Does Your Chiller Need Antifreeze?

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No Comments

There are increasing numbers of residential chillers, as well as a wide variety of commercial and process chillers. Not many topics apply to all categories, makes, and designs; the use of antifreeze, however, is one that does.

“Your chiller system can suffer flash freezing or serious damage when exposed to freezing conditions,” explained Rex Martin, product manager for Tecumseh Products Co.’s Cool Products Division, Clinton, Mich.
“Antifreeze can protect equipment from low-ambient and freezing process conditions,” he said. “If your chiller is exposed to freezing ambient conditions, you must protect your system. If your chilled-water supply temperature is 50 degrees F (10 degrees C), it is likely that you will need antifreeze.”
If leaving chilled-water temperatures are below 50 degrees, Martin noted that problems could develop. “It is likely that flash freezing of the plates in the evaporator can be robbing system efficiency — or, worse yet, causing permanent damage to the heat exchanger itself,” due to cracks and subsequent leaks caused by expansion of the freezing water.
It is true that antifreeze can reduce system performance somewhat. However, “Under these near-freezing conditions, system performance can actually be improved with the use of antifreeze.”
Because antifreeze can reduce a chiller’s efficiency, it is important that the correct amount be used so that reductions are as low as possible while the system gains optimal benefits from it. “Antifreeze used in proper concentrations will keep flash freezing from occurring and reduce the possibility of chiller failure,” Martin explained.
What To Use, What Not To Use
“Never use automotive anti-freeze in a chiller system,” Martin pointed out. “The additives found in this type of antifreeze can foul heat exchangers and result in poor heat transfer.”

Does anyone ever use automotive antifreeze in a chiller? “People out there have,” Martin replied. It could be more of a risk with the increasing number of residential chillers on the market, he continued. Homeowners and maintenance technicians may consider the addition

of antifreeze to their chiller system, so they pick it up from the auto parts store and put some in their system.

Martin recounted the story of a guy who tried to use his lawnmower as a hedge trimmer. He picked it up, one hand under the housing, and tried to trim his hedges with it. Almost unbelievably, the guy won a multi-million dollar lawsuit against the manufacturer because nothing on the mower stated that users shouldn't put their hands near the blades while the machine is operating. (This is one reason why so many products now have what some people refer to as "idiot warnings.")

The antifreeze situation might not be as obvious as the lawnmower example, but the lawnmower story should help you remember the antifreeze warning.

Propylene Glycol Capacity Correction Factor

Percent Propylene Glycol By Weight	15%	20%	25%	30%	35%	40%	50%
Freezing Point In °F	24°	18°	15°	9°	5°	-5°	-30°
Capacity Factor Multiplier *	0.922	0.986	0.972	0.960	0.950	0.928	0.878
Pressure Drop Multiplier	1.040	1.080	1.130	1.210	1.260	1.470	2.790

Table 1. At standard ARI 590 condition: 54 degrees F entering fluid temperature, 44 degrees leaving fluid temperature, 95 degrees ambient temperature, 0.0005 fouling.

Martin said two basic types of glycol are used in chillers: ethylene and propylene. They are available in temperature ranges of -60 degrees to 350 degrees F (-51 degrees to 177 degrees C) and work well for chiller applications, he said. "With glycol in the system, chilled water is protected from freezing in the heat exchanger.

"Ethylene glycol tends to be the preferred coolant in most chiller applications. If your application is pharmaceutical or if contact with food or potable water is possible, a clear propylene glycol is the right choice," he advised. "Coolant solutions with dyes or special inhibitors are toxic and should not be used in these applications. Some states and local regulations do not accept ethylene glycol and require the use of propylene."

System construction needs to be considered when choosing the type of antifreeze, Martin pointed out. Some manufacturers offer inhibited glycol, he said, which can also help reduce corrosion. "Even with inhibited glycol, chilled-water systems using iron, steel, or galvanized water piping and fittings can suffer from corrosion problems and pitting."

Despite longstanding industry knowledge of their potential for problems, these metals are still encountered in system applications, both retrofits and some newer systems. Chiller systems should use copper, stainless, or Schedule 80 PVC pipe and fittings.

Antifreeze Effects

As was mentioned earlier, antifreeze will reduce chiller system performance to a degree, depending on the amount introduced. The more antifreeze that is added, the lower the efficiency.

"Btu output is reduced as the concentration of glycol is increased," Martin stated. "In most cases, it is not recommended to use concentrations of propylene glycol higher than 50 percent by weight, or concentrations of ethylene glycol higher than 40 percent by weight."

For new systems: "System design engineers will compute how much antifreeze you should use." (See Tables 1 and 2 for propylene and ethylene glycol capacity correction factors.) "When calculating the required chiller size for your application, the output of the chiller should be corrected to reflect the effect of the lower heat transfer properties of glycol vs. water. Pump flow rates also decrease as glycol concentrations are in-creased. The system's total pressure drop should be corrected for the increase of glycol and the process pumps sized accordingly."

Ethylene Glycol Capacity Correction Factor

Percent Ethylene Glycol By Weight	10%	15%	20%	25%	30%	35%	40%
Freezing Point In °F	25°	21°	17°	11°	5°	0°	-10°
Capacity Factor Multiplier *	0.980	0.960	0.950	0.930	0.920	0.910	0.890
Pressure Drop Multiplier	1.080	1.110	1.160	1.210	1.270	1.320	1.380

Table 2. At standard ARI 590 condition: 54 degrees F entering fluid temperature, 44 degrees leaving fluid temperature, 95 degrees ambient temperature, 0.0005 fouling.

For retrofits: "Say you need five tons of cooling and you have five tons of chiller capacity," Martin explained; use the conversion factor, but work it backwards from the way it would be applied for new systems. Figure the loss of cooling efficiency.

Reviewing the chiller settings, validate the process heat load or cooling requirements and change the process to accommodate the reduced cooling.

Water quality and system design efficiency also determine “the limiting or safe low-temperature freeze point,” he said. “Some chillers may go as low as 47 degrees F (8 degrees C), while older or less efficient models may require settings as high as 60 degrees F (16 degrees C) to keep water from freezing.”

Once a system is protected with coolants, “it is important to keep it that way. It is a good idea to keep a premixed antifreeze solution on hand in five-gallon buckets or drums for use in the event of occasional system water loss.”

For example, “If you determine you need a 20 percent glycol solution, and you have leaks, spills, or evaporation, you could lose water,” Martin explained. “These losses can effectively change your antifreeze solution concentration. If maintenance has that five-gallon bucket on hand, it’s right there for the technician to add if the system needs it.” There is no guessing on how much antifreeze is required. “Utilizing the premixed solution will allow maintenance of the correct limiting or safe low-temperature freeze point.”

It stands to reason that a chiller system’s antifreeze should be checked periodically. The frequency “entirely depends on the system,” Martin said. Residential systems, for instance, might have relatively low water loss; process systems in some other environments might require more frequent checking. Go with the manufacturer’s recommendations for regular maintenance and service.

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