

Climate protection in food refrigeration

Vacuum insulation panels (VIP) with silica from Evonik



The ideal solution for ascending to higher energy efficiency classes: Vacuum insulation panels (VIPs) with silica from Evonik harbor great potential for the next generation of environmentally friendly supermarket cabinets.

The growing demand for refrigerated foods is fueling higher energy consumption and space requirements. Therefore, the retail sector needs energy-efficient and space-saving refrigerated cabinets and counters. Vacuum insulation panels with silica from Evonik lower energy costs and help protect the climate by guaranteeing the very best thermal insulation with low wall thicknesses – thereby allowing manufacturers of supermarket cabinets to advance their devices to higher energy efficiency classes.

Food should be fresh and quick to prepare – which is why supermarket customers often head for the refrigerated section. With the growing demand for frozen food, dairy products, chilled drinks and convenience products, refrigeration and freezing equipment is taking up ever more space in supermarkets.

Today, refrigerated goods already take up 21% of sales area on average, and the industry expects the cooled product ranges to expand further still. It is therefore no surprise that refrigeration technology makes up an average of 40% of installation costs and accounts for almost half of energy consumption in the food retail sector. These figures are from the “Cooling Technology in Food Retailing 2021” (*„Kältetechnik im Lebensmittelhandel 2021“*) study by the EHI Retail Institute in Cologne, which surveyed refrigeration technology managers from 22 leading food companies in Germany, Austria and Switzerland. At the same time, the retail sector is working to massively reduce its energy consumption and improve its carbon footprint.

This is confirmed by Detlev Müller, Head of Technology, Energy and Safety at the organic supermarket chain tegut, which has around 290 stores throughout Germany: “We want to be sustainable and lower unnecessary consumption. Of course we also want to save money. In addition, tegut is aiming to generate competitive advantages through energy efficiency; that is, it wants to outperform its competitors.”

NEW ENERGY EFFICIENCY CLASSES ALSO AFFECT REFRIGERATING APPLIANCES FOR SUPERMARKETS

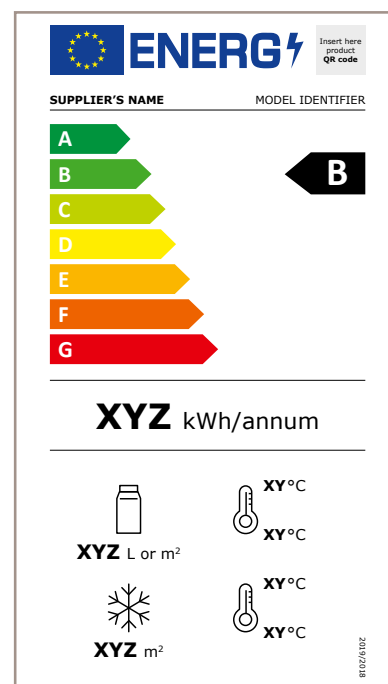
Intelligent refrigeration concepts and more efficient equipment help reduce energy consumption, and their development is being accelerated through new, stricter regulations from the European Union. “User needs and climate goals, as well as the resulting need for action and legal requirements, form the framework for the planning of refrigeration concepts,” comments Benjamin Chini, who heads the Energy Management research field of the EHI Retail Institute. In the United States, too, there are requirements and incentives aimed at significantly lowering the energy consumption of retail food refrigeration. The Energy Star ENERGY STAR® label identifies devices that meet the strict requirements of the U.S. Environmental Protection Agency (EPA). The EPA has also initiated the GreenChill program and certification system, a voluntary partnership program for food retailers and manufacturers of refrigerating appliances and refrigerants, which is aimed at cooling food in a more environmentally friendly manner and reducing CO₂ emissions.

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Benjamin Chini, EHI Retail Institute, Köln

In the European Union, electrical devices have to be certified with the new EU energy efficiency label since March 2021. This categorizes the devices into the efficiency classes A (highest efficiency) to G (lowest efficiency) and indicates the annual energy consumption and, in the case of supermarket cabinets, the storage capacity. The previously used plus categories in class A are no longer used. These new rules are so strict that a lot of refrigerating appliances that were previously among the best in the class with a rating of A+++ have now dropped to class C. Of course, the EU setting the bar higher also creates an incentive for manufacturers to develop innovative, climate-friendly technologies. The new Ecodesign Directive entered force at the same time; this aims to ensure that equipment is designed in a more environmentally friendly manner, taking into account their reparability and recyclability alongside their energy efficiency.

Both EU Directives also apply for “refrigerating appliances with a direct sales function.” This category includes freezers and refrigerators, as well as beverage coolers in supermarkets. Their purpose is to present food so that it is clearly arranged, attractive and readily available for customers while reliably cooling the products within; at the same time, however, they should use as little energy as possible. Although open refrigerated counters are increasingly being replaced by supermarket cabinets with glass covers, the loss of energy due to the large glass surfaces and the frequent opening and closing of doors remains a challenge in terms of energy management. Another approach for achieving energy efficiency is improved insulation – for example with vacuum insulation panels (VIPs) with an insulating core made out of silica from Evonik.



