

Case story | EEV

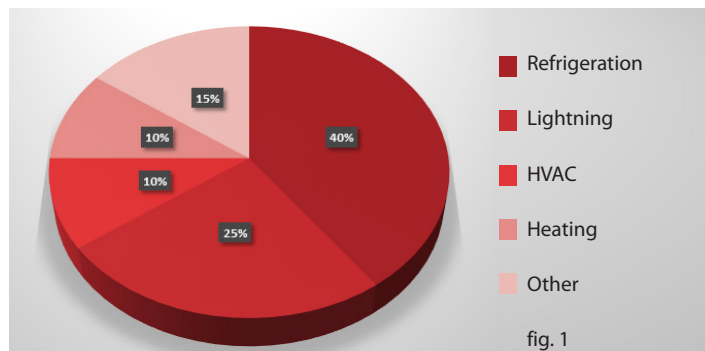
# Optimization of refrigeration system within Pyaterochka chain

# 18 %

energy saving with  
AKV in combination  
with adaptive  
algorithms

Operating costs reduction is an important process for today's store chains that enables them to improve business profitability and become environmentally responsible. Therefore, more companies, including those in the food retail segment, are willing to invest in energy-saving technologies.

Before considering any technology, it is necessary to assess which system is the most energy-intensive within a modern grocery store. According to our data, approximately 40% of all electricity costs, at this kind of facility, accrue to refrigeration equipment (see Fig. 1). Therefore, managers responsible for product chain energy efficiency pay special attention to optimization of this type of system.



Danfoss has great experience in developing and implementing end-to-end energy saving solutions in the shopfitting. As example, ADAP-KOOL® electronic system, which combines Pack and Case controllers, master controllers with monitoring function, sensors, valves and other components. ADAP-KOOL® is a shorthand of the phrase "adaptive cooling", which expresses the basic idea: adaptive algorithms embedded in the solution allow the refrigeration plant to work in an optimal mode, not compromising food quality and automatically adapting to changing environment.

Such issue as operational excellence and operating costs reduction is fairly relevant for X5 Retail Group, since it operates more than 15 thousand Pyaterochka stores in the Russian Federation. Over the years, the company has gradually adopted technologies to achieve necessary levels of savings at each relevant stage.

In today's environment characterized by increased market competition, as well as by the environmental concerns, it is time for the introduction of a new level of energy-saving technologies, namely the transition to electronic valves supplying liquid refrigerant to the evaporators of display cabinets and cold rooms.

It is necessary to understand that the the electronic controller is the primary element that enables the stated level of savings. It is this component that is responsible for implementing the adaptive control algorithm.

The partnership between X5 Retail Group and Danfoss within this project is stipulated by the availability of unique controllers of adaptive algorithms developed by Danfoss to achieve maximum efficiency of system work.

What should be the control system of supplying refrigerant to the evaporators? On the one hand, the expansion valve should protect the compressor from the liquid refrigerant, that is, there must be some stable superheat at the outlet of the evaporator. On the other hand, in order to reduce energy consumption, superheat must be minimal. The amount of superheat determines the filling of the evaporator with a liquid refrigerant. The higher the superheat is, the less refrigerant will boil in the evaporator, respectively it brings to lower evaporation pressure, and therefore higher system power consumption.

That is, we can talk about the need to maintain a "minimum stable superheat" that, on the one hand, will protect the compressor, and on the other hand, will not bring to overconsumption of electricity.



Obviously, the magnitude of the minimum stable superheat will depend on the load on the evaporator. When the load increases, the boiling intensity of the refrigerant inside the evaporator increases, so the superheat setpoint should also increase to protect the compressor. When the load decreases, the superheat setpoint can be reduced to reduce energy consumption.

Results of pilot installations in X5 Retail Group stores demonstrated that AKV electronic valve by Danfoss in combination with adaptive superheat logic, can save up to 18% of energy consumption, at the system level. This algorithm is implemented in all Danfoss controllers designed to control evaporators with electronic expansion valves and is unique in the market today.



The results of pilot projects proved an acceptable payback time for investments in a new refrigeration automation system. But then came an issue of how to ensure a smooth transition from a mechanical valve solution to a new electronic system in case of several thousand new stores openings annually. Pyaterochka chain management had doubts the transition will be painless for businesses, given large number of refrigeration suppliers, installation and service organizations the employees of which are only accustomed to baseline systems. Problems were expected to occur with the opening of new stores on time and maintaining required temperature regimes due to possible errors in installation and system settings. That all could lead to losses due to product write-offs. Therefore, transition to a new system slowed down to provide certain smoothness.

Danfoss has launched a massive program to train installation and service organizations to minimize possible risks and address concerns of Pyaterochka chain management. The work was also conducted with manufacturers of refrigeration equipment - potential and current suppliers to the Pyaterochka chain. A detailed instruction on the installation and configuration of system elements was developed for manufacturers. We have also made sure that the requirements of this instruction are reflected in design, production, and support documentation produced by each manufacturer for their products. These preparations made it possible to move to the next stage i.e. transition of newly opened stores to an electronic expansion valve solution and a new control system.

The fact that first generation of the ADAP-KOOL® series evaporator management solution by Danfoss was introduced in 1987 - was an additional argument for reliability and safety of the system implementation. This was one of the first solutions in the refrigeration market to involve microprocessor control. Nowadays we offer a sixth-generation solution. Despite the complexity of algorithms, part of the ADAP-KOOL® philosophy has always been easy to install and configure. The user only has to choose system configuration and to adjust temperature setpoint (or choose the type of product in a cold storage room or display case). All other settings, including superheat and defrost control, are automatically made by the controller. This principle, together with energy-efficient adaptive algorithms, is fundamental to the model range of electronic components of the system from the time to date ADAP-KOOL®.

Danfoss specialists provided necessary technical support during assembly stage of equipment with new components and its further installation in Pyaterochka stores, the support included onsite training and consultation of engineering companies. We have also developed step-by-step instruction for installation and commissioning of the refrigeration management system in Pyaterochka store. It avoids unnecessary delays and provides on-time store opening, with proper quality of the works performed and in accordance with the Chain's technical assignment.



Ivan Borisov, Head of Technical Expertise and Audit, Pyaterochka, notes: "The project of transition to an electronic evaporator management system was developed most thoroughly, both economically and technically-wise. However, there have been certain concerns about roughness that are inevitable when switching

to a new solution especially on the scale of thousands of stores. It is worth noting that Danfoss, being our partner to this project, with its operational technical support and proactive response to problems helped us to provide seamless transition within a few months. Taking into consideration such good results we decided to include this solution into the Standard for new stores and it has been already purchasing since the middle of 2020. However we will not stop there and we proceed seeking new opportunities to optimize operating costs."

It should be noted that nowadays electronic refrigeration management systems implementing adaptive algorithms is the most affordable energy saving technology for optimization store operation, both in terms of technology and economics.

The best outcome could be achieved by combining adaptive algorithms with other energy efficiency technologies for the store, such as cooling system with natural refrigerant R744 (CO<sub>2</sub>), integration of cooling and heating systems, integrated management of engineering systems as well as remote monitoring and optimization based on data analysis.

M.V. Vysotsky, Director of Food Retail business unit  
M.Y. Katraev, Product Sponsor Electronics