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FEATURE
Secondary refrigerant loops

Crackin' the ton

A LOOK BACK AS WE BRING UP 100

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IN THE LOOP

Salt-based solutions like potassium formate (pictured) could represent the next evolution in secondary heat-transfer liquids.

Secondary refrigerant loops are becoming more important as refrigeration systems grow in complexity and the use of ammonia/CO_2 becomes more common across a wider range of applications. However, as ***Sean McGowan*** *discovered, there is more to a secondary refrigerant than meets the eye.*

As we detailed in last month's issue of HVAC&R Nation, concerns about the rate of emissions and impact on global warming by hydrofluorocarbons (HFCs) has brought about a phase-down that will begin in Australia next year.

It follows the previous phase-out of ozone-depleting chlorofluorocarbons (CFCs) and the current phase-out of hydrochlorofluorocarbons (HCFCs).

Such moves have already pushed the HVAC&R industry to adopt alternatives. With natural refrigerants such as ammonia and CO_2 becoming more commonplace, fourth-generation refrigerants and HFOs are also becoming part of the future mix.

However, these alternatives present a challenge to the industry.

"We are moving to a future where refrigerants will have more challenges associated with them, including higher levels of toxicity and flammability," says A-Gas Australia's commercial manager Graeme Dewerson, M.AIRAH.

To manage the extra risk, there is a trend towards centralising the primary plant while adopting a heat transfer fluid in a secondary loop to remove heat from the process.

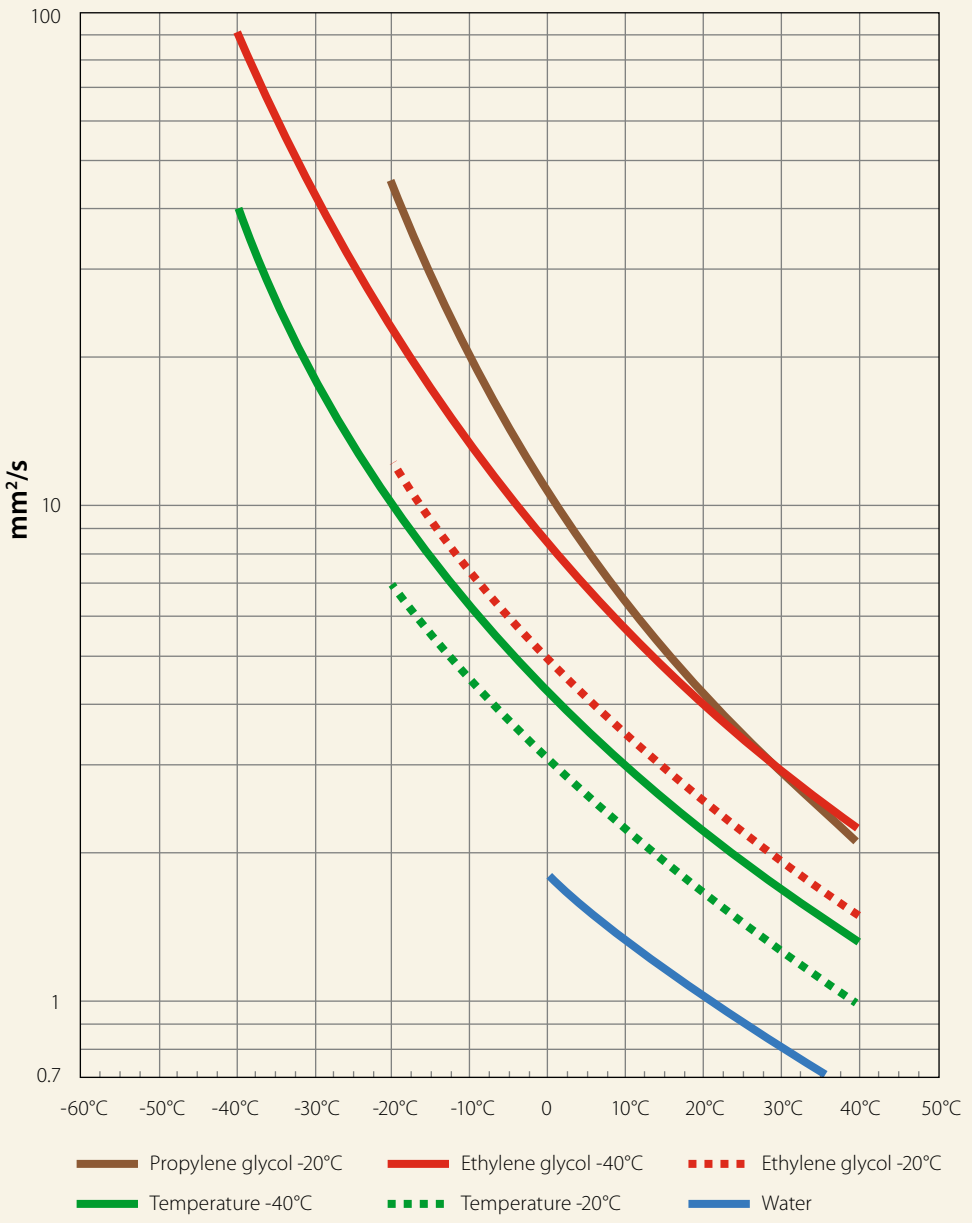
"As refrigerants come with higher pressures, more toxicity and more flammability, keeping the system away from people is going to become more important," says Dewerson.