VIPS FOR CLIMATE PROTECTION IN THE REFRIGERATED SECTION

Many supermarket cabinets are insulated using plastic foams. With this conventional type of insulation, however, an improved insulating effect is only possible with a greater insulation volume and thus thicker walls, thereby reducing the amount of space available for storing refrigerated goods.

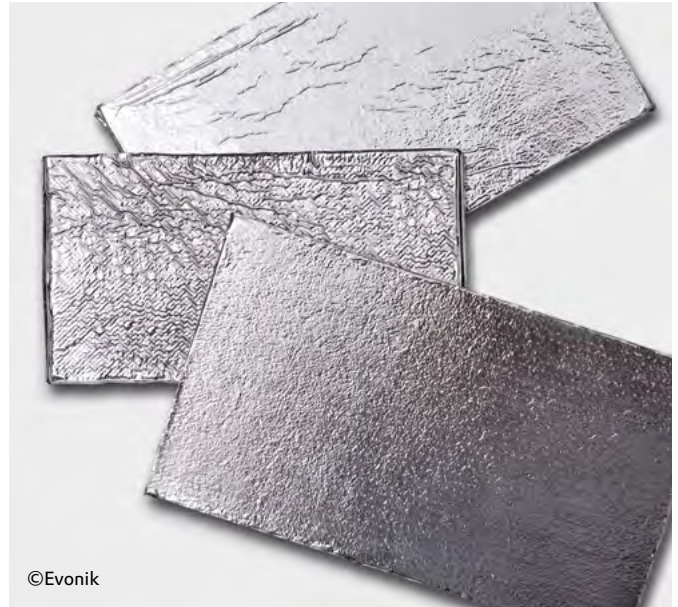
Ultra-flat vacuum insulation panels (VIPs) are an alternative here: They insulate up to ten times more effectively than conventional insulating materials with the same material thickness.

Dr.-Ing. Gabriele Gärtner, Leiterin Forschung und Anwendungstechnik



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From sand to silica: silica is a natural component of rock and sand. Evonik manufactures different types of silica with specific properties for various industrial applications.



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Vacuum insulation panels (VIP): A support core made from compressed silica powder is shrink-wrapped in a multi-layer special film. Insulation panels filled with fumed silica provide excellent insulation against heat and cold.

WHAT IS SILICA?

Sand is the starting material for silica. The particles are based on silicon dioxide, a natural mineral. By the way, the two components in this compound, oxygen (approx. 47%) and silicon (approx. 27%) are some of the most common elements in the Earth’s crust when measured by weight. Evonik creates silica from these compounds with custom properties for industrial applications. It truly is a

product with many talents: It is common in many everyday applications, for example as an anti-caking agent in powders, as a carrier substance for catalysts or active ingredients, as reinforcement fillers for polymers or as insulation materials. They optimize the flow capability of fluids and improve the storage properties of powders. AEROSIL® is a fumed silica that is synthesized in a 1,200 degrees

Celsius hydrogen flame. AEROSIL® fumed silica is used as thermal insulation in everyday applications, such as in insulation panels for refrigerators and under ceramic cooktops.

Thermal Insulation bei Evonik

“VIPs enable manufacturers of supermarket cabinets to design space-saving appliances with the very highest energy efficiency. And they help food retailers to lower energy costs and improve their climate footprint,” says Carina Geier, Global Marketing Manager Thermal Insulation at Evonik.

Carina Geier, Global Marketing Manager Thermal Insulation bei Evonik

AEROSIL® INSULATES AND STABILIZES

Inside the VIP is a core made of an ideally microporous mineral insulation material – for example made from AEROSIL® fumed silica from Evonik. Silica is a proven and environmentally friendly insulation material. The powdery material is pressed into sheets and enclosed by a multi-layer film that is impermeable to air under a vacuum. AEROSIL® performs three tasks in VIPs: It serves as an insulating material and a supporting structure, as well as ensuring that the vacuum is maintained over a long period of time. Dr.-Ing. Gabriele Gärtner, Head of Research and Application Technology Thermal Insulation at Evonik, explains it as follows: “The silica core is capable of withstanding immense pressures. Although the particles form a structure with well over 90% micropores, the core retains its shape even under the conditions of an almost 100% vacuum. In technical terms, it is virtually

impossible to generate an absolute vacuum as individual air molecules remain in the shell. There is still some thermal conductivity due to the movement of these molecules, albeit on a minimal scale. The silica core reduces this even more, as its microporous structure and the chain-like arrangement of the particles restricts the movement area of these air molecules considerably. This special structure significantly increases the pressure at which the thermal conductivity of air in the material is exactly half that of stationary air (0.026 W/(m·K)), thereby vastly extending the service life of the vacuum insulation panel. "The already very good insulation performance provided by AEROSIL® is increased by between three to five times by the vacuum in a VIP."

