White Paper

Deep-Freeze Storage

kardex

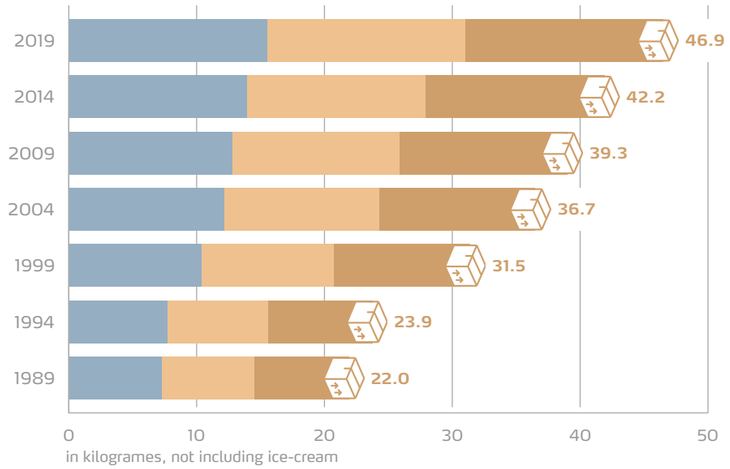
Top tips for cold storage

The market for frozen food products is growing consistently and retailers continue to expand their product range and floor space. In line with this development, the demand for appropriate production and storage capacity is growing along the entire supply chain. The necessary infrastructure calls for intralogistics systems and processes with maximum efficiency, performance and availability.

More and more consumers are opting for refrigerated and frozen foods from the convenience range. According to a recent survey by the German Frozen Food Institute (dti), per capita consumption of convenience foods in 2019 amounted to 46.9 kilograms (dti Sales Statistics 2019). 20 years earlier, the figure was 31.5 kilograms (dti info graphic).

The annual logistics expenditure for frozen and refrigerated goods is approximately 8 billion euros, with external service providers billing approximately 35-40% of this amount. The remaining 60-65% of these costs relate to in-house solutions, totaling to approximately 5 billion euros. (Source: IKB Deutsche Industriebank AG, Corporate Blog). IKB anticipates this sector will grow 3-4% annually.

Per capita consumption of deep-frozen products



Insourcing becomes more attractive

Transport and storage service costs for refrigerated and frozen-food logistics continue to rise due to limited capacities, increasing personnel, and energy costs. Knowing this, investing in highly-efficient, internal resources that enable insourcing are becoming more and more viable. This includes compact channel storage, mobile racking, and high-bay storage up to 45 meters high, coupled with multiple storage and retrieval by fully automated storage and retrieval machines. These resources enable high-performance and economic pallet storage within a minimum footprint.

Within automated logistics plants, a deep-freeze high-bay warehouse is the core element. It ensures the required storage space and that storage and retrieval machines work 24/7 to execute a fast and reliable inflow and outflow of goods. In addition, buffer storage for shipping areas enables sequencing of full loads to stage the required pallets for each tour or truck. This accelerates a truck's dispatch and minimizes the holding time for pallets containing frozen goods at the refrigerated staging areas, which means that these areas can also be designed on a smaller scale.

Individual stations are connected by powerful conveying systems and intelligent control software, integrated into the existing ERP system. The warehouse management system assumes a critical role here. In addition to the management of master data, best-before dates, and batch tracing, the warehouse management system also controls the storage and retrieval processes, just-in-time supply to the picking stations, and goods staging at goods issue with integrated loading control.

Key issues to consider when constructing a new deep-freeze warehouse

- Energy consumption
- Requirements relating to employees, technology, insulation & fire protection
- Growing diversity of containers with different handling requirements

Growing diversity

Careful planning has a major effect on long-term energy costs. It is especially important to consider the transitions between individual storage areas. Airlocks and control doors are critical as, in deep-freeze warehouses, the storage and retrieval of products can lead to significant wastage of energy.

