

ARMACELL SOLUTIONS

# Supermarket

Supermarkets and grocery stores are pillars of our society and are constantly looking for ways to improve the shopper's experience and adapt to new shopping landscapes. With tight margins and high overhead, supermarket corporations as well as mom and pop shops each need to find strategies to keep costs down. Controlling the cost of refrigeration and optimizing energy use is one way this is achieved. Armacell has new Supermarket Solutions in store for the grocery market.

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MAKING A DIFFERENCE AROUND THE WORLD



# SUPERMARKET SOLUTIONS

Supermarkets and grocery stores are a \$6.8 billion industry that has seen slow but steady growth in the past five years. Recent events have also shown how essential this industry is to American well-being. However, supermarkets operate on very low profit margins, about 1-2% of sales, with very high overhead. By far a grocery store's highest expense is product inventory (food) at around 75%. Next is labor at about 10% of its expenditure.

That doesn't leave much left over for all the other costs of running and maintaining a business. While energy costs are only about 2% of revenue, 56% of a supermarket's total electricity load is refrigeration. The EPA estimates a 10% reduction in energy usage is equivalent to increasing net profit margins by 16%!

There are more than 38,000 supermarkets in the US and each one has on average of 10 walk-in cooler or freezer units. These refrigeration units must run 24/7; obviously there's no turning them down at night when the store is closed, so finding strategies to save energy starts with the design of the system.

## ENVIRONMENTAL HISTORY

To understand the challenges of refrigeration technology, we need to look back at the Montreal Protocol of 1987. When scientists began to track the alarming depletion of the ozone layer, the international community met to create a treaty designed to phase out the use of ozone-depleting substances like chlorofluorocarbons (CFCs), commonly used as refrigerants and propellants. Next on the list were hydrochlorofluorocarbons



The average US  
Supermarket is  
**50,000 ft<sup>2</sup>**

(HCFCs) to be reduced by 2015. This spurred the measurement of a refrigerator's ozone-depleting potential or ODP. Hydrochlorofluorocarbon (HFC) refrigerants like R-22 were developed that have a low ODP of 0.05 compared to CFCs which have an ODP of 1. Unfortunately HFCs have other concerns in that they are greenhouse gasses that contribute to global warming. Therefore the GWP or global warming potential is also calculated. To balance all this potential, a third score of total equivalent warming impact (TEWI) is used to verify a refrigerator's overall sustainability. Supermarkets use the TEWI score to help gauge the aggregate climate impact of a refrigeration system.

The need to find low-GWP alternatives has led to the emergence of hydrofluoroolefins (HFOs) and so-called natural refrigerants like CO<sub>2</sub>, propane, butane and ammonia. One downside is that with the exception of CO<sub>2</sub>, these refrigerants are flammable, and NFPA, ASHRAE and other building and life safety codes must govern the safe use of these systems.

## REFRIGERATION SYSTEMS

Supermarkets use several types of refrigeration cases, cooler rooms and freezers. There are the medium cooling, horizontal, open cases where cooled produce, meats and cheeses are displayed at about 35-38°F. These are the least energy efficient as all the air curtain



cooling is released into the store. Usually at the back of the store you'll find upright refrigerators with doors where dairy products are kept at 38°F, but these are just the front ends of much larger cold-rooms behind the main shopping floor. Most stores have aisle and aisles of upright freezers where the coldest items are kept anywhere from -5 to -24°F. All of these display units are operated by refrigeration plants either in the back rooms or on the roof.

Direct expansion (DX) and secondary loop (SN) systems are common in supermarket design. One difference between the two types of systems is the amount of refrigerant used. Because DX systems require twice as much refrigerant and due to environmental concerns and regulatory pressures, SN systems are gaining in popularity. DX systems also rely on the refrigerant changing from liquid to vapor as it boils entering the evaporator. There is no change of state of the coolant in SN refrigeration.

A traditional DX system consists of compressors, condensers, expansion valves and evaporators. The system operates at high pressure to maintain around 100°F of constant temperature using a refrigerant vapor expansion and compression cycle. When the system expels the cold air at the display cases, it gains heat at the same time. Liquid refrigerant boils at a low temperature turning to superheated vapor at the end of the evaporators. The compressor will pump the superheated vapors from evaporators on the low-pressure side and compress to high-pressure side of compressor to engage the compression cycle.

