

Success Story



where

- Convenience Store in São Paulo, Brazil
Av. L. C. Berrini 123

what

- Heos DC waterloop technology to fit Express format needs
- Best in class variable speed compressors and electronic expansion valve technology for a next generation of self-contained cabinets
- Advanced monitoring system for data analysis and continuous performance improvements

why

- Energy Saving
- High quality food preservation
- Avoid in-store noise issue
- Refrigerant charge reduction
- Speed up commissioning phase

when

- May 2017

who

- Technology leader and designer: Eletrofrío

Heos sistema: Real comparison against a waterloop ON-OFF system

The latest convenience store opened on the financial sector of São Paulo, represents the state of the art for Energy Saving and Food Quality technology based on next generation of showcases working on a DC waterloop system.

The project has been realized with the aim to experience the benefits, mainly in terms of energy saving and food preservation, of new self-contained cabinets equipped with variable speed compressors technology. Another key point of Heos sistema is represented by the operational costs (OPEX) reduction, associated to the sustainable eco-friendly initiative of the retailer.

Along with the constant support of CAREL, the other player involved in the opening of this store was **Eletrofrío**: brazilian company based in the south of Brazil, has more than 70 years experience designing, assembling and installing refrigeration systems for commercial application.

Thanks to the close collaboration between CAREL and Eletrofrío, the results obtained include:

- **Energy saving of 39%** if compared to an on/off waterloop system.
- **Temperature stability which means higher food preservation and longer days shelf-life.** This is obtained by a system designed to modulate its capacity by controlling the refrigerant flow inside evaporator and wide variable speed compressor which almost never stops, always supplying the actual cooling load.
- **Evaporating temperature increased up to 8K** above standard solution, thanks to DC variable speed compressor. This technology allows to reduce the consumption by decreasing the compressor speed up to 16% of maximum speed.

Description of the systems

With the aim to compare different technologies, two different stores have been selected: a convenience store, which operates with Heos solution, and another standard store with the same format which is using an On/Off waterloop system.

The differences between the two technologies are stated in the next paragraph.

Each store has 7 stand-alone cabinets divided as Low Temperature (LT) and Medium Temperature (MT).

All the showcases are connected by a waterloop circuit, responsible to convey all the heat produced by each unit and to reject it outside the store by a simple dry-cooler, installed at the roof of the store.

The detailed description of the store's selling area is shown in the table below, identical for both systems.

Application	Cooling Capacity	Number	Type
MT	19,98 kW	5	Vertical 2,75m open
LT	3,84 kW	2	Vertical 2,35m with doors

Heos waterloop solution

The Heos Sistema solution applied to semi-plug-in cabinets uses stand-alone metal cases containing all refrigerant components that are placed at the top of the showcase, restricting the refrigerant pipes just between the unit and the evaporator coil placed inside the cabinet.

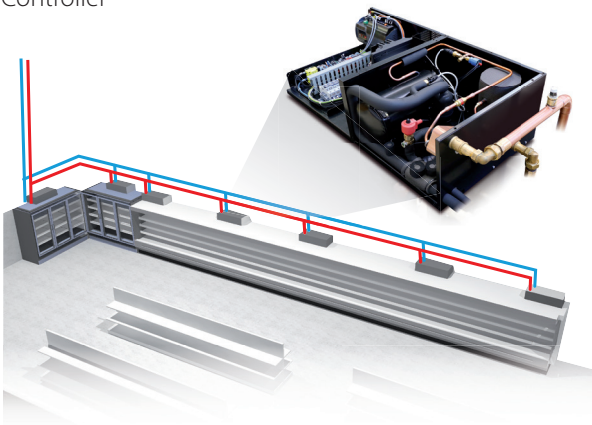
This pipe length reduction means both lower refrigerant charge and welding procedure. Therefore the possible refrigerant leakages will be minimized.

The showcase contains:

- Evaporator
- R410A as refrigerant for both (MT and LT) units.

The enclosure box contains:

- DC High Efficiency compressor
- Inverter
- Electronic Expansion Valve
- Plate Heat Exchanger as condenser
- Controller



Layout of the convenience store store in Sao Paulo

The water loops of the two systems are composed by:

- Dry-cooler with modulating fans
- On-Off centrifugal pumps (duty and standby)

Standard ON-OFF waterloop solution

Based on the traditional semi-plug-in cabinets project, most of the components are installed inside the cabinet and just the condenser (Plate Heat Exchanger) is placed at the top of the showcase inside a metal box.

