“How to consume less and better!”

TRL 9

Main NEBs (other benefits)

Lower greenhouse gas emissions
Longer equipment life
Lower maintenance costs
Lower operational costs

Control strategies for oversized cooling systems

Some cooling systems could prove to be oversized for several reasons: for instance, they could have been designed considering an eventual future extension or evaluating different cooling loads, that have changed during the years. Moreover, mainly in the past, bigger machines were more reliable and efficient thus were preferred instead of several smaller machines. This aspect can represent a challenge in the load control of the system, mostly in case it is old and do not have an updated control strategy or there isn’t a thermal storage, etc.

There can be, in fact, several control strategies that is possible to evaluate in case it is necessary to change the cooling system, both for technical reasons and for regulatory updates. The need to change the refrigerant, for example, could offer the opportunity to consider also a different approach, for instance less oversized machine, several smaller machines, variable speed machines, etc

Description of the possible technologies

Traditionally, an oversized cooling system, operates at partial load via an on/off strategy, that is surely not expensive to set up, but can cause problems during transient periods, in which, generally, machines work with lower performances, moreover on/off cycles tend to be more wearing. In addition, in many cases machines designed or adapted to operate at partial load can have at partial load a higher efficiency than at full load.

There are different approaches to solve or at least attenuate the on/off strategy problems.
First of all, it could be interesting to consider a thermal (cold) storage. This could allow the system to work at its best condition (100% load) and use the storage to adapt the load

demand of the circuit. Another opportunity could be using a Variable Speed Drive (VSD), that gives the chance to better operate at partial loads and reduce the starting stress of the motor.
Another way is to make a mechanical partialisation, excluding one or more cylinders for reciprocating compressors or using a slide valve for screw compressors: both these opportunities have the aim to mechanically reduce the load by lowering the refrigerant flow in the compressor, but it isn't much efficient.
Another opportunity could be using more smaller compressors in parallel so that they can be turned off if required, eventually only one with VSD.
Finally, another opportunity, could be using a by-pass valve after the compressor, thus reducing the refrigerant circulating in the circuit.

Benefits

A well-designed control strategy, together with the energy savings can offer different benefits, such as:

- Reduced operational costs
- Reduced maintenance costs
- (in some cases) Risen reliability.

Overview of the possible approaches

	System	How it works	Advantages	Possible disadvantages
Load shift	***Cold Storage***	*Cold storage to buffer the required load*	*Reduction of on/off cycling*	*It is necessary to carefully design the circuit to avoid cold over production.*
Electric	***On/off***	*Turn on and turn off the compressor*	*Simple and cheap, just a thermostat needed*	*Ambient (or fluid) temperature is never constant. Frequent transient periods in which the compressor performances are low. Higher stress of the machine.*
	VSD	*Variable speed drive*	*Reduction of on/off regulation, good performances at partial loads, lower stress for the machine*	*If the engine speed is too low there can be problems for the lubrication*
Mechanical	***Cylinders closure***	*On reciprocating compressors, one or more cylinders can be excluded*	*More power levels with just one compressor*	*The pistons not compressing the gas are still active, this means that the energy saving is not directly related to the lowering of cooling power*
	Slide Valve	*On screw compressors, it is possible to put a slide valve that generates a gas recirculation*	*Having more power levels with just one compressor*	*The energy saving is not directly related to the lowering of cooling power*
On the refrigerating system	***Compressors in parallel***	*More compressors are used: some of them can be turned off*	*Consolidated system in the refrigeration sector. Good performances at partial loads. Higher reliability due to redundancy*	*More Expensive*
	By-pass valve	*A by-pass is inserted to leak a certain quantity of gas after the compressor to lower the flow inside the circuit*	*Continuous load variation from 100% to 50%*	*The specific consumption increases since the gas flow is constant, while reducing the load: it is necessary to carefully design the circuit.*

BEST PRACTICES – REFRIGERATION SYSTEM
FACTSHEET

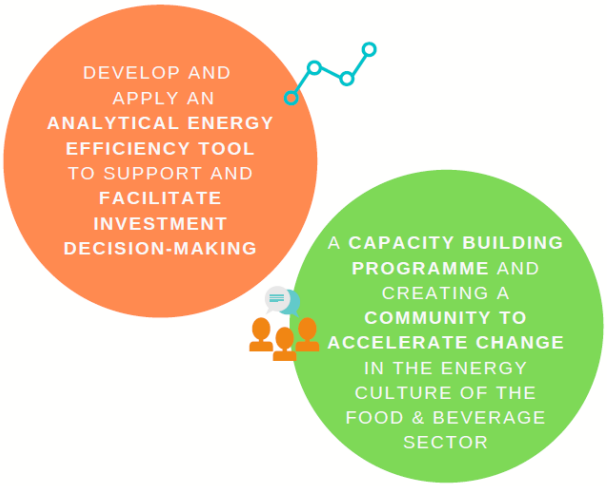
ICCEE
Improving Cold Chain Energy Efficiency in food and beverage sector

About ICCEE

The project ICCEE, **www.iccee.eu**, funded by the EU programme Horizon 2020, aims at improving energy efficiency in the cold chain of the food & beverage sector and making it easier for the sector to:

- undertake energy efficiency measures across the entire supply chain and
- accelerate the implementation of energy audit results.

ICCEE follows a holistic approach that moves from a single company perspective to the assessment of the entire cold supply chain. Existing financing schemes for SMEs will be assessed: the optimal ones will support the implementation of energy efficiency measures. ICCEE objectives build on 2 pillars:



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