Solstice® ze (HFO1234ze)

Process Innovation: New generation cooling fluid drives heat recovery in food processing

Honeywell

clauger

Solutions designer in Refrigeration & Process air

Moving to a greener future.

"Our focus is always on how to improve production technology to make processing more efficient and more economical…with the lowest environmental impact"

Sylvain Noel, Clauger

In the food industry, heat recovery linked to refrigeration systems is a key element in delivering hot water at temperatures that enable vegetables to be processed. However, there is a limit on the temperature that can be achieved through condensing and desuperheating via compressors – typically around 35°C. The process requires much hotter water, so processing typically involves ammonia-based refrigerants capable of supporting heat recovery system temperatures reaching 80°C. But desired water temperature is 97°C (minimum 100°C of condensing temperature) and ammonia (NH_3) cannot reach temperatures above 80°C of water temperature, while CO_2 does not have enough efficiency at positive, high temperatures.

These challenging needs prompted leading industrial process refrigeration company Clauger to enlist the support of Honeywell and its new generation, low GWP (Global Warming Potential) refrigerant Solstice® ze. Using Solstice ze Refrigerant, Clauger has designed a heat recovery system capable of both processing foodstuffs at the required temperature and rapidly cooling products through chilled water. The technology has been developed for a high end food processing company with a focus on achieving vegetables with the best quality smell, flavour, texture and preservation.

It is an innovation that has delivered impressive results at a prototype stage:

- Good overall Coefficient of Performance (COP), resulting in excellent efficiency
- Single process solution offering simultaneous hot (98°C) and chilled (2°C) solutions
- 100% non-ozone depleting refrigerant with a GWP of <1

Background: Where process efficiency meets environmental responsibility

Clauger specialises in developing refrigeration and process air conditioning applications for a wide range of industrial sectors, including food, pharmaceuticals, cosmetics, electronics and chemicals and works with 3,000 customers in more than 90 countries.

Most process sites possess sources of heat energy (waste water treatment, CIP – Cleaning In Place –, air compressors, refrigeration machine rooms, extraction systems etc.) that can be harnessed to generate high temperature water at a lower cost than conventional boilers. In food processing, factories have traditionally operated ammonia-based refrigeration systems as the basis for heat recovery to provide hot water.

However, with the incoming F-Gas rules setting the basis for the responsible use of lower GWP refrigerants, and with ammonia's limitation to reach temperatures above 80°C, Clauger decided to explore a new approach for a customer using boilers to heat water for food processing and chillers to cool the products to the required temperature. Working with EDF, Clauger designed a prototype heat recovery system using the refrigerant R245fa. This system was laboratory tested and achieved good results….but in the search for an even lower GWP, more sustainable fluid, Clauger decided that a new refrigerant was needed.

From this start point, the company participated in a wider partnership, involving the end user plus Honeywell (and its Solstice ze technology), L'Ecole des Mines de Paris and Total – Ademe, to build a second prototype machine. The aim was to develop a machine that was not only capable of delivering hot water at 97°C but could also immediate cool the product down to 2°C using chilled water. This second machine would be assessed against key criteria, including environmental performance, process effectiveness and pay-back linked to energy efficiency.

Field & Laboratory Test: Implementation and Results

The second prototype was scaled 1:10 in order to validate system functionality and performance in the field.

Honeywell's Solstice® ze material was chosen for the following reasons:

- It is a one-component gas
- It possesses a low GWP (<1)
- It is a safe fluid for use in this application
- It exhibits excellent thermodynamic properties at low pressure

The system designed by Clauger for the prototype uses a pair of semi-hermetic reciprocating compressors (Bitzer (66F 100.2Y)) operating independently on the same circuit, with electronic oil management. Across the range 3/53°C the compressor COP is 3.54.

The second stage (BPHX pinch=5°C) involves two tandems of hermetic scroll compressors (Bitzer GDS80485VA range), with active oil management, operating over a 35-65Hz frequency range with variable speed.

