Customers are saving thousands of dollars with new high-tech insulation.

What's Important?

When buying a walk-in cooler or freezer, the initial cost of the walk-in is almost always the deciding factor. The cost to operate the walk-in is rarely considered. You may think all walk-ins perform about the same. This mistake can cost you dearly.

You pay for the walk-in once, but if the insulation is inefficient, you will pay for that every month for the life of the walk-in. In the following, you will find an evaluation of two types of insulation that are being used in walk-in coolers and freezers.

Construction

Walk-in coolers are generally constructed of modular panels made of insulating material and protective skins. The protective skins can be made of metal or fiberglass. The purpose of the skin is to protect the insulation, which is fragile and cannot be used independently.

The insulation is usually plastic foam material that is either injected or bonded between the metal skins. The insulation material provides the walk-in with resistance to heat flow, which allows the walk-in to be refrigerated and hold cold temperatures.

Types of Insulation

In the walk-in cooler and freezer business, there are two common types of plastic foam insulation, polyurethane and extruded polystyrene. Extruded polystyrene is not to be confused with expanded polystyrene, which is also used in walk-in coolers. Expanded polystyrene is white and has different structural and insulating properties. In this document, we will be discussing extruded polystyrene only.

Polyurethane

Polyurethane can be applied in two different ways in the construction of walk-in coolers or freezers. One method is

to pour or inject the two part plastic foam between two sheets of metal in a mold and produce a walk-in panel. Another method, less frequently used, is to box pour a block of foam 4 feet x 20 feet, then cut the block to panel thickness to be laminated between two sheets of metal to form a walk-in panel.

Extruded Polystyrene

The newest insulation to be used in walk-in coolers and freezers is extruded polystyrene foam. It has been used very successfully for years in insulating areas of high moisture exposure and high R-value requirements, including low temp warehouses, underground concrete insulation and house sheathing. This insulation is manufactured by extruding polystyrene plastic through an extrusion mold that creates a foam panel with the thickness, width, and any length needed to produce walk-in panels. The insulation is planed to exact tolerances of width, thickness, and length. The finished foam is then bonded between two sheets of metal and run through an automated press to form the walk-in panels.

What difference does it make?

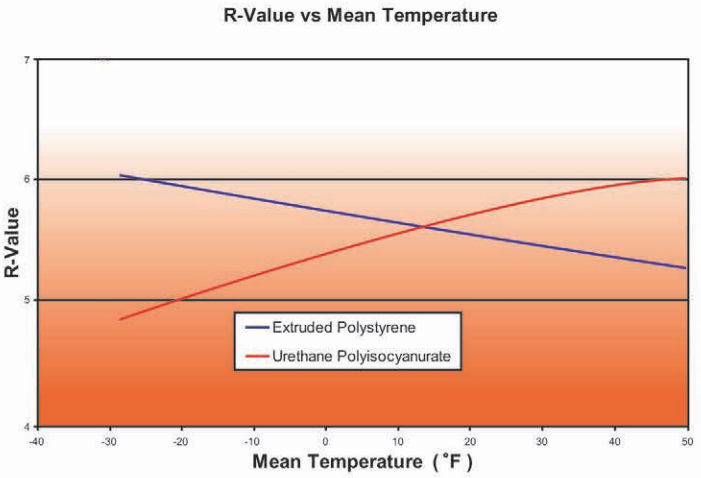
Insulation is NOT all the same. Each type of insulation brings with it strengths and weaknesses that must be evaluated for each individual application requirement. The two factors that can affect the insulation's performance are temperature and moisture.

Temperature

Insulation performance is usually rated in what is termed R-value. The higher the R-value, the more resistance to heat flow, therefore the better its insulating properties. Some insulation performs better the lower the mean temperature and some perform better at higher temperatures. Therefore, the operating temperature of the insulation can affect its performance.

When looking at polyurethane and extruded polystyrene at -10° F to 50° F mean temperature, polyurethane has a lower R-value the lower the mean temperature and extruded polystyrene has a higher R-value the colder the application.