The showcase contains:

- Standard Reciprocating On-Off hermetic compressor
- Liquid line solenoid valve
- Thermostatic Expansion Valve
- R404A as refrigerant for both (MT and LT) units

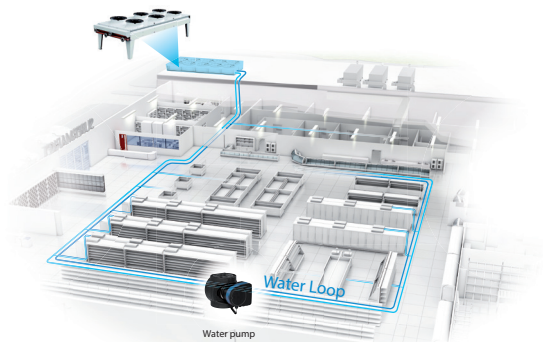
The metal box contains:

- Plate Heat Exchanger as condenser
- Controller



Components placement in the On-Off solution

- Dedicated PLC designed for water loop in Heos system and a parametric universal controller in the On-Off solution.



The advantages of the Heos Sistema pointed by the installer Eletrofrio are:

- Low noise emission
- Low power consumption in steady state operation (some cabinets up to 0,50 kW)
- Easy startup (all units comes pre-tested from factory)
- Temperature stability

Energy consumption comparison considerations

The two stores selected, furthermore the same size and cooling capacity, are placed at São Paulo city near each other, therefore external environmental conditions can be considered equal for both stores.

The measurements were done by collecting the energy consumption every week for the same time period.

The data acquired from the two stores was comparable and sub-divided in:

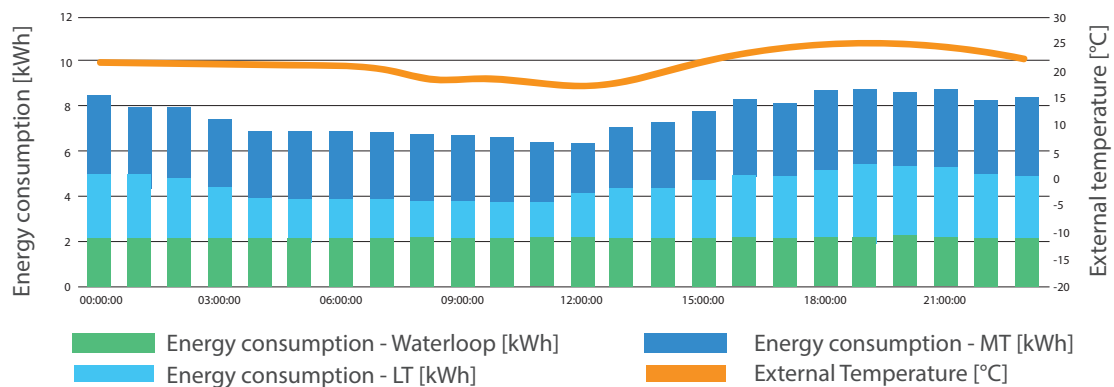
On/Off waterloop system	Heos sistema
Energy meter 1: Total MT, LT cabinets and waterloop	Energy meter 1: MT cabinets Energy meter 2: LT cabinets Energy meter 3: Waterloop (dry cooler, pumps)

The data acquisition process began in May 2017 and lasted one month: the results obtained between the two systems are stated in the table below.

Technology	Compressor type	Valve type	Number of days	Total consumption	Saving
ON/OFF	Reciprocating On-Off hermetic	TEV	30	9638 kWh	39%
Heos Sistema	Horizontal rotary Variable speed DC	EEV	30	5861 kWh	

Data collection is ongoing, in order to extend the benefit calculation across an entire year.

The graph below reports the average energy consumption of the data period acquired:



Self adaptative to external conditions

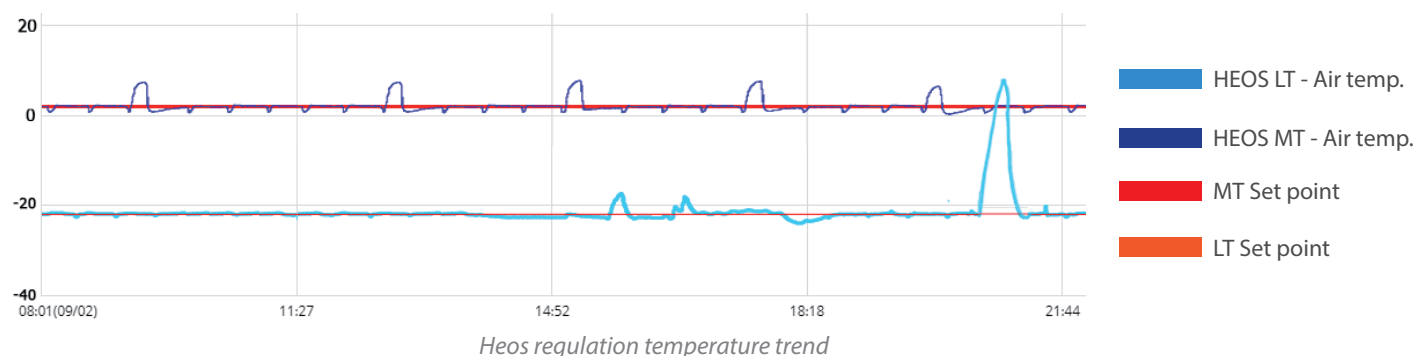
Electronic Expansion valve can take advantage of low external temperature during night or cold days, due to the fact that it can operate without a minimum condensing temperature, reducing the pressure ratio and increasing subcooling of the liquid that is feeding the evaporator in order to maximize the efficiency and therefore reduce the compressor speed and saving energy. Indeed in the other system, the thermostatic valve must maintain a minimum condensing pressure to assure the proper working of itself, wasting potential cooling capacity.



