OWENS CORNING®

INNOVATIONS FOR LIVING®

Extruded Foam Insulation Keeps Cold In, Ice Out

Freezer produced by U.S. Cooler

AN OWENS CORNING CASE STUDY

Most people see ice and think cold. For the folks who know walk-in coolers and freezers, however, ice tells a different story – it means the freezer's insulation is failing and water vapor is finding its way inside. It means the refrigeration equipment is working overtime and utility bills are taking a bite out of the store's profits.

Ice can also mean the freezer is not insulated with an extruded, closed cell foam insulation.

U.S. Cooler, a division of Craig Industries, Inc., Quincy, IL understands those differences and has built a business by making premium walk-in coolers and freezers insulated with Owens Corning FOAMULAR® 250 extruded polystyrene foam insulation.

"Using extruded, closed-cell board stock to insulate our freezers gives us a big advantage in the marketplace," says Allen Craig, president of Craig Industries one of the company's two founders and owners.

"Customers who buy competitive products because of a lower purchase price could pay dearly for that decision in the future with high energy bills."

COVERED WITH ICE

Craig is seeing evidence of those decisions now as his company replaces walk-in freezers at a chain of stores. At a recent replacement, he noticed the problem as soon as he stepped inside the freezer being removed.

"The walls were all frozen on the inside of the panel," he explains. "The inside walls were covered with ice around the perimeter, at the edges and the seams. They had ice build-up on them. The ice indicated that the wall has moisture in it. Moisture was leaking in."

To find out for sure, Craig collected samples from the 10-year-old freezer and sent them to the Owens Corning Technology Center for FOAMULAR insulation in Tallmadge, Ohio. Lead test technician Bill Ramsey knew there was a problem as soon as he opened the package.

"They were ugly looking," says Ramsey. "They were laminated to plywood and the plywood was soaking wet and black, like the material had been sitting under a dock. They were very heavy and musty smelling. The plywood was beginning to rot. They were pretty bad. If I had pulled something like that out of my house I would have been in a panic."

Barb Fabian, manager of testing and materials research at the Tallmadge facility, visited a freezer replacement and noted a problem as soon as she touched the wall of the unit being taken out of service. "It felt like a sponge," says Fabian.

To prepare for removal of the old freezer, it had been turned off several hours before she arrived at the site. Despite the time and spongy feeling, there was still ice in the panels of the freezer.

When the samples Craig removed from the most recent decommissioning were tested, Ramsey found the water content

by weight to be as much as six times the weight of the foam alone. The range was from 106 percent to 610 percent, with average water content by weight of 382 percent.

"Lots of water," says Ramsey. "And when you have water in insulation, it kills the R-value." The biggest difference in wet and dry R-values was found in the sample with the most water content. The sample with 610 percent water content by weight had only half the R-value when still wet. The sample had an R-value of 7.3

when it was wet, and 14.7 when it was dried.

"Water is very much a non-insulator," says Ramsey. "Its conductivity is such that if you get a lot of water into a sample, the heat is just going to transfer right through it. It short-circuits the insulation."

If water gets inside a freezer wall, the water will help transfer the heat rather than resist heat transfer. Water enhances heat transfer; it's like a thermal bridge.

RESISTANT TO MOISTURE

FOAMULAR® insulation, being a closed-cell product, is very resistant to moisture. To verify that point, Owens Corning subjected the material to an extended test at its Technology Center.

"We submerged samples of FOAMULAR F150 and F250 in water for more than one year," explains Fabian. "During that entire time the samples absorbed no more than three-tenths of one percent by weight, the 24-hour requirement in ASTM C 578 for extruded polystyrene foam."

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>
> ALLEN CRAIG, PRESIDENT OF CRAIG INDUSTRIES

Ramsey says the product is also effective in resisting water vapor, which is a much more insidious form of water.

"With cold temperatures and low humidity inside the freezer, and higher temperatures and more humidity outside the freezer, there is going to be a vapor drive to go through whatever wall is separating those two conditions," explains Ramsey.

"If you could see a cutaway of the wall on edge, and see the temperatures that are inside that wall, you would find a dew point. And wherever dew point occurs, vapor is going to condense. No matter what kind of foam is used, that's what's going to happen.

"But the more resistant the material is to the vapor coming through in the first place, the less is going to get in there over time," he continues. "That's the strong point of extruded FOAMULAR insulation over all these other foams. An extruded, closed-cell foam insulation is less water vapor permeable. The water vapor does not go through it as quickly or as easily as it does these other materials."

