FREE COOLING: BREAK FREE FROM THE COST OF PROCESS COOLING

ics cool energy

INTRODUCTION

Given the intrinsically process-heavy nature of the UK's industrial manufacturing, process cooling is one of the biggest costs incurred. For many industrial end-users, process cooling is achieved solely via an air or water-cooled chiller or cooling tower.

However, all industrial applications with a water leaving temperature of 10°C or more – regardless of sector – can start to be cooled via the external ambient air temperature, rather than by electro-mechanical refrigeration, thanks to a process known as free cooling.

WHAT IS FREE COOLING?

In its purest form, free cooling works by the unit – usually either a free cooler working in series with a chiller, or a chiller with a built-in free cooling coil – detecting the ambient air temperature and process return temperature.

When the ambient air temperature drops below the process fluid return temperature, a 3-way diverting valve diverts the returning process fluid through the free cooling coil. Here, the cooler ambient air removes some of the process heat, and subsequently cools the returning fluid.

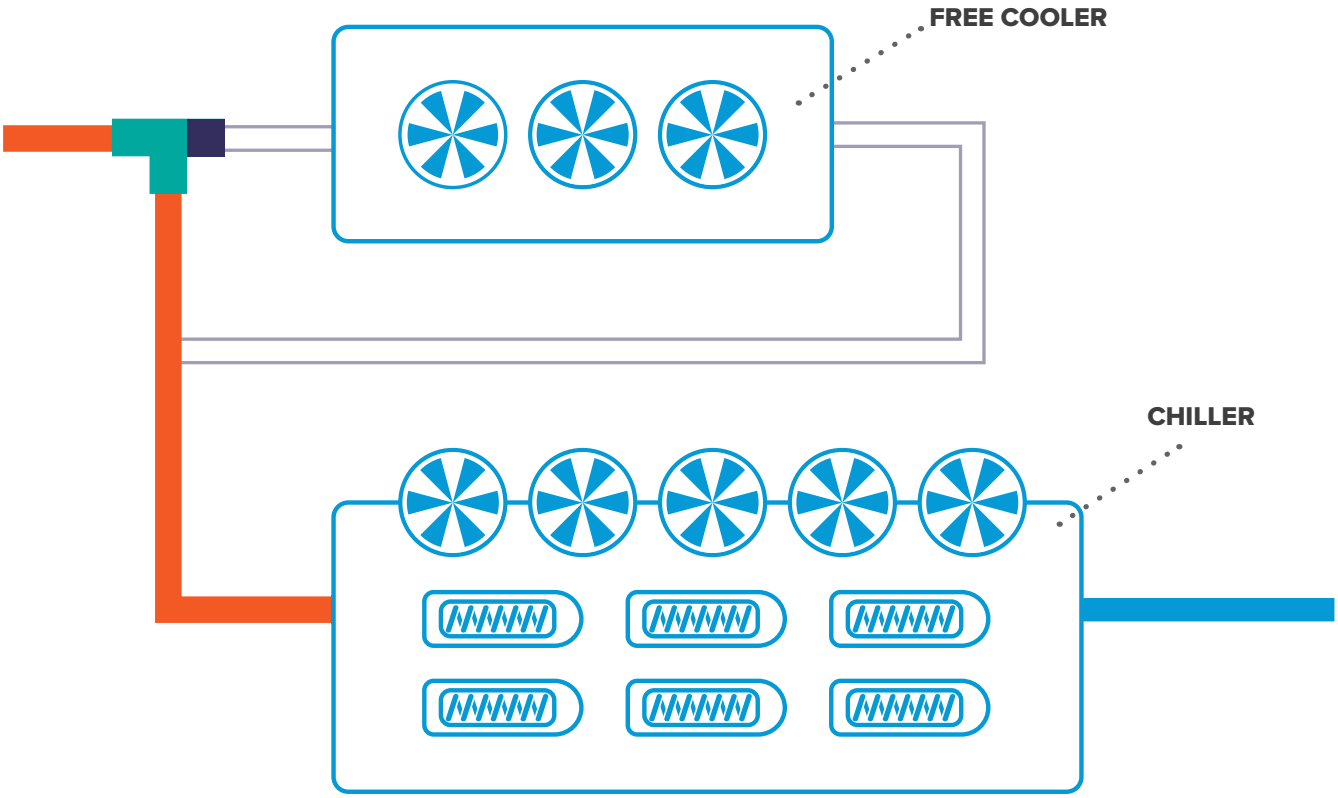
As the ambient air temperature continues to fall, the amount of heat taken out of the process fluid by the air increases, progressively reducing the load on the chiller until all of the process heat is taken by the ambient air in the free cooling unit. The process fluid is therefore being cooled just by the power used for the fans, rather than by using a compressor, which is traditionally the most energy-intensive element of a chiller.