We need only look at the use of ammonia, which continues to be a mainstay of process cooling, and the role secondary loops play in delivering energy-efficient cooling while isolating the dangers posed by fluid to the plantroom.

Although the secondary heat-transfer fluid (or secondary refrigerant) is one of the least expensive components of the system, its role is critical to the overall refrigeration system operating both effectively and efficiently.

So, as the industry looks to reduce the energy consumption of associated pumps and heat

KINEMATIC VISCOSITY OF SECONDARY HEAT TRANSFER FLUIDS



A kinematic viscosity comparison between salt-based fluid (Temper) and glycol.

Source: A-Gas and Temper Technology

exchangers, heat-transfer fluids are receiving much greater attention.

And not surprisingly, there are a number of options available.

GOOD OL' GLYCOL

Glycol has long been the standard go-to product for secondary refrigeration loops.

While in its raw form, glycol can cause metals to corrode. The addition of a chemical inhibitor means this can be prevented, making it suitable for use as a heat-transfer liquid.

"Glycol has become a very successful product," says Dewerson. "You can put it into a system and leave it for many years, and you won't get a single trace of rust so long as there's enough inhibitor in there."

The two forms of glycol most commonly used in Australia are monoethylene glycol (MEG) and monopropylene glycol (MPG).

MEG is less expensive than MPG but is toxic on ingestion and cannot be used in processes where it may come into contact with food.

MPG offers the HVAC&R industry the benefit of being non-toxic, so it can be used in all applications, making it the product of choice by many.

According to Dewerson, MPG for heat-transfer applications is designed to be food-safe (in the event of a leak) as both the glycol and corrosion inhibitor are non-toxic.

"In food, beverage and dairy applications, using MPG just makes sense," he says.

However, the use of glycol as a secondary heat-transfer fluid does have a downside: the amount of pump energy required to circulate glycol around the system, especially in low temperature (LT) applications.

"When you cool fluids they become more viscous, and the greater the kinetic viscosity the greater the power consumption required to pump it around the system," Dewerson says.

A secondary refrigerant loop using glycol at -15°C will require around 35 per cent glycol to 65 per cent water, but a system operating at -40°C will require a much larger ratio of glycol to water, thereby increasing viscosity. The low temperature will further increase viscosity, resulting in a further increase in pump energy use.

"It's at these temperatures that you might want to move away from a glycol solution and consider other options like salt-based solutions," Dewerson says.

LOWER VISCOSITY SALT SOLUTION

Designed to be both non-toxic and food safe, salt-based solutions (or brines) are the next evolution in secondary heat-transfer liquids.

A solution designed in Europe combines two organic salts (potassium formate and potassium acetate).

Tests show that it achieves greater heat-transfer properties than glycol and has much lower viscosity, particularly at low temperature. This means smaller pumps and heat exchangers can be used on the secondary loop system, delivering significant reductions in capital cost and energy consumption.

And, if the idea of a salt-based solution sounds like a recipe for a corrosive disaster, don't fear.

"The salts used in this product are not as aggressive as your standard sea salt, so they are easier to inhibit," says Dewerson. "And they're food safe, as is the chemical inhibitor used to protect the system from corrosion."

The inhibitor creates a localised, temporary thin protective layer across the metal surface that allows for good heat transfer while protecting against corrosion. This makes it safe to use with copper, bronze, brass (dezincification resistant), steel, stainless steel, cast iron and plastic pipes such as ABS and PE.

Pre-mixed, it is available in -40°C and -55°C mixes as well as in lower freeze protection mixtures.

Though more expensive than glycol, Dewerson says the energy efficiency benefits of using a salt-based solution in the secondary loop are significant, and provide a return on the extra investment. This is particularly so when used in large systems such as those serving process-cooling applications.

"With an industry looking to find energy-efficiency savings wherever it can," says Dewerson, "a salt-based solution really does tick all the boxes." ■

GOOD COMPANY

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