ENGINEERING
TOMORROW

Case study: Cold storage model **ready** to support the **cold chain in India**

Danfoss has supported in setting up the first European standard cold chain model in India.

Effective logistics

The cold storage solution has the capacity to store 7,200 Euro-pallets in five chambers for cold and frozen storage, with a total volume of 26,340 m^3. Three of the five rooms are designed to operate at different temperatures between -25 °C and +20 °C throughout the year. Two rooms are flexible within the freezing range and most of the time, will be used to store ice-cream at -25 °C or seasonal products, such as white buttercream, at -21 °C. A 1500 m^3 docking station with six insulated, electric operated shutters can handle up to 200 pallets per day. The docking area is kept at +10 °C in winter and at +25 °C in summer to minimise the moisture load of the evaporators in the chambers. Positions of the pallets in the high rise (14 meters) chambers are computer controlled. Special forklift trucks with position monitoring fetch and lift the pallets as requested.

Expected 15-25% energy savings

Geographically, the company is perfectly situated in the outskirts of Delhi, just three kilometers from the Delhi border and close to the new highway from Delhi to Agra. The operation is in a starting phase and working at 25-35% of maximum capacity.

Director of Sabharwal Food Industries Pvt. Ltd., Mr. Anil K Sabharwal, is satisfied with the cold storage solution:

"We have been a Danfoss customer since 1996, and the cold storage solution is a result of the products and people behind them. Danfoss has offered and installed their best in class controls, valves, VFDs (Variable Frequency Drives) and system managers. We expect 15-25% energy savings but being a new project and not operating at full capacity, we expect to know the detailed results over the next six to nine months."

Food safety is number one priority

Growing demand for improved food quality, freshness, better hygiene standards, temperature controlled delivery, and year-round availability is crucial for Sabharwal Food Industries Pvt. Ltd. The new cold storage model is compliant with FSSAI/ food safety norms and is ISO certified.

Six vehicles can be docked at a time at the entries to the cold storage chambers. The delivery from the vehicle to the storage rooms goes through a sealed process where the entire area ais temperature controlled to avoid food loss.

The entry is swipe card controlled to minimise human contact with the food products. Also, tracking and traceability is important for Sabharwal Food Industries Pvt. Ltd.

Each pallet and cold room rack has a location number to ensure traceability of the food products in the cold storage chambers. The temperature can be individually set per chamber and is monitored/stored in the data system.

Danfoss expects the new cold storage model to become the best practice across India. It will also serve as a showroom for customers who are interested in seeing how they can save energy, reduce costs, and increase food safety and run a profitable company.

Control technology

Optimum flexibility is achieved by creating two independently working refrigeration plants. One is built as a two-stage NH_3 pump circulation system, based on two Mycom screw compressors and two Vilter piston compressors. The two piston compressors can also act as a separate single stage NH_3 pump circulation system. Three cold rooms can be connected to either the low or the high temperature part of this system. In this way, the best matching evaporating temperature for the goods can be used. Combined with a remote temperature adjustment, the storage conditions of the goods are kept at an optimal level for minimum weight loss. Each room is monitored and visualised on a full-screen Danfoss System Manager enabling smart optimisation.

Energy efficiency optimisation

Energy consumption for cold stores is highly influenced by the design criteria of the refrigerating system. Studies in Europe revealed that 60-70% of the total consumed electricity in cold stores is used for the refrigeration plant. For modern buildings, like that of Sabharwal Food Industries Pvt. Ltd, efficient industrial illumination will change this to 80-90% of the total energy consumption. The same study showed that there is a huge difference in the kWh/m^3/year consumption between the cold stores. Taking out the extremes the variation is still 1 to 5. For freezing application it varies from 27 to 135 kWh/m^3/year if

the top and bottom 10% are removed. Climate conditions and loading pattern are partly responsible for these differences. System design and maintenance create the largest difference. Mr. Anil K Sabharwal decided for the best practice in order to achieve the lowest possible kWh/m^3/year for his plant.

3-5% better overall heat transfer

On the technical side, optimisation is achieved on different levels. First of all, there is the modulating control of the compressor capacity by means of Danfoss FC103 frequency converters. Adjusting the compressor speed results in the highest possible suction pressure and, combined with the reduced electricity consumption of the compressors, the efficiency result is optimal. Also, the modulating control of the liquid level in the receivers supports the stable operation of the compressors. The level is measured by the guided radar-based technology Danfoss Liquid Level Sensor (AKS4100) sending its 4-20 mA signal to the ICM motor-controlled injection valve. Another aspect is the ice-removal from the coolers. This is done by the efficient hot gas defrost method, using the energy in the refrigerant to heat the cooler and melt the ice. A zero-pressure drop 2-step solenoid valve (ICLX Flexline™) in the wet return line of the coolers is of high impact, especially in freezing mode, as it creates the highest possible suction pressure in the liquid receivers and thereby, the best system efficiency. It is also interesting to note the choice of aluminium tubes for the air coolers. Compared to the standard steel or stainless steel tubes, these air coolers are expected to achieve 3-5% better overall heat transfer, again resulting in a higher evaporating pressure and thereby higher system efficiency.