> **Ultimately, free cooling is fast, effective and economical; and can result in process cooling energy savings of up to 80%.**

HOW FREE COOLING WORKS

> Partial free cooling can be achieved as soon as the ambient air temperature is 1°C below the process return temperature; while full free cooling can be achieved when the ambient air temperature is around 5°C below the process supply fluid temperature.

The UK's ambient air temperature is low enough to achieve at least partial free cooling for the majority of the year, with average monthly temperatures exceeding 13°C for just three months (June to August) in 2017.



TYPES OF FREE COOLING

> Free cooling can be achieved in one of two ways, either as a standalone unit where the chiller works in series with an independent free cooling unit, or by integrating a free cooling coil into an existing chiller installation.

STANDALONE

A standalone free cooling system sees an independent free cooling unit working alongside an electro-mechanical chiller.

As the system comprises of at least two units, it requires greater amount of space given the footprint of the equipment, and the subsequent need to allow air to circulate around the units.

However, the increased footprint means a larger surface area, which can allow better part loading to be achieved – akin to an 80% saving on running costs a year. What's more, standalone free cooling systems have the capacity to provide 100% free cooling at a higher ambient air temperature than integrated free cooling chillers.

From a cap-ex perspective, a standalone free cooling system can work alongside an existing chiller. As such, start-up costs can be lower as the original chiller can remain in service, while additional equipment may be eligible for funding through schemes such as the Carbon Trust's Green Business Fund.

INTEGRATED FREE COOLING

Integrated free cooling units are a viable option for sites which may not have the available floorspace to accommodate standalone units.

It is ideal for high capacity systems with limited available footprint, as a standalone system on that scale would require significant floorspace to accommodate the necessary equipment.

However, for an integrated system to achieve 100% free cooling, the ambient air temperature needs to be lower; usually in the region of 2°C, compared 5°C for standalone systems.

WHY FREE COOLING SHOULD BE USED?

THE KIGALI AGREEMENT

While you'd be forgiven for not knowing – or even having heard of the Kigali Agreement – it is set to shape the industrial cooling landscape over the years to come. While it can make for some uncomfortable reading for those not fully-prepared, free cooling is an accessible way for end-users to meet its requirements and reduce their environmental impact.

In short, the Kigali Agreement was a 2016 amendment to the Montreal Protocol, which marked a global commitment to a concentrated phase-out of hydrofluorocarbons (HFCs) from 2019 to 2050. HFC refrigerants with a high global warming potential (GWP), have been widely used as part of industrial cooling applications over the last two decades. However, they represent a significant environmental threat.

While the EU phase-out has been underway since 2011, further cut-off dates are on the horizon, with the next due in 2022. As a 'developed country', the UK has committed to reducing its HFC usage by 85% between 2019 and 2036; and it would not be a surprise to see the production costs – and therefore cost purchase price – of high GWP refrigerant gases continue to rise as a consequence.

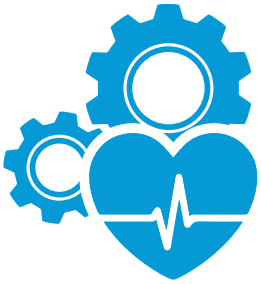
The Kigali Agreement will effectively force end-users to use 'greener' alternatives to ensure compliance. Aside from using more environmentally-friendly lower GWP alternative refrigerants, such as R1234ze or R531A; embracing free cooling is a tangible way for end-users to help protect the environment, future-proof themselves against any further legislative tightening, and avoid the financial penalties linked to breaching the Montreal Treaty.

