

Case Study - Food Retail

The power of adaptive solutions - field tests in Ukraine

To prove the energy saving potential of adaptive technology, Danfoss performed test studies at two leading players in the Ukrainian convenience sector. The tests returned energy savings of up to 34 % when replacing conventional control solutions with adaptive technology.

Proving the advantages of adaptive solutions

Tough competition and a constant push to cut down on operational costs are the main drivers of the convenience market in Ukraine as in many other countries. In order to explore smart ways to bring down the energy consumption, two retailers – both leading players in the convenience sector – commissioned Danfoss to carry out in-store tests to analyze and document the energy saving potential of adaptive control solutions.

“The field tests in the Ukrainian c-stores clearly demonstrated the power of adaptive technologies for food retail refrigeration. By enabling the system to perform with the highest possible COP and the highest possible capacity of the evaporators according to varying load conditions, we recorded potential energy savings of up to 34 % in the stores. When you compare the potential savings with the relatively low investment costs required to enable adaptive refrigeration, you get pay-back times of only 2-3 years in a typical convenience store in Ukraine, says Sergiy Kolinchuk (FR Sales Engineer).

The test cases also revealed other low-hanging fruits for improving COP and for prolonging service-life of refrigeration equipment in the stores.

Test site 1

– Adaptive solution returns energy savings up to 34 %

Convenience store in Ukraine operated by one of the leading retailers in the country looking for cost-effective solutions in the daily operation of the c-stores.

- The purpose of the test was to provide reliable data about potential energy savings when replacing conventional thermostatic control with adaptive, self-learning technology to cold cases and powerpack.
- The test was performed on 6 MT cases and 2 semi-hermetic compressors with unloaders. Each case was fitted with conventional thermostatic expansion valves to measure the energy consumption of the non-adaptive solution; and with AKV valves and controllers to benchmark the energy savings with adaptive technology. The power pack was fitted with fixed and floating Pc control respectively.
- The energy consumption benchmark was performed during 12 days by switching between conventional mode and adaptive mode every 24 hours.
- The test ran for two periods, one during summer with average temperatures during the day above 30° C and the other during early fall with average day temperatures around 15-20°C.
- The tests returned average energy savings of up to 25 % during summer and up to 34 % during fall with adaptive control technology.



Date	Daily consumpt. kWh	Savings kWh	Savings %
25.08.2014	262.9		
26.08.2014	184.4	78.5	30%
27.08.2014	265.5		
28.08.2014	199.4	67.1	25%
29.08.2014	263.1		
30.08.2014	197	66.1	25%
31.08.2014	262.4		
01.09.2014	219.1	43.3	17%
02.09.2014	278.4		
03.09.2014	229.1	49.3	18%
04.09.2014	270.6		
05.09.2014	201.3	69.3	26%
06.09.2014	262.1		
07.09.2014	200.8	61.3	23%
08.09.2014	276.4		
09.09.2014	208.3	68.1	25%
10.09.2014	266.4		
11.09.2014	213.4	53	20%
12.09.2014	255.4		
13.09.2014	177.6	77.6	30%
14.09.2014	262.2		
15.09.2014	187.7	74.5	28%
16.09.2014	258.7		
17.09.2014	176.9	82.8	32%
Average savings			25%

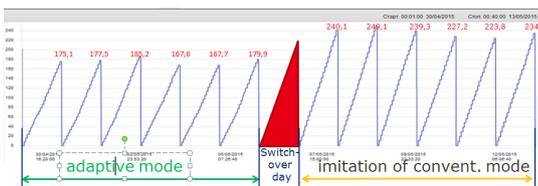
Date	Daily consumpt. kWh	Savings kWh	Savings %
21.09.2014	250		
22.09.2014	166	84	34%
23.09.2014	261		
24.09.2014	201	60	23%
25.09.2014	246		
26.09.2014	166	80	33%
27.09.2014	245		
28.09.2014	170	75	31%
29.09.2014	249		
30.09.2014	166	83	33%
01.10.2014	254		
02.10.2014	162	92	36%
03.10.2014	230		
04.10.2014	148	82	36%
05.10.2014	227		
06.10.2014	142	85	37%
07.10.2014	227		
08.10.2014	147	80	35%
09.10.2014	218		
10.10.2014	139	79	36%
11.10.2014	247		
12.10.2014	158	89	36%
13.10.2014	252		
14.10.2014	164	88	35%
Average savings			34%

