ICYNENE™
HEALTHIER, QUIETER, MORE ENERGY EFFICIENT®

THE ICYNENE® ADVANTAGE

APPLICATION CASE STUDY:
Creating a Comfortable, Durable and Efficient Metal Building

Synopsis:

- ✓ Reduced heating and cooling loads and cut energy costs by 30%
- ✓ Created a tight building envelope to maximize indoor comfort
- ✓ Minimized the threat of condensation and moisture build-up in a metal frame structure
- ✓ Complemented the HVAC performance to create a healthy indoor environment
- ✓ Minimized the transfer of airborne sounds and odors (i.e. diesel exhaust) from the shop to the office space

Overview:

Buildings can provide shelter and encourage productivity, but they can also consume vast amounts of energy. In fact, energy represents the single largest operating expense in an office property. ENERGY STAR® reports that reducing energy use by 30% is equivalent to increasing net operating income and building asset value by 5%. [i]

Reducing energy consumption (and annual operating costs) was one of the key objectives for building owners Maryanne and Ken Wiggers of Prairie Foam Insulators (PFI). PFI is in the business of creating more energy efficient buildings in both the residential and commercial sectors. As an Icynene Licensed Dealer, PFI has been educating builders and homeowners on the merits of Icynene for over 10 years. In late 2001, the Wiggers decided to create an Icynene-insulated space of their own in which they would continue to operate their expanding business.

As a qualified air barrier ICYNENE LD-C-50™ † controls the flow of airborne moisture minimizing the threat of condensation in the metal building; therefore, there is no moisture build-up in an Icynene-insulated building even after years.

Hot humid summers and frigid winters accompanied by strong winds were just a few of the challenges that needed to be addressed in the construction of the PFI building.

The Challenge:

Located in Central Iowa in the town of Huxley, the PFI building is subject to typical weather conditions of the Upper Midwest Region: summers are hot and humid with outdoor temperatures of 91°F; and winter outdoor temperatures are approximately -5°F[ii], often accompanied by strong winds. The first challenge in designing the PFI building was to address the potential for condensation and moisture build-up in the building envelope, which can result from the bi-directional vapor drive in this mixed climate. The Wiggers decided to avoid the problems often associated with condensation and moisture build-up such as mold and mildew growth, metal corrosion and deterioration, and diminishing R-value due to wetting, sagging and settling of insulation material.

Another challenge was to create a tight building envelope that would offer a healthy, quiet and comfortable working environment for the building's occupants.

A final, but important consideration was to complete the project as quickly as possible, while ensuring that the long-term operating costs of the building were minimized.

The Solution:

In order to meet these challenges, the Wiggers decided to use the Butler® building system. This integrated structural steel building system uses components that have been pre-engineered and fabricated in a factory, based on the building's unique design and specifications. A key player in metal buildings for over 100 years, the system ensures timely, economical, problem-free construction – and trouble-free structures with low life cycle costs.[iii]

PFI has been educating builders and homeowners on the merits of Icynene for over 10 years. In late 2001, the Wiggers decided to create an Icynene-insulated space of their own, where they could continue to operate their expanding business.

Icynene was chosen for this metal building because of its ease of installation, the comfort it creates in an indoor environment and the long term benefits of investment.

Working with Jensen Builders, Ltd. (Ft. Dodge, IA), Maryanne and Ken devised the overall layout of the building. With outer dimensions of 200' (length) x 75' (width) x 18' (height), the building was designed to accommodate:

- a two-story stacked block of four separate office areas totaling 7,500 ft^2 of floor space in the front of the building
- 11,250 ft2 of heated shop and warehouse space in the rear of the building

In the design process, it was determined that the Butler® steel-frame structure would incorporate the following components to help address their needs:

- steel siding and a standing-seam steel roof
- a stem wall insulated with R-10 rigid foam around the perimeter of the building complementing Icynene for strong thermal performance
- 15,000 ft^2 of 5-inch concrete slab floor poured over PEX tubing (for in-floor radiant heating) stapled to 2-inch R-10 rigid insulation for a thermal break
- 2 natural gas boilers with 366,000 BTUH capacity and 92 AFUE efficiency (for in-floor radiant heat)
- four standard air conditioners for each office - two 1.5 ton and two 2 ton capacity
- Icynene open cell foam insulation sprayed at an average depth of 4-5 inches directly onto the steel wall panels, the gable ends and the underside of the steel roof

The Results:

Icynene was integrated into this metal building project because of its ease of installation and to fulfill the owners' desire for a comfortable indoor environment and a better long-term investment.