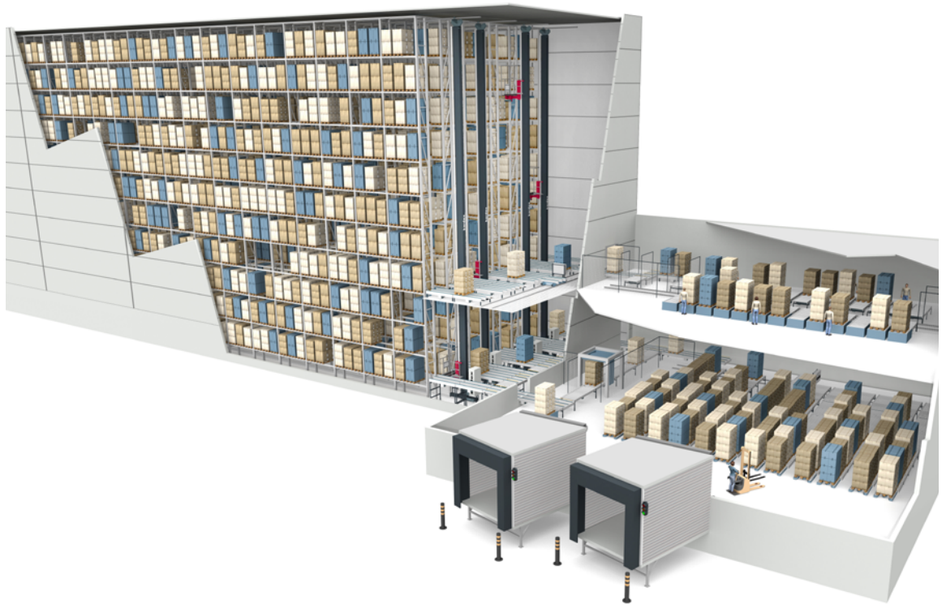
Independent from the manufacturer, an effective concept when constructing a new deep-freeze warehouse begins with the process and operational flow design. With this as a basis, you can then define the building structure and transitions between the various areas with different temperature zones. Next, the capacity and performance parameters for air-conditioning and cooling technology as well as high-bay racking, storage and retrieval machines, and conveying technology are defined. An appropriate picking concept and selecting the right software to manage the processes complete the planning.

Construction of deep-freeze high-bay warehouse

Telltale condensation

The cardinal rule is that the cooling chain must not be interrupted under any circumstances. The goods must not thaw, and ice crystals must not be allowed to form on the products.

According to the Hazard Analysis and Critical Control Points guidelines (HACCP), the prescribed temperature in a deep-freeze warehouse where food is stored must be –18°C or below. In many deep-freeze warehouses in the food logistics sector, temperatures are between –30°C and –18°C. Especially during the summer season, they require a high energy input to maintain these temperatures. The planning of these plants should therefore focus on energy costs, which can be minimized by keeping the size of the building shell as small as possible. Optimal space economy can only be achieved with automatic storage since, with manual processes, the employees require significant amounts of free space and space for movement. When designing a building shell, attention should be paid to minimizing the external radiating surface, while at the same time taking into account connections to existing buildings.



Automated deep-freeze warehouse

Airlocks prevent ice formations

As a result of the unavoidable transitions between individual storage and cooling areas, insulation is a critical topic. The number of these interfaces should be kept to a minimum and all doors and gates should be opened as infrequently as possible and for as short a time as possible. To minimize energy loss at these transitions, high-speed doors, air curtains, and airlocks prove most effective. In the case of gates, it is important to note that air in a deep-freeze warehouse is significantly dryer than air in normal-temperature zones. The additional humidity outside cooled areas can lead to ice formation at the transitions. Airlocks with floor and wall heating can help to compensate for this disruptive factor.