Therefore, extruded polystyrene performs better at lower temperatures and polyurethane R-value actually performs worse at lower temperatures.



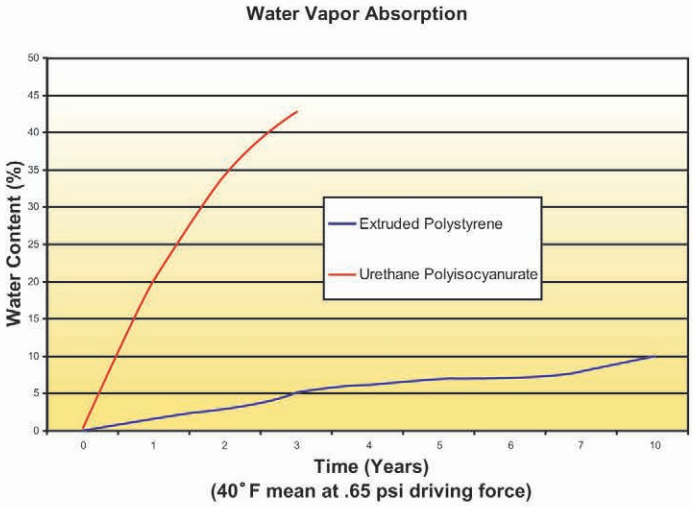
See Reference 1

Moisture

The largest factor that can affect the insulation's performance is moisture. Usually insulation is expected to keep something warmer or colder than the other side of the insulation. This temperature differential (TD) causes, in many cases, a dew point to form inside the insulation. Once the dew point is reached, moisture is trapped. As water has a much lower R-value than insulation, the water reduces the R-value of the insulation. The more water resistance the insulation has, the better the insulation performs in high TD situations.

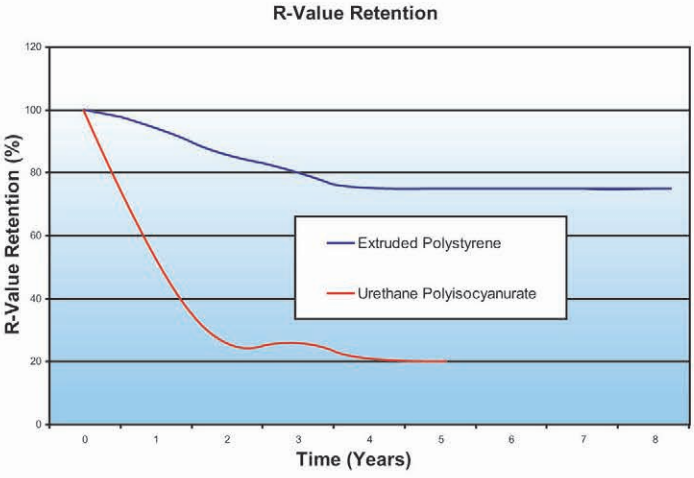
Since walk-in coolers and freezers are high TD applications, sometimes 110° F on the outside and -20° F on the inside, the higher the moisture resistance of the insulation, the better. When looking at the water vapor permeance of the different foams, it is found that polyurethane allows more water vapor permeance and

the least. Since water lowers the R-value of insulation, extruded polystyrene retains its R-value better than polyurethane.



See Reference 2

As you can see in the following graph, polyurethane loses over 75% of it's R-value in five years and extruded polystyrene loses only 25% of its R-value. Therefore, extruded polystyrene's performance, in actual walk-in conditions when moisture is considered, is over three times as good as polyurethane.



See Reference 3

Why are some companies claiming polyurethane has the highest R-value?

When some companies quote R-values of 32 to 34 for polyurethane walk-ins, they are quoting what is called fresh R-values, the R-value you have when you first take the insulation out of the mold. The operating temperatures of the insulation are not being considered. They are quoting R-32 to R-34 at 75º F mean operating temperature. The 32.5º F mean temperature of a walk-in freezer and the effect of moisture penetration, as in real life applications, are not being considered.