Internal and external safety

The well-being of the workers and the environment has a high priority for Mr. Anil K Sabharwal. In practice, this means no uncontrolled refrigerant emissions. For that reason, it was clear that wherever possible, welded connections should be used to couple the piping to all kind of valves and similar components. All Danfoss Flexline™ products fit this requirement and on top of that, the relative high maximum working pressure and the PED certification of these components does give an extra safety assurance. In this respect, stop valves appear to be simple products, but the reliability of their packing glands is an important issue. Leakage should not occur, not even after many operations. Pressure shocks in a refrigeration system will cause great harm, internally for certain and sometimes externally. Smooth operation of control valves and solenoid valves will prevent these kinds of shocks. The 2-step solenoid valve (ICLX Flexline™) in the wet return line of each cooler is a good example of how to avoid pressure shocks after the defrost period. In the first step, this valve opens just a bit and relieves the pressure from the cooler to the central

suction. When the pressure in the cooler is low enough to be safe, the valve opens fully. External safety is also embedded in the relief valves mounted on all pressure vessels. Danfoss safety relief valve (SFA) is known for its reliable opening at set pressure and for the closing function if the pressure has been reduced to 10% below the set pressure. This minimises the emissions in case the pressure becomes too high.

Personal safety is secured by the availability of gas masks and fresh-air line masks in case corrective action must be taken after an ammonia leak. Walking tracks and safety lines are part of the emergency system in every cooling room. Frequent safety meetings with all employees keep the focus on possible dangerous situations. Of course, a fire alarm is part of the system, as well as an emergency assembly point and a wind sock to be able to gather up wind in case of an ammonia leak.

Cost of ownership

The initial investment in the new cold store is 250 million INR. The return on this investment should come via a trouble-free operation, combined with a high volume of pallets. Often ignored in an industrial cold store is the risk of extra costs in connection with accidents and component failure. Most of the time, the cost of the repair is much less compared to that of loss of production or even loss of goods. For the owner of a cold store, complex preventive maintenance will be an investment of which it can never be proven that it pays back. Only after a breakdown of the plant, without maintenance, the cost balance can be calculated. But who wants to wait for that? Mr. Anil K Sabharwal invested in a petrol driven power generator to take over during electrical power outages. Only in this way he can assure the high quality of the stored goods. For each compressor, there is a spare available for immediate replacement if something should happen. The Danfoss controls have a proven record of extremely solid performance and, with a good maintenance schedule, they will maintain this for several decades. On top of that, the new Flexline™ products have the important benefit of the "parts program" principle. The welded house will stay in the pipe system and the operational insert can be replaced as complete unit, enabling a safe, quick and reliable transition to a complete, fully operational, new valve. The off-period for the plant is kept to an absolute minimum in this way.

For standard preventive maintenance, Danfoss delivers dedicated repair kits for a professional service job. A clear proof of good investment is the application of the Flexline™ valve station (ICF) for liquid supply to the coolers. All essential components are mounted in the same house with stop valves on the inlet and outlet. The internal volume of the valve station (ICF) is extremely small, and in case a filter has to be cleaned, it takes ample time to remove the refrigerant and to start the cleaning job. Maintenance personnel tend to clean more often when that job is easier. A clean system is a more efficient system, so it pays back from two sides.

Summary

The above description reveals some of the important drivers of an efficient cold storage model, initiated by Sabharwal Food Industries Pvt. Ltd. in India. Most of the drivers are the result of common sense, down-to-earth thinking. The strength in this solution is the combination that makes all drivers move in the same direction of an efficient and profitable operation.

About the company

Sabharwal Food Industries Pvt. Ltd. is an ISO 22000:2005 certified company offering cold storage and storage of bread, baked goods, and processed foods. The company has a dedicated workforce of 300 people. Sabharwal Food Industries Pvt. Ltd. provides solid and cost-effective farm-to-consumer solutions. They have strong relationships with their customers – some of the most respected food companies in India and worldwide.

Danfoss Industries Pvt. Ltd., Plot No. A-19/2, SIPCOT Industrial Growth Center, Oragadam, Kanchipuram District - 602105, India
Phone: +91 44 6715 1000 | Website: www.danfoss.in