

HARNESSING WATER FOR COOLING

Accelerate Europe takes a look at three innovative companies employing water as a refrigerant in centrifugal, evaporative and absorption cooling for air-conditioning and refrigeration purposes.

– By Charlotte McLaughlin

Water (referred to as R718 as a refrigerant) is one of the earliest providers of cooling. Harnessed in the form of snow and ice since 1,000 B.C., it was first used to preserve food by the Persians in around 400 B.C. when they started putting ice in a pit called a Yakhchal (a primitive type of evaporative cooler).

Since these early beginnings water – which is readily available, odourless, colourless, non-toxic and non-flammable, and has zero ozone-depleting potential (ODP) and zero global warming potential (GWP) – has been little thought about as a cooling technology.

This is changing as three innovative companies, solely focused on water as a refrigerant, are employing very different technologies to use water for air-conditioning and refrigeration purposes – heralding a return to this most natural of natural refrigerants.

THE CENTRIFUGAL WATER-CHILLER

German company Efficient Energy has been winning awards for its eChiller, which employs a centrifugal system.

In 2016 it won a German Refrigeration Award and in 2017 it won two awards – one from the Future Thinking Data Center conference and the other from the company Partslife.

The eChiller uses a turbo motor to evaporate and condense water in a vacuum to provide cooling and reject waste efficiently, according to Jürgen Süß, CEO of Efficient Energy.

Its COP is four times higher than an R410A system, offering electricity savings of 50,000 kWh, electricity cost reductions of €7,000 and emissions reductions of 31 tonnes CO₂e, as demonstrated over the course of 2015 in a data centre application: namely the server cooling racks, says Süß.

Field tests have also shown that it provides 35 kW refrigeration capacity even in warm ambient conditions – and is therefore capable of providing year-round cooling.

Production costs are also low. Most of the components can be made of plastic due to the low pressures that are used by the machine, according to Süß. Low pressures of 10 to 100 mbar mean they “don’t have to comply with pressure regulations,” Süß says, making the units safe and economical to produce.

The eChiller has been commercially available since the last quarter of 2017, following a test phase. It has primarily

been installed in data centres, but also in plastic modelling, the chemical industry and the car industry.

"One project was to cool a building," Süß told *Accelerate Europe*. Efficient Energy is seeing more market success as word gets out about the chiller. "They tell their colleagues what we have been able to achieve, and they contact us," he says.

"We are now doing three to five projects a month," he adds. This year Efficient Energy is hoping to install between 75 and 100 of the chillers. "It will be a three-digit number by the end of the year," he believes.

SOLAR COOLING YOUR HOME, YOUR NEIGHBOURHOOD

Purix, established in 2011 in Denmark and with an Italian subsidiary in Bari, offers a conventional absorption cooling system with a difference. The big difference is that it is hooked up to a solar heating system to provide renewable energy.

The units are a plug 'n' play modular system design, meaning they can be stacked together in a system for higher capacities. They can deliver cooling capacities from 2.5 kW right up to 160 kW, using water as the refrigerant.

The company is mainly targeting the residential and district cooling sector with this technology, seeing potential in its ability to replace traditional air-conditioning technology. "The largest market segment for air conditioning is systems with low cooling capacities below 10kW. Global cooling demand is growing fast, and we can see great market potential," Lars Munkøe, co-founder and director at Purix Aps, told *Accelerate Europe*.

Compared to a traditional HFC-based direct expansion split air-conditioning system with an A class EU energy rating, the Purix system was found to deliver an 85% reduction in CO₂ emissions and electricity consumption, according to Munkøe.

For Munkøe, in countries that have experienced power outages from high air-conditioning use like Australia, "it's a matter of whether you have cooling or not".

The attachment of a solar generation system negates the need for electricity. "I don't think you can go anywhere and buy a solar absorption system," he says. Absorption cooling and solar generation can be integrated but are usually sold separately, he says, meaning consumers are responsible for choosing the most environmentally friendly and stable option.

The system can also be hooked up to an existing solar heating system, a gas boiler or a district heating network. "There is high potential with district heating networks," says Munkøe, "where the heat is not used during the summer months".

This type of system would be well suited to Italy's warm summer climate, he believes. According to trade body Euroheat & Power, the southern European country has 303 district heating systems, which could use the heat that does not need to be produced in the summer months for cooling instead.

The product also is able to cope with warm ambient temperatures. "Italy is very far south and we have a factory there," Munkøe says. The company also believes this technology could be employed in data centres.

Munkøe predicts strong growth for the company. "Annual growth will be 50% in 2018," he says.

EVAPORATING THE HEAT AWAY

HVAC firm Oxycom can evaporate one cubic metre of water to deliver almost 700 kWh of cooling. In a power plant, for example, the same amount of water is used to generate just 50 kWh of electricity, according to Oxycom – which conventional split air-conditioning systems can convert to no more than 150 kWh of cooling.

The Dutch company uses evaporative technology to recirculate water to pre-cool the ambient air. As no humidity is added, the air leaving the heat exchanger has a lower dry bulb and wet bulb temperature than the outside air.

BELOW
Efficient Energy's
water chiller.

"Over the past 10 years we have developed indirect evaporative cooling with the main goal of being as good as traditional air conditioning but saving 90% energy, and we managed," Hans Reinders, CEO of Oxycom, told *Accelerate Europe* at Mostra Convegno Expocomfort in Milan, Italy in March 2018.

The company typically installs the system in building environments and in pre-condensing cooling chillers to increase the efficiency of chiller systems. "We make chillers just 30-40% more efficient," Reinders says.

The inter-cool system works like traditional air conditioning, he says, explaining: "The unit filters the air, the

unit heats the air, the unit cools the air, and all that with 80-90% savings."

The company has made installations in the United Arab Emirates (UAE) and Saudi Arabia as well as in its home market of the Netherlands.

"Mostly we have installed them in industrial spaces, in warehouses and in production places, where there are lots of people. We all know that indoor air quality is very important," Reinders says. "We know that if we can create quality indoor air in a production environment, then you can get 5-10% more performance of your people, you get 30% less sickness, and all that due to the simple fact that you have clean air."

Reinders argues that heating and cooling with evaporative technology can help homeowners to save on their air-conditioning and heating bills.

"A typical Dutch home uses 150 euros per month in gas and electricity," he argues. "If we can bring that down to 75 euros, we would save a lot on CO₂ and energy costs for a home."

All these different companies using water as a refrigerant are showing that R718-based technology is a viable energy-efficient solution for cooling that does not have to contend with some of the problems facing other refrigerants. ■ CM