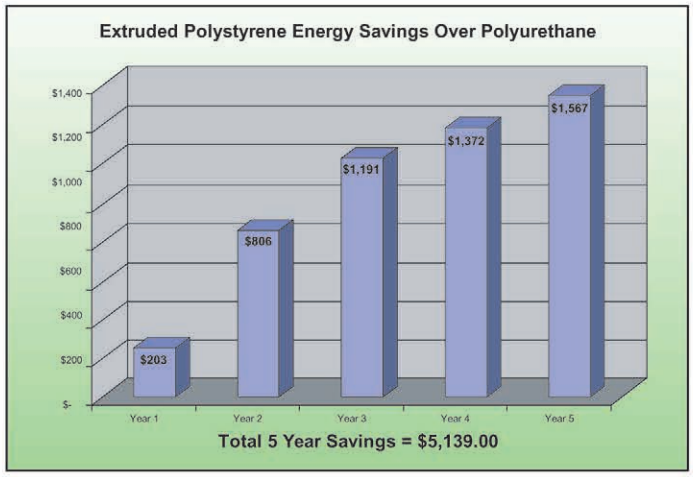
To find the actual operating R-value of any insulation, you have to look at how it performs in real life applications. Since a walk-in freezer usually operates at -10º F inside and 75º F outside, a 32.5º F mean temperature needs to be used. Since moisture and aging mostly occur up front, a 60 month decreasing R-value needs to be considered. In 5 years the R-value of 4" polyurethane has dropped to an R-value of 6 and 4" extruded polystyrene to an R-value of 15. The performance R-value for extruded polystyrene has become almost three times better than urethane.

What does this all mean to you?

Extruded polystyrene can provide thousands of dollars in energy savings during the life of the walk-in.

Example

Using as an example, a 10' x 12' x 7'6" freezer operating at a 32.5º F mean temperature with a refrigeration system with 90% efficiency and an electric cost of $.09/kWh, an extruded polystyrene walk-in will save up to $5,139.00* in energy savings over a polyurethane walk-in in the first five years. This savings is shown in the following graph.



Assumptions

1. Mean temperature of 32.5º F
2. 10' x 12' x 7' 6" freezer – 900 Cu. Ft.
3. R-value reduction data is valid and applies equally to walls, floors, and roof panels
4. The aged R-value for each insulation type is foamed in place polyurethane R-6 per inch and extruded polystyrene. R-5 per inch at 75º F mean.

5. Overall refrigeration system efficiency is 90%
6. The cost of energy is $0.09/Kwh
7. Constant dollar economics (i.e. the cost of energy increases at the same rate as inflation)
8. Data used for calculation comes from the U.S. Corps of Engineer's (CRREL) test data. See Reference 3

* Estimated savings are based on stated conditions. Your actual savings may vary due to a different operating environment.

Conclusion

When considering the actual performance of walk-in coolers and freezers, it can be seen that being an informed buyer pays substantial long-term benefits. Price should not be the only consideration when purchasing your walk-in. Initial purchase savings can be eliminated by excessive operation costs over the lifetime of the walk-in. Thorough analysis of initial cost plus operating cost will lead you to the best decision for your business.

References

U.S. Cooler Company
325 Payson Ave.
Quincy, IL 62301
1.800.521.2665
www.uscooler.com

Reference 1
Owens Corning Internal Study
Owens Corning
One Owens Corning Parkway
Toledo, OH 43659
1.800.438.7465 | www.owenscorning.com

Reference 2
U.S. Army Corps of Engineer's (CRREL) test data. "Wetting of Polystyrene and Urethane Roof Insulation in the Laboratory and on a Protected Membrane Roof." Wayne Tobiasson, Alan Greatorex, and Doris Van Pelt; Cold Regions Research and Engineering Laboratory, Hanover, NH 1987.

Reference 3
U.S. Army Corps of Engineer's (CRREL) test data. "New Wetting Curves for Common Roof Installations," by Wayne Toblasson, Alan Greatorex, and Doris Van Pelt; Cold Regions Research and Engineering Laboratory, Hanover, NH 1991.

*For information on all aspects of the Cold Regions Research And Engineering Laboratory, visit www.crrel.usace.army.mil