Special features for planning and constructing deep-freeze warehouses

- Avoid unnecessary empty spaces with a compact building shell design
- Minimize number of transition areas and airlocks; deploy high-speed doors
- Use cold-resistant technology and operating materials
- Adapt cold air flows to racking and stored goods
- Take account of heat emission from motors & frequency converters

Of course, the cooling technology must be planned in detail and scaled appropriately to ensure consistent cooling in all storage areas. It is advisable to involve a specialist at an early stage of the planning to take account of all relevant factors in the design and structure of the cooling technology. After all, the installations required for cooling will influence the arrangement of the racking, which must provide sufficient space and access for the evaporators. The evaporators serve to transfer the cooling capacity and to distribute the cool air throughout the entire storage space. The flow of cold air through the storage area and around the goods stored must be carefully planned, as must the configuration of motors, drives and frequency converters which radiate heat in the deep-freeze warehouse.

Cold-resistant technology

With regard to motors and drives, these must be equally as cold-resistant as the storage and retrieval machines and the conveying technology. The same applies to oils, greases, lubricants, and component seals which must also be designed for extremely low-temperature usage. It is important to pay special attention to electronics deployed in deep-freeze warehouses.

Fire protection in deep-freeze warehouses is also a key topic during the planning phase. It is critical to comply with additional provisions such as VdS 2032 "Fire protection for cold and deep-freeze warehouses". In a deep-freeze environment, water is unsuitable for fighting fire. A conventional sprinkler system is only appropriate if the design ensures that the pipes only fill with water in the event of a fire. Alternatives include sprinkler systems with anti-freeze solutions and fire prevention through oxygen reduction systems.

The subsequent repair and exchange of aggregates can be simplified and accelerated through the use of plug-in and bolted connections instead of hard-wired connections. Design elements such as these have a positive effect on regular maintenance operations and during emergency situations, and consequently improve the availability of a high-bay warehouse. It means that unscheduled downtimes can be kept to a minimum and, considering the three-shift operation frequently deployed in the frozen-food sector, such downtimes can quickly lead to high costs.

- Implement optimal ergonomics in the picking areas
- Simplify service and repairs using plug-in and bolted connections
- Adhere to fire protection regulations for refrigerated and deep-freeze warehouses

Employee-friendly working conditions

Whereas fitters and service personnel usually have relatively short deployments in deep-freeze warehouses, picking personnel must be prepared for longer stints under cold conditions. Working a shift at temperatures between –18°C and –30°C puts an intense physical strain on the body. Any form of automation – for example, automated storage and retrieval instead of goods handling via forklift truck – is welcomed. In situations where there is no alternative to manual picking, light-controlled or speech-controlled systems make the work easier, lower the error rate, and increase productivity. An analysis of the delivery structures and selection of the optimal picking solutions make up another key part of plant planning and can help ensure employee-friendly working conditions at picking stations.

In this context, automation of deep-freeze logistics becomes especially important. Here, the goals are not only maximum effectiveness, scalable processes, and error-free order handling, but also keeping manual tasks under difficult working conditions to a minimum. Additional goals include greater energy efficiency in high-bay warehouses through a compact building shell and the elimination, where possible, of empty spaces.

Kardex Mlog headquarters in Neuenstadt am Kocher, Germany

Diverse references

Automated deep-freeze warehouses offer the optimal basis for sustainable success. Stored products are monitored consistently while compact, closed-circuit building cooling ensures constant temperatures. Compared to a manual warehouse, a well-planned deep-freeze warehouse enables greater storage volume with minimal personnel and management costs.

Manufacturers such as Kardex Mlog offer a complete portfolio which illustrates the various automation options available. The company, based in south-western Germany, can point to diverse reference projects and can claim more than 50 years of experience in planning, implementing and maintaining fully automated logistics solutions. Worldwide, more than 3,000 storage and retrieval machines manufactured by Kardex Mlog are in use today. Effective and secure handling of pallets is one of the company's core competencies and Kardex Mlog estimates a time period of 12 to 15 months for construction of a new automated storage facility. Refurbishments can be completed much faster.