Sealing Air Leaks

Once Icynene was applied to the steel wall panels, gable ends and the underside of the steel roof, a blower door test was conducted to assess the building's air-sealing capabilities. As the test reveals, the building achieved an airtightness of 0.7 ACH @ 50 Pa[iv] surpassing the requirements set for residential buildings in the area. Building America (DOE) standard for new houses is 1.5 ACH @ 50 Pa. The PFI building achieved an airtightness level better than that of a tight residential structure.

As an effective air barrier, Icynene greatly reduced the air infiltration minimizing the load on heating and cooling equipment.

"Our heating and cooling bills are much lower than they would have been if we had used air-permeable fiberglass insulation," says Ken Wiggers.

Icynene soft foam insulation was sprayed at an average depth of 4-5 inches onto steel wall panels, gable ends and the underside of the steel roof.

Once Icynene was applied to the steel wall panels, tests revealed that the PFI building achieved an airtightness level better than that of a tight residential structure.

Lower Operating Expenses

In the PFI building, the office space is heated and air conditioned year-round with a fairly consistent thermostat temperature set point of 72°F. The shop is kept at about 60°F throughout the winter heating season.

Ken enlisted an energy auditor, Cenergy, LLC to conduct an energy performance analysis of the building. The projected results show that by using Icynene instead of the conventional fiberglass insulation, the Wiggers would save 30%, or $2,510 per year, in energy bills.

Annual Operating Cost	Icynene	Fiberglass Batt Insulation	Savings
Total Heating Cost	$4,997/yr	$7,165/yr	$2,168/yr
Total Cooling Cost	$552/yr	$894/yr	$342/yr
Total Heating and Cooling Cost	$5,548/yr	$8,058/yr	$2,510/yr (31%)
Average Monthly Cost	$479	$688	$209 (30%)

Source: Audit – Energy Analysis and Cost Comparison[v]

Note: The Energy Analysis data is recorded for Icynene and fiberglass applied at the same R-value.

According to Ken, the "real-life" savings are much greater than represented by the Energy Analysis. *"When the outdoor temperatures drop to about 30°F at night, the office areas can be heated with the fluorescent lights,"* he says. *"This feature proved to be very beneficial when a boiler became non-functional and could not be repaired for several weeks. We were able to regulate the indoor temperature by simply switching the lights on and off!"*

Icynene in Metal Construction

Condensation – In a building insulated with an air-permeable material such as fiberglass insulation, airborne moisture can flow into the building envelope through cracks and gaps (at joints in the finishing materials, openings where the vapor retarder is poorly sealed, etc.).

As a qualified air barrier Icynene controls the flow of airborne moisture minimizing the threat of condensation in the metal building; therefore, there is no moisture build-up in an Icynene-insulated building even after years.

Corrosion – Icynene is 100% water-blown – ideal for metal buildings because it does not contain CFCs or HCFCs that can cause metal corrosion. Icynene will not trap any moisture or chemicals between the foam and the metal.

For seven days, a steel sample compressed between Icynene foam insulation at 85 ± 5% relative humidity and at 118 ± 5°F conditions, revealed no corrosion.[vi] However, the uncovered edge of the steel sample, which was directly exposed to the humid surroundings showed slight signs of corrosion. The test verified that Icynene does not contribute to metal corrosion and can be safely applied in metal buildings.

R-value – Icynene does not contain synthetic blowing agents so it does not off gas; therefore, the R-value of the insulation remains stable and does not diminish with the aging of the building.