REDUCTION IN ENERGY BILLS

One of the stand-out benefits of a free cooling system is the sheer amount of energy – and therefore utility bills – it can save.

While free cooling can bring about a reduction in energy consumption for any process cooling application with a water leaving temperature of 10°C or more, it should be particularly attractive to larger manufacturers, such as those working in the chemical and pharmaceutical sectors. Here, utility bills could easily be in the region of £1m+ per annum.

Given the scale of such costs, any saving on process cooling costs is likely to equate to tens of thousands of pounds a year compared to a system which relies 100% on electro-mechanical cooling.



LOWER LIFECYCLE COSTS

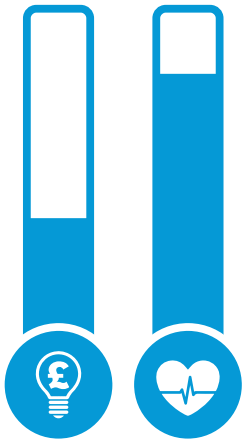
While a free cooling system will still require electro-mechanical power – and therefore cost – to operate the fans and pumps in a system to circulate the heat transfer fluid, the major energy savings are made when the ambient air temperature is low enough to bypass at least one of the chiller's compressors.

Further costs can be saved due to the reduced load on the chiller – particularly the compressors and fans – as they are not worked as hard, or at all in some cases. As such, maintenance costs can be lower over the lifetime of the system.

From a health and safety point of view, unlike cooling towers, free cooling systems pose no risk of legionella and therefore do not require additional water treatment costs beyond the norm to mitigate the risk of an outbreak.

LIMITING FACTORS

> While the benefits of free cooling are relatively clear cut, it is important to address some of the factors which are likely to have limited its adoption to date.



Lack of awareness is perhaps the biggest reason as to why free cooling is not as widespread as it should be. While many industrial end-users are conscious of areas that can be targeted for energy savings – industrial lighting being a typical example – process cooling and the cost-saving potential it can offer is often overlooked, as people believe the only way to generate cooling is via a chiller or a cooling tower.

The cap-ex cost for new equipment is another issue, particularly for SME manufacturers who do not possess the same financial muscle in their facilities and maintenance budget as larger companies or multi-national organisations.

An SME-specific scheme which can also improve access to energy-saving equipment such as free cooling systems, is the Carbon Trust's Green Business Fund. Aimed at those SMEs with an annual energy spend in excess of £50,000, the fund allows relevant businesses to apply for up to £5,000 worth of grant funding to contribute towards the capital cost of the equipment.

Another option open to end-users who are not in a position to purchase free cooling equipment outright, is to consider hiring a system during the cooler months of the year. Short and long-term packages are widely available, many of which – including those from ICS Cool Energy – encompass installation, commissioning and on-going maintenance within a single monthly fee. The cost of hiring the equipment can quickly be off-set by the energy savings made by using a free cooling system. Additionally, short-term hire packages can also prove to be a viable contingency option if any existing free cooling equipment breaks down or requires significant downtime for remedial work to take place. It can often be delivered to site and be up-and running within 24 hours, limiting the impact on business-critical cooling applications.

FINAL THOUGHTS

In short, free cooling can be used to support nearly any process cooling system which has a water leaving temperature of 10°C or more - and often even lower, in some applications. While many are yet to take advantage, either through lack of awareness or scepticism about whether or not it can deliver on its promise, the fact of the matter is that free cooling provides a tangible and accessible way for industrial end-users to make significant utility savings, almost instantly.

With the process cooling industry set to find itself under further scrutiny as the next phase of the Montreal Treaty comes into force, traditional refrigerant gases – and the equipment which uses them – will become more and more expensive to run. As such, the pressure will be on to find 'greener' alternatives to facilitate process cooling. Low-GWP refrigerants are one solution, but with the UK's cool climate offering amenable ambient air temperatures for the majority of the year, free cooling is well placed to offer a long-lasting, sustainable and cost-effective solution, that can deliver consistent energy savings for many years to come.

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