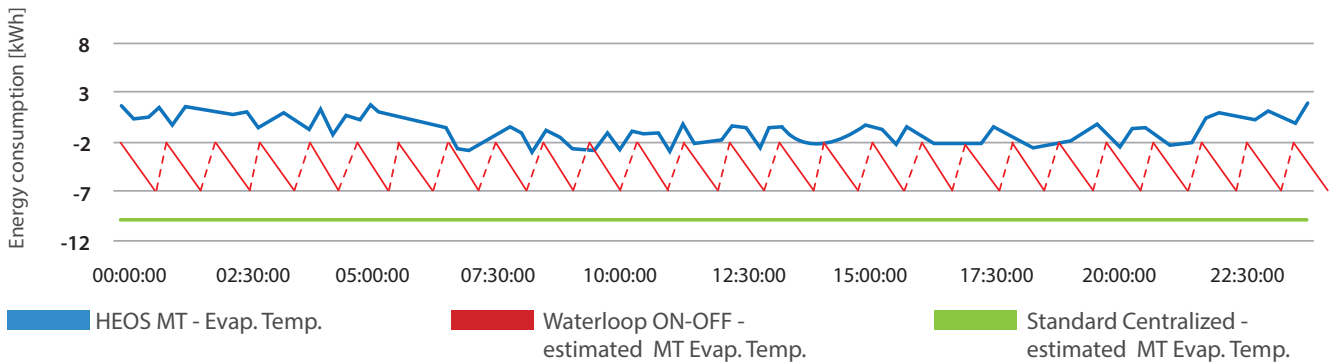
Temperature Stability

The fundamental concept behind Heos sistema is represented by the continuous modulation. Synergy between variable speed DC compressor and electronic expansion valve, managed through an advanced control, allows stable temperature control, thus ensuring maximum quality of food preservation.

An ON-OFF unit would not be able to keep a constant control temperature, rather this would fluctuate by several degrees.



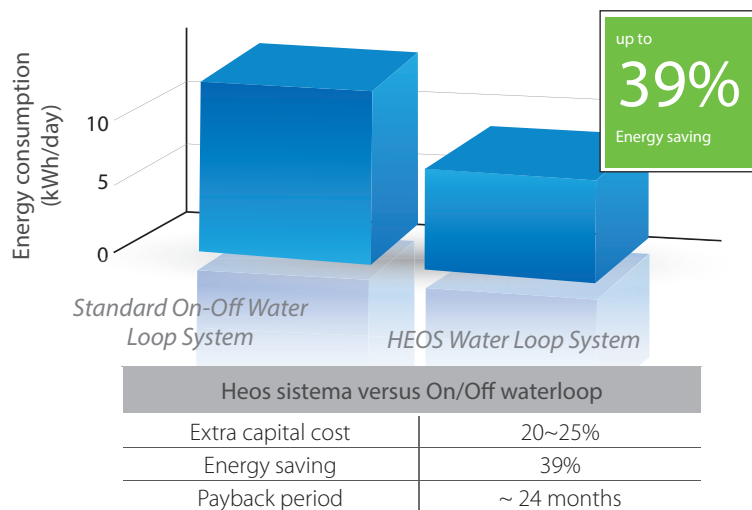
Everytime the unit is working in partial load condition, the evaporative temperature needed to produce the requested cooling load is higher than the nominal one, allowing to reduce the compressor consumption. An ON/OFF compressor is always working at its nominal condition, not allowing this saving. As a consequence of the continuous modulation provided by Heos sistema, the evaporation temperature increases and also the COP. This fact can be highlighted during night mode when the cooling load reduces, direct impacting on the evaporation temperature.



Evaporation temperature trend of the different technologies

Conclusions

All the on board technology applied to Heos, reflects directly on the energy consumption reduction if compared to the standard solution. The integration of all functions in a single controller, increases the capability to get the best efficiency of each part of the system maximizing the capacity and eliminating the inefficiency.



Innovative and Eco-friendly solutions, like Heos, alongside with CAREL and Eletrofrio as company's partners, support the retailer to reach their commitment with sustainability, one of their main pillars. The first retail store to have this kind of technology is a milestone in the fight against natural resources waste. CAREL shares the same principle and it recognizes environmental issues as a high corporate priority, collaborating to preserve the planet's biodiversity.

As a recognition per all achievements, the XX FEBRAVA of 2017 technical judge commission in partnership with ABRAVA (Brazilian Refrigeration Association), gives the "Selo Inovação" mark to Heos Sistema. This award is given to solutions that promote creativity and innovation.

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