Adhesion – Insulating steel frames is no challenge. When applied directly to the walls and underside of the roof, Icynene adheres to the substrate. It remains flexible and soft allowing it to expand and contract

along with the building structure in order to prevent delamination and cracking. The material delivers a reliable air-seal, and thermal performance for years.

Optimal Indoor Environmental Quality

The PFI building is located next to an Iowa corn field, and the strong winds frequently pick up dust. Fortunately, Icynene creates an effective air-seal, blocking the intrusion of outdoor allergens, odors and pollutants from entering the building. Icynene also provides an air barrier between the shop (where there can be diesel exhaust and other fumes) and the office area. By creating a tight envelope, Icynene also complements the HVAC equipment in the building to function as designed so that building occupants have better indoor comfort and air quality.

Icynene also significantly minimizes unwanted airborne sounds. In the PFI building, Icynene dampens the sounds and is very effective in controlling the air-borne flanking sounds originating from the shop area. This helps create a quieter office space and working environment.

"Our building performs as designed," says building owner Ken Wiggers. *"Rapidly escalating natural gas and electricity costs have been muted by the relatively low design and actual energy load on the heating and cooling system. And on top of it all, the building is very comfortable."*

Icynene Puts The Building Owners' Goals in Reach for Any Metal Building Project:

- ✓ Insulates and air-seals in one step to eliminate the need for sealing material and accelerates the construction process
- ✓ Optimizes energy efficiency to deliver 30% in energy savings
- ✓ Provides predictable airtightness and allows for rightsizing of heating and cooling equipment
- ✓ Locks out dust, allergens and other outdoor pollutants
- ✓ Minimizes airborne moisture flow movement to reduce the incidence of condensation and related mold and mildew
- ✓ Minimizes unwanted airborne sounds
- ✓ Expands 100 times its initial volume ensuring complete fill of cavities and providing a continuous air barrier
- ✓ Uses no CFCs or HCFCs to reduce the threat of corrosion in steel applications
- ✓ Maintains original cured form - does not shrink, sag or settle over time

Icynene Insulation

Icynene foam insulation products are sprayed into/onto walls, crawlspaces, underside of roofs, attics and ceilings by Icynene Licensed Dealers. They expand in seconds to create superior insulating and air-sealing results. Every crevice, crack, electrical box, duct and exterior penetration is effortlessly sealed to reduce energy-robbing random air leakage. Icynene products adhere to the construction material and remain flexible so that the integrity of the building envelope seal remains intact over time.

Icynene is ideal for residential, commercial, industrial and institutional indoor applications. The products are:

Healthier: Icynene spray foam products are CHPS (Collaborative for High Performance Schools) EQ 2.2 Section 01350 Compliant, meeting nationally recognized requirements as Low-Emitting Materials (LEM) and Environmentally Preferable Products (EPP). Icynene spray foam products are 100% water-blown and contain no HFCs or PBDEs. Icynene seals out dust, pollen and other allergens from entering the structure. As air barriers, Icynene products minimize the potential for airborne moisture build-up and related problems such as mold and mildew.

Quieter: By air-sealing the building envelope, Icynene effectively minimizes airborne sounds. Icynene is perfect for reducing unwanted noises from home theaters, plumbing runs and playrooms.

More Energy Efficient: Icynene delivers up to 50% more energy savings versus traditional insulation.

Information about Icynene insulation can be obtained by calling Icynene Inc. (800-758-7325), visiting the website Icynene.com, or contacting your local Icynene Licensed Dealer.

Endnotes:

i http://www.energystar.gov
ii Air Conditioning Contractors of America (ACCA) Manual J, 8th Edition
iii Butler® Building Systems Design and Selection Guide
iv Blower Door Test conducted on PFI Building in January 2007
v Audit report by Cenergy, LLC (Elite Software Development, Inc.) of Waukee, IA January 2007
vi Uthane Foam/Steel Corrosion Test performed by Centre For Building Science, University of Toronto

† The Icynene product installed and addressed in this project example is Icynene's classic formula, ICYNENE LD-C-50™.

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For more information, contact your local Icynene Licensed Dealer

Visit our website: Icynene.com
or call
1-800-758-7325

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