SUPERMARKET CABINETS WITH 50% LOWER ENERGY CONSUMPTION

VIPs have great potential for next-generation energy-efficient refrigerated cabinets. This was demonstrated, for example, by the TEC50 research project, a joint project involving several medium-sized companies from Germany, which was supported in 2017 with funding from the German Federal Ministry of Research. In this project, a refrigerated display case manufacturer partnered with an insulation producer, a manufacturer of insulating glass and an IT company to develop two refrigerated display case prototypes with 50 percent lower energy consumption than conventional units. This was achieved by redesigning all system components - using VIP as the insulating material in combination with highly efficient insulating glass and sensors for AI-supported control technology.

The U.S. Environmental Protection Agency (EPA) also issues the following recommendation to appliance manufacturers: "Currently available refrigerator technologies such as innovative refrigerants and variable speed compressors as well as advancements in vacuum-insulated panels (VIPs) yield significant efficiency improvement."

"Vacuum insulation panels with silica last around 30 years, but often even longer. Once the product has reached the end of its life, the AEROSIL® core can simply be removed and ideally reused – or, if this is not an option, be disposed of with other same-type materials. As synthetic silica does not differ from naturally occurring silica, it can be reintroduced into the natural geological cycle or, for example, used in construction materials."

Carina Geier, Global Marketing Manager Thermal Insulation at Evonik

VIP WITH AEROSIL®: STRONG PERFORMANCE AND LONG LIFE CYCLE

The retail sector is moving with the times: "In the context of the climate crisis and the increasing consideration of consequential environmental costs in economic incentive systems, there is a great willingness to invest in future-proof energy concepts," states the EHI study. According to this, three quarters of the 18 surveyed retail companies now deem energy efficiency to be the top priority when planning refrigeration concepts, followed by goods presentation (57.9%) and handling by customers and personnel (31.6%). Alongside the safety of installations and goods, the tegut supermarket chain also rates energy efficiency and durability as the most important criteria when acquiring supermarket cabinets.

The EHI Retail Institute has determined that the life cycle of appliances is becoming increasingly important and that retail companies are accepting longer amortization periods.

Manufacturers of supermarket cabinets can improve the ecological footprint of their appliances by using environmentally friendly insulating materials. Accordingly, VIPs with silica can form one of the many elements of a sustainable refrigeration system and help cut back on energy consumption and reduce the carbon footprint of food refrigeration. And when consumers reach into the refrigerated section at their supermarket, they can be sure that the retail sector is taking responsibility for protecting the climate.

Retail companies in Germany, Austria and Switzerland, depending on company size invest between €6 million and €55 million in refrigeration technology every year.

BENEFITS OF VIPs WITH AEROSIL® FOR REFRIGERATION IN THE FOOD RETAIL SECTOR

- Supermarket cabinets with higher energy efficiency save costs and minimize the carbon footprint
- Insulating effect is five to ten times better than that of conventional insulating materials
- Compact, energy-saving supermarket cabinet, also for stores with limited space
- Long-lasting, with a useful life of more than 30 years
- Environmentally friendly and recyclable mineral-based insulating material

APPLICATION AREAS OF VIPs WITH SILICA

- Households and food retailing: Refrigerators and freezers
- Medical and pharmaceutical: Transport boxes and containers, refrigerators and freezers
- Logistics: Transport of cooled and frozen goods
- Construction sector: Insulation for buildings and water cisterns
- Heavy industry: Insulation pipelines

THREE QUESTIONS TO ...

DETLEV MÜLLER

Head of Technology, Energy and Safety at the organic supermarket chain tegut

What is motivating tegut to reduce its energy consumption?

We want to be sustainable and lower unnecessary consumption. Of course we also want to save money. In addition, tegut is aiming to generate competitive advantages through energy efficiency.

Which criteria are important when buying supermarket cabinets?

Plant safety, goods safety, energy efficiency and durability, as well as ease of use by the customers and good visual presentation of goods.

Which technical solutions is tegut using to lower the energy used for food refrigeration?

We have equipped the refrigerated shelves and cabinets with glass swing doors and all freezers with sliding glass doors. Energy-saving fans and energy-efficient and durable LED lighting elements are fitted in all refrigerated cabinets and freezers. Variable-speed compressors are used on the CO₂ multi-compressor refrigeration systems. Refrigeration technology, lighting, heating, air conditioning and ventilation are controlled by the building services management system in an energy-efficient manner. Moreover, we have standardized service contracts containing clear requirements for setting and maintaining the refrigeration systems.

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