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ENGINEERING IN CUBA

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Badger State Fruit Processing is a family-owned business started by Wayne Gardner and his brother Tom to provide a combination of services to Wisconsin’s cranberry industry. Because cranberries have a short harvest season — from late September to October — essentially all of the fruit is ready at the same time. In the 1990s, processing facilities struggled to keep up with demand as more and more fruit was produced each year. In response, Badger State Fruit Processing built its first cold storage facility in 1996, adding a vital link to the distribution chain between growers and processors.

Over the years, the enterprise has continued to grow. A second raw material cleaning/receiving station and warehouse was built in 2003, and in 2005 they completed construction of a 78,750-square-foot juice processing facility. Today, Badger State Fruit Processing has the capacity to process 25 million pounds of finished product annually, and accounts for more than 2 million gallons of cranberry juice concentrate and 5 million gallons of single strength juice.

In 2012, Plant Manager Mark Konrardy was tasked with leading an 186,250-square-foot plant expansion in a design-build delivery. In adding a massive cold-storage facility to existing operations, one of the most important variables was how to meet demanding temperature control requirements while minimizing the cost impact on operational expenses. Konrardy began by researching insulation options and developed an initial list of key quantifiable parameters grouped into three categories — performance, environmental impact, and cost.

“All three factors are intertwined in terms of impact on long-term operations,” Konrardy said. “Our insulation needs weren’t just in the walls and roof, but included foundation perimeter and underslab applications as well, making this more of a six-sided challenge. After much consideration, we decided that ACH Foam Technologies products were the best fit and they came through on a variety of fronts.”

The product’s long-term insulating properties, measured in R-values, was one of two significant factors related to performance. Manufactured from expanded polystyrene (EPS) foam, ACH Technologies’ Foam-Control PLUS+ architectural insulation and Foam-Control roof insulation both provide a fully warrantied R-value that maintains its effectiveness for 50 years.

Other types of insulations may claim higher initial R-values for their products, but third-party testing has shown that off-gassing occurs over time and reduces the products’ effectiveness. Specifically, polyisocyanurate manufacturers use long-term thermal resistance (LTTR), a weighted average R-value of their product over a designated period of time.

In 2010, Mark Graham, associate executive director of technical services for the National Roofing Contractors Association (NRCA), confirmed that relying on LTTR values for long-term performance may be misleading to designers. “Although the LTTR method of R-value determination and reporting may be appropriate for laboratory analysis, research comparison, and procurement purposes, NRCA does not consider LTTR use to be appropriate for roof system design purposes when actual in-services R-value can be an important aspect of roof system performance,” Graham said.

ACH Foam Technologies’ EPS foam insulation, on the other hand, doesn’t suffer from off-gassing and therefore retains the originally specified R-values over the entire life of the product.
As of January 2016, the NRCA made a change to its previous recommendation of R-5 per inch thickness in heating conditions and R-5.6 per inch thickness in cooling conditions. The NRCA Roofing Manual: Membrane Roof Systems — 2015 issued an update, also published by Graham, in which the NRCA revised its design in-service R-value recommendation to 5.0 per inch thickness in all climate conditions. NRCA is making this change based on its R-value testing and testing by others who have validated NRCA’s results. This change will also help to streamline the specification process for roofing designers.

The second performance criterion was compressive strength. The underslab insulation was required to withstand the weight of the cold storage facility’s massive freezer units. The solution was Foam-Control PLUS+ 400, which has a compressive strength of 40 psi, enabling it to support the weight of the freezers without risk of structural collapse.

Environmentally it was important to Badger State Fruit Processing to keep things as ecologically friendly as possible. After all, they make their living growing and harvesting a natural product; supporting a balanced environment is critical. ACH Foam Technologies’ Foam-Control PLUS+ 250 is composed of up to 15 percent recycled content, the highest amount of all rigid foam insulations, and the product itself is recyclable. Perhaps more significantly, it’s not the reduced volume of construction material used but rather the life cycle energy savings that will make the biggest environmental difference.

“Insulation can be expensive, but the cost savings we are realizing include both near- and long-term benefits,” Konrardy said. “With the non-degrading R-values of these products, the costs of maintaining the desired temperatures and the energy required to do so is substantially reduced. However, that’s not the only way ACH helped us save money on this project.”

Working closely with Pat Austin, ACH Foam Technologies’ architectural sales representative serving Wisconsin and Michigan’s Upper Peninsula, Badger State’s design team developed a layering system that met the R-value and compressive strength requirements yet still managed to further reduce overall construction costs.

“The trick was to meet the required R-value for the areas below the freezer units as cost effectively as possible,” Austin said. Six inches of insulation were required to achieve the target R-value but the structural engineers revealed the design only required 2 inches of Foam-Control PLUS+ 400 at 40 psi. Engineers then selected a two-layer system combining 2 inches of Foam-Control PLUS+ 400 on top of a 4-inch layer of Foam-Control PLUS+ 250. By using two densities of material, Austin estimated they were able to save the project more than $54,000 compared to the cost of a 6-inch layer of Foam-Control PLUS+ 400 exclusively, a savings of 13 percent.

In addition to the underslab application, the project also called for 1,975,000 broad feet of Foam-Control flat EPS roof insulation where R-value considerations are just as important but required compressive strength is significantly reduced. In roofing applications, builders often point to the ease of installation and the long-term effectiveness of an insulation product that maintains the original R-value as distinguishing characteristics in the decision-making process.

“EPS is always a viable insulation solution,” Austin said, “especially when care is taken to understand long-term thermal resistance and how that may degrade over time with certain rigid foam insulations.”

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