Ramsey says his tests also indicated an inconsistency in the dry R-values among the samples. Those differences may have been due to problems with spray foam being applied in an inconsistent manner so that the insulating properties are not the same throughout the assembly.

"It's very hard to fill a void evenly with spray-in-place foam," adds Craig. By comparison, extruded foam is consistently formed in a factory and assures an even density throughout the board stock.

The uniform density of the closed-cell extruded sample is evident in comparison with the inconsistent sprayed urethane sample.

BUBBLES AND VOIDS

"My sales team call the urethane foamed-in-place samples 'Swiss cheese,'" says Craig. "That's about what the urethane samples look like with all of the air bubbles and voids".

"Water will collect in the voids and freeze," he continues, "and as we know, water is not a good insulator."

Craig says some of the urethane foam samples they collect have ice in them when they are cut open. Almost all of them are wet.

"We have cut apart competitors' doors that have been out of commission for weeks or months and they are still leaking water. Sometimes the appearance of the sample can be deceiving because it looks fine, but when you touch the sample it just disintegrates because there is so much moisture in it."

PUDDLES OF WATER

Craig says moisture was a driving force in prompting the store's chain to replace their old freezers that had been insulated with urethane foam.

"Moisture from the ice was running down the sides of the units

FEATURES & BENEFITS

- Extruded foam insulation, being a closed-cell product, has outstanding moisture resistance for long-term thermal performance.
- Extruded foam insulation is formed in a factory process that assures an even density and R-value throughout the board stock.
- With extruded polystyrene foam, R-value increases as the mean temperature decreases so the insulation's rated thermal performance is maintained or improved at freezer operating temperatures.
- FOAMULAR insulation maintains its R-value over repeated freeze/thaw cycles, assuring long-term thermal performance.

and getting on the floor," he explains. "There were puddles of water on the floor and they were afraid people were going to slip and fall. They had to keep mopping them up and putting wet-floor signs out.

"Energy cost savings are another consideration," adds Craig. "That makes the case for change even more compelling."

NEW BALLPARK

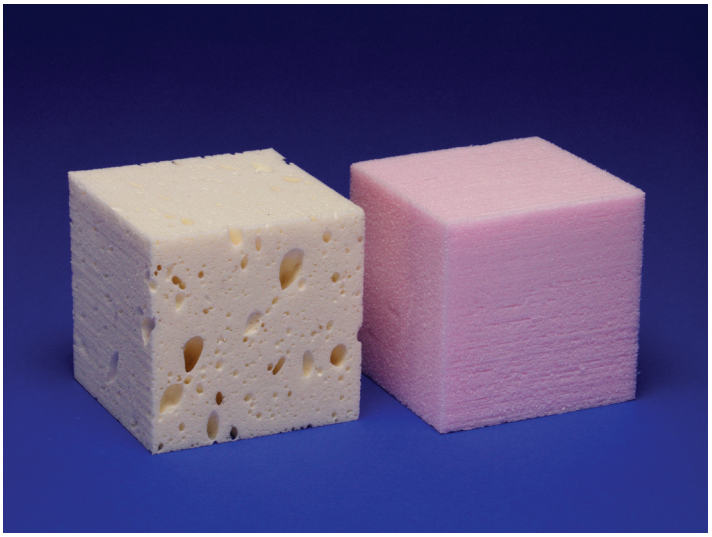
Craig also points out that the R-value of a material is dependent upon the mean test temperature. For extruded polystyrene foams, the R-value increases as the mean temperature decreases. This is not so for polyurethane foams. And walk-in freezers are designed to function at much lower temperatures than conventional building walls.

"When we tested competing insulations at the lower temperatures that are standard in freezer operation, we found that they were in a whole new ballpark," says Craig.

When the mean temperature of the test wall assembly was set at -10° F, extruded polystyrene came out with an R-value of 8.0 while polyurethane dropped to 7.7. To illustrate the longer lasting insulation qualities of extruded polystyrene over polyurethane, R-values were evaluated after 200 freeze/thaw cycles. After the equivalent of 5 years of use, extruded polystyrene outperformed polyurethane with a value of 4.9 in comparison to polyurethane's 2.1 in the –10° F assembly.

What does this mean to standard walk-in freezer users? **Big savings. Choosing extruded polystyrene can result in an estimated energy savings of up to 34% a year.**

"These findings prove that extruded polystyrene is the insulation of the future," says Craig. "By keeping cold storage units at a consistent temperature with low moisture absorption, this insulation will have superior performance over time."



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