This design means that Clauger is able to exploit the variable RPM capability of each tandem. At 48/100°C, the compressor COP is 3.28 and the maximum discharge temperature is 112°C.

Refrigeration power	150 kW
Fluid	HFO1234ze
Water inlet	+2°C
Heating power	200 kW
Water outlet	+97°C
COP	Hot: 2.8 / Cold: 2.6
ROI	2.5 Years

The machine was set up on a sample process line for constant monitoring by the customer against a series of specified parameters. After some months of testing, the results matched the requirements.

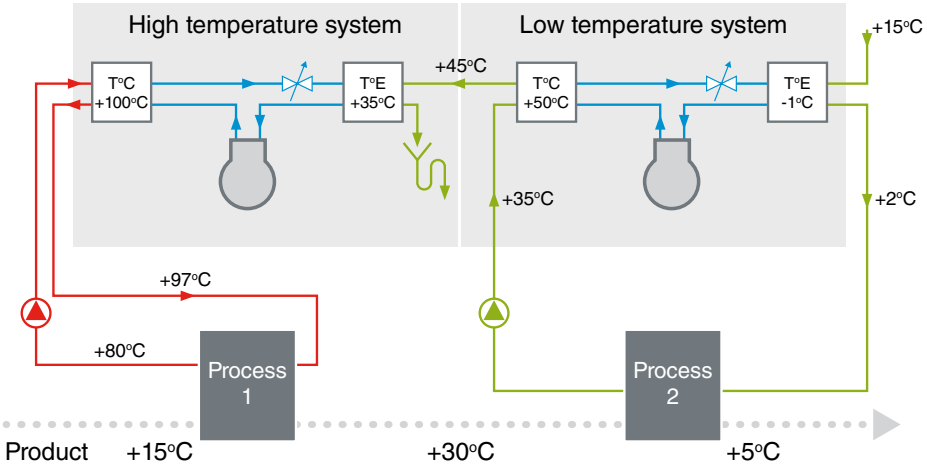
After further assessment by the cluster of companies, a full sized machine will be built and installed on one of the customer's existing process lines. This will enable the end user to apply the technology more widely across the company's operations.

Scale up to the 1/1 size will mean going from current charge of 4kg for the positive temperatures and 10kg for the negative size to a total of around 30kg for the 400kW.

Feedback: A Positive Result for Low GWP Technology

"If the on-going trial is successful, we plan to roll-out similar technology across many of our plants around the world. The system offers both the performance levels we need and low environmental impact." *Customer spokesperson.*

"Solstice ze offers a pathway for the future for this type of technology and for hitting the 80°C limit, combining performance within agreed specifications together with very low GWP." *Clauger spokesperson.*



Sector Perspective: Processing a low GWP industry

There are considerable environmental and operational benefits associated with adopting Solstice® ze as a sustainable approach to food processing. The Honeywell refrigerant is an important enabler for efficient heat recovery operations in industrial sites, enabling energy to be harvested and applied to hot water applications.

With the success of this prototype, it is anticipated that many other similar applications will benefit from the design innovations linked to the use of Solstice ze.

Solstice ze is 100% non-ozone depleting and meets the criteria that are most important to refrigerants customers: Performance, Cost Effectiveness, Environmental Impact and Safety. It also benefits from low toxicity (ASHRAE class A) and is non-flammable at ambient temperature (ASHRAE class 2L). It is significantly safer in use than alternatives such as hydrocarbons and ammonia, which are either extremely flammable or highly toxic.

For more information on Solstice ze **www.honeywell-refrigerants.com/europe**

F-Gas ready

Solstice® ze (HFO1234ze) is not considered a fluorinated greenhouse gas and thus is not subject to the phase-down scheme from the F-Gas Regulation in the European Union.

It is widely available and can be used without an end date.

Solstice® ze
Refrigerant
F-Gas Ready
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More information

Download the free software from Honeywell Genetron Properties Suite at:
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