Condensers cool the refrigerant back into a liquid and sends it to a receiver. The liquid flows through thermostatic expansion valves (TXV) that meter the flow of refrigerant from



the high-pressure side to the low-pressure side and back to the compressor which create the refrigeration cycle.

A secondary system includes the primary DX system and a secondary SN system. The SN system incorporates a hydronic, or fluid-circulating process that removes the need for DX evaporators for hydronic heat exchangers in the cases and coolers. The coolant used in a SN system does not need to change state into a vapor and any heat absorbed by the coolant is transferred to the chiller which serves as the evaporator for the DX side. A benefit of the SN system is that it reduces the total amount of refrigerant in stores and makes it easier to find refrigerant leaks to the chiller and condenser. Also it reduces the install cost because lower cost Type M copper or plastic piping can be used to circulate the coolant as compared to the more expensive L-copper used in DX.

## ENERGY SAVINGS TRENDS

The energy efficiency and safety of a refrigeration system depends on its optimal performance. The EPA estimates that a typical large supermarket refrigeration system holds about 4,000 pounds of refrigerant and has an annual leak rate of about 25% or 1,000 pounds. Not only does this make the system need constant maintenance, but it exemplifies the concern for higher OPD refrigerants being released into the environment. Couple that with possible flammability of some coolants, and supermarkets need to do all they can to ensure the security of their systems.

Many of those leaks happen at the long sections of piping and dozens of TXV connections in a DX system. Alternatively SN systems use only one TXV at the chiller and much less piping, reducing the opportunities for leaks and lowering installation and maintenance costs.

Other technology includes distributed systems that have all the mechanicals at or near the cases they serve. Smaller self-contained propane units contain only a small refrigerant charge (about 5.3 ounces per refrigerant circuit) and have a low leak rate of about 2%. Depending on the size, a store using only self-contained refrigeration equipment would only need 110 pounds of propane. That's a significant refrigerant reduction!

Uncertainty regarding which refrigerants might be on the next phase-out list means supermarkets have to make smart choices today. And they want to. Many supermarket leaders are pledging to go to net-zero buildings with low TEWI refrigeration scores. As shopping and shoppers change, the grocery store experience will look different in the future. Since younger generations want to live in walkable urban areas, we may see the influx of smaller intown markets and fewer suburban megamarkets. We'll definitely see more closed cases for energy efficiency and freshness.

## HEADS UP

Another important design point for supermarkets is right overhead. Most refrigerant piping is usually suspended in the open ceilings of the store. If it is insulated, the suspension system must carry the load without compressing or damaging the insulation. If insulation is torn or crushed the thermal integrity of the system is compromised and condensation and dripping may occur, causing damage to products below or dangerous puddles which could become a liability if a customer falls. Factory-made metal saddles and installer-fabricated saddles themselves have been known to work their way loose and fall to the aisles below, another problem for supermarket management.

A well-designed pipe suspension or mounting system protects the insulated pipe by spreading the load over a wider area, avoiding insulation compression from the combined pipe and fluid weight and prevents tearing and damage to the insulation and/or vapor retarder caused by thermal linear expansion and vibration. Considering the product and installation characteristics during the planning phase of the pipe system is critical to ensure a good design and avoid unwanted issues.

The 1-piece Insuguard product line is engineered for HVAC/R DX systems for strut applications only, while Insuguard Multi is designed for HVAC/R and SN systems that can accommodate multiple supporting systems like Clevis, H-beam, I-beam, steel angle or even floor mounts. Because installation requires no tools, the installer simply clicks Insuguard into place for struts or uses Insuguard Multi adapters to connect to other types of suspension or mounting

system, regardless of size. Pipe movement is accommodated without compromising the insulation or displacing the saddle, with a design that includes rounded edges that curve away from the pipe at both ends. While eliminating insulation tear-off is critical, both saddles also protect liquid lines inside the high laterals walls that totally isolate the piping from the support system, which will eliminate the risk of costly refrigerant leaks.

Incorporating the ArmaFix® EcoLight pipe supports eliminate the crush point where the saddle meets the insulation. A PET core supports the pipe, keeping the insulation thickness constant and preventing a thermal bridge at the fixing point. These two support products keep the piping insulated and secure, giving grocers one less thing to worry about.

