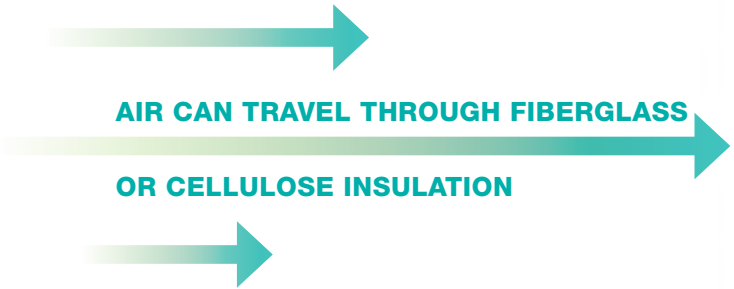
WATER VAPOR

Water Vapor is a hitchhiker carried into the building envelope by air leakage.

CONDENSATION occurs when water vapor in the air encounters a surface that is cooler than the dew point temperature – the temperature at which the air cannot hold all of its water vapor, causing some of the water vapor to condense into liquid water.

WATER in the building envelope:

- Reduces insulation effectiveness
- Creates a site for potential mold growth



"Of all the environmental conditions, moisture poses the biggest threat to structural integrity and durability, accounting for up to 89% of damage in building envelopes."

Bomberg, M. and W. Brown, Construction Canada 35910 1993, pp 15-18, *Building Envelope and Environmental Control: Part 1 – Heat, Air and Moisture Interactions*

CONDENSATION WITHIN THE BUILDING ENVELOPE

Both air leakage and diffusion allow water vapor to enter the building envelope. Air leakage, by far, has the potential to move more water vapor. It is controlled by building an airtight building envelope.

SPF helps create a tighter seal in the envelope.

Diffusive transport of water vapor is controlled by vapor retarders.

Bayseal® closed-cell foam qualifies as a vapor retarder at thickness of ≥1".

Vapor retarders should never be installed on both surfaces of the building envelope. This creates potential to trap water inside.

SPF

IS THE ANSWER

Bayseal® and Ecobay® spray polyurethane foam can be the ideal material for insulating commercial and residential buildings. Spray polyurethane foam helps reduce air and moisture intrusion, can reduce energy bills*, strengthens the structure, and helps protect the internal air from air pollutants and allergens.

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RATINGS AND AFFILIATIONS

Bayer is a proud signatory of the Spray Foam Coalition Code of Conduct. Bayer SPF insulation has been tested and received rating classifications from:

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Go to polyurethanes.bayer.com to learn more about the competitive advantages of spray polyurethane foam.

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