Test site 2

– Adaptive solution returns energy savings of 25 %

- Convenience store in Ukraine operated by one of the leading players in the country's retail sector as part of a major review of sales technology and equipment.
- The purpose of the test was to uncover potential solutions to decrease operational costs even further by benchmarking high-end adaptive systems with conventional systems using thermostatic expansion valves.
- The test was performed on the same system equipped with AKV valves but operating in two modes: fully adaptive and imitation of traditional mode.
- The test comprised 15 MT cases and powerpack with two compressors; one MT cold room and one LT room with individual Compressor Unit and 10 LT case with built-in Compressor Unit.
- The test ran for six days with adaptive control and for six days with conventional control. The test took place in the month of May, which is representative for average temperature levels in a climate with large temperature fluctuations summer/winter, day/night.
- The test proved energy savings of 25 % with adaptive technology despite the fact that frequency converters contributed to decreasing on consumption in both modes
- When adding Frequency Converters (FC) to the compressors, the energy saving potential rose to 32-35 %.

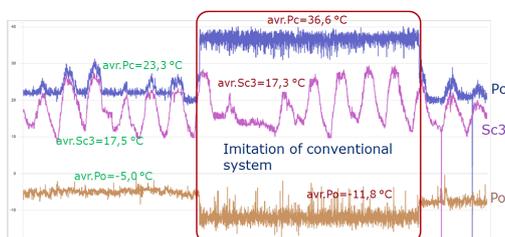
Average savings (1413-1053)/1413= 25%,
Outdoor temperature was equal (avr. 17,5 °C, min.9, max.30)



Improving evaporating temperature by 7° C

Other interesting findings emerged from test site 2. When operating in conventional mode, the Po (suction temperature) was close to minus 12° C, a much favored level in traditional systems to ensure that the cases are kept at an even, low temperature at all times regardless of ambient temperature and use. The adaptive mode kept the Po on just minus 5° C without compromising the temperature level of the cases.

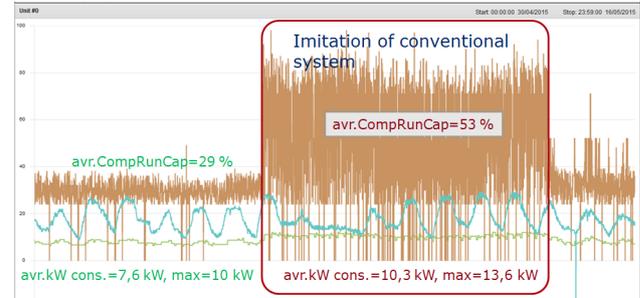
Other findings from the pilot: power pack operation



Longer service-life and less service costs

The test installation at site 2 also revealed a drastic reduction in compressor run capacity from 53 % in conventional mode to only 29 % in adaptive mode. This means significantly less running time and fewer starts/stops of the compressors. These factors result in longer life-time of the power pack and less service costs. Furthermore, adaptive technology combined with compressor FCs opens new possibilities to decrease the compressor size in the first place.

Other findings from the pilot: energy consumption



Conclusion

Test site 1

Average energy savings of 34 % in fall/winter, 25 % during summer Pay-back time of adaptive technology estimated at 2-3 years

	Conventional	Adaptive
Po	-12°C	-5°C
Pc	?	?
SH (Superheat)	12 K	7.5 K

Test site 2

Average energy savings of 25 %, up to 32-35 % if frequency converter installed on compressors Pay-back time of adaptive technology estimated at 2-3 years

	Conventional	Adaptive
Po	-11.8°C	-5° C
Pc	36.6° C	23.3° C
SH (Superheat)	?	5.5 K
SC3	17.3° C	17.5°C
Average compressor run capacity	53 %	29 %

“Our test installations in Ukraine have proved that when combining adaptive superheat control featured in Adap-Kool® controllers with suction pressure optimization and floating condensing pressure control you can achieve significant energy savings. The reduced energy consumption does not in any way compromise food safety, since high refrigeration performance is maintained during all load conditions is one of the main conclusions of the study”, says Sergiy Kolinchuk.