## INSULATION FOR SUPERMARKETS

The refrigeration systems in supermarkets need to function at top performance to attain the energy-efficiency that they need, which means they require the proper insulation. Armacell's insulation systems are ideal for insulating miles of liquid and suction lines, chilled water piping, chillers and cooling tanks. Insulating pipes, refrigeration lines or HVAC cooling systems not only promotes energy efficiency, but it also prevents condensation on below-ambient temperature surfaces—a critical issue for supermarkets and grocery stores.

Specifying Armacell Solutions for supermarkets is prudent for several reasons. Armacell uses a fiber-free, formaldehyde-free, low VOC formulation for its foam insulation, which makes it an excellent option for any environment, eliminating particulate that can jeopardize air quality and equipment. A closed-cell structure also prevents moisture ingress and naturally resists the growth of mold and mildew with anti-microbial protection of Micoban®. Most importantly, the flexible nature of Armacell's insulation means it installs easily in tight spaces in floors, walls or ceilings. You can count on Armacell insulation retaining its thermal integrity over time, lasting well into your future. ■



# SUPERMARKET BUILDINGS RELY ON OUR PROVEN SOLUTIONS

## PROJECTS WON

- **Brookshire's Food & Pharmacy** –  
Winnboro, TX
- **Caseys General Stores,  
Distribution Center** –  
Springfield, MO
- **Costco Wholesale** –  
Charlotte, NC  
Chicago, IL  
Dallas, GA  
Denver, CO  
East Lyme, CT  
Pflugerville, TX  
St Cloud, MN  
Seattle, WA
- **Food Lion Grocery Store** –  
Marshall, VA  
Salisbury, MD  
Summerville, SC
- **Harris Teeter Supermarket** –  
Fayetteville, NC
- **H-E-B Grocery** –  
Dripping Springs, TX  
Fredericksburg, TX  
Round Rock, TX
- **Hy-Vee** –  
Cedar Rapids, IA  
Springfield, MO  
St Paul, MN
- **Jewel-Osco Supermarket** –  
St Louis, MO
- **King Soopers Supermarket** –  
Denver, CO
- **Kroger** –  
Columbus, OH  
Lawrenceville, GA  
Sylvania, OH
- **Meijer Supermarket** –  
Blissfield, MI  
Detroit, MI  
Indianapolis, IN  
Stevens Point, WI
- **Publix Super Market** –  
Atlanta, GA  
Clearwater, FL  
Madison, AL
- **Rouses Supermarket** –  
Lake Charles, LA
- **Safeway** –  
Denver, CO  
Gig Harbor, WA  
Oakland, CA
- **Sam's Club** –  
Denver, CO  
Sanford, FL
- **Target Superstore** –  
Kissimmee, FL
- **Village Beach Market** –  
Vero Beach, FL
- **Walmart Supercenter** –  
Adrian, MI - Detroit, MI  
Clanton, AL  
Elgin, TX  
Portland, OR  
Manor, TX  
North Logan, UT
- **Wegmans Food Market** –  
Medford, NY  
Rochester, NY  
South Riding, VA
- **Whole Foods Market** –  
Denver, CO  
East Harbor, MD

## SMART SOLUTIONS FOR YOUR BUSINESS

Armacell's Solutions Portfolio groups insulation products into comprehensive packages aimed at making the specification of the right insulation for mechanical systems easier than ever before. Building professionals can easily identify the best insulation products for use in an air plenum or on HVAC/R mechanical piping. Packages offer two levels of cost and service: High and Superior Performance with a 10- or 15-year warranty.

All data and technical information are based on results achieved under typical application conditions. It is the customer's responsibility to verify if the product is suitable for the intended application. The responsibility for professional and correct installation and compliance with relevant building regulations lies with the customer. By ordering/receiving product you accept the Armacell General Terms and Conditions of Sale applicable in the region. Please request a copy if you have not received these.

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## ABOUT ARMACELL

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As the inventor of flexible foam for equipment insulation and a leading provider of engineered foams, Armacell develops innovative and safe thermal and mechanical solutions that create sustainable value for its customers. Armacell's products significantly contribute to global energy efficiency making a difference around the world every day. With more than 3,300 employees and 27 production plants in 19 countries, the company operates two main businesses, Advanced Insulation and Engineered Foams. Armacell focuses on insulation materials for technical equipment, high-performance foams for acoustic and lightweight applications, recycled PET products, next-generation aerogel technology and passive fire protection systems.

For more information, please visit:  
[www.armacell.us](http://www.armacell.us)

