Blender Products, Inc.

HVAC MIXING UPDATE

FREEZE PROTECTION: WHY USE THE AIR BLENDER® MIXER INSTEAD OF GLYCOL?

The use of glycol to prevent the freezing of hydronic coils is a common strategy used by design engineers. Glycol is often viewed as a low cost, easy option for providing freeze protection. However, glycol has significant limitations as an effective tool for freeze protection. The purpose of this article is to examine the short-comings of glycol in these systems and contrast that to the effectiveness of using the Air Blender® static mixer.

Figure 1: Typical Coil with Freeze-stat

ASHRAE Guidelines For Using Glycol

When winter design temperatures are below 20°F, using glycol to prevent frozen coils is a common design strategy. However, ASHRAE only recommends the use of glycol in extraordinary operating conditions, as can be seen from the following passage taken from 2004 ASHRAE Handbook – HVAC Systems and Equipment page 12.16:

> *In systems in danger of freeze-up, water solutions of ethylene glycol and propylene glycol are commonly used. Freeze protection may be needed (1) in snow-melting applications; (2) in systems subjected to 100% outside air, where the methods outlined above my not provide absolute antifreeze protection; (3) in isolated parts or zones of a heating system where intermittent operation or long runs of exposed piping increase the danger of freezing; and (4) in process cooling applications requiring temperatures below 40° F. Although using ethylene glycol or propylene glycol is comparatively expensive and tends to create corrosion problems unless suitable inhibitors are used, it may be the only practical solution in many cases.*

In light of this passage, the remainder of this article will explore why glycol is "comparatively expensive" and examine if glycol is a "practical solution" for typical economizer systems.

Costs of Glycol

Initial Cost. Typically, the purchase price of glycol is viewed as the only upfront cost of including it in water systems. However, other initial cost items include larger pumps to handle the higher viscosity of the water system and larger coils to compensate for the reduced heat transfer properties. Figure 2 details the need for increasing pump sizes and/or coils sizes depending on the concentration levels of glycol. Further, there are costs associated with adding control points for monitoring glycol concentrations.

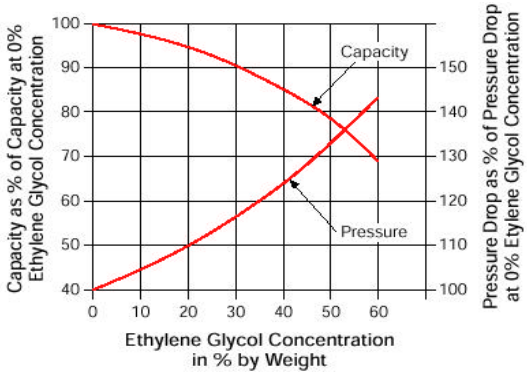

Figure 2: Impact of Glycol on Heat Transfer & Pressure Loss

Operating Costs. Higher energy costs result from increased pressure loss and reduced heat transfer because glycol is in the water system. In addition, glycol levels must be monitored continually for the system to operate as designed. Because of this, it is often necessary to contract a separate maintenance company to monitor and operate the system.

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Engineering a System to Combat Frozen Coils

Glycol System. Because the high costs of using glycol, ASHRAE advises that minimal concentrations be used. However, as Figure 3 shows, in order to maximize freeze protection, high concentrations of glycol must be used.

Ethylene Glycol			Propylene Glycol		
Percent Concentration		Freeze Point °F	Percent Concentration		Freeze Point °F
By Mass	By Volume		By Mass	By Volume	
5	4.4	29.4	5	4.8	29.1
10	8.9	26.2	10	9.6	26.1
15	13.6	22.2	15	14.5	22.9
20	18.1	17.9	20	19.4	19.2
25	22.9	12.7	25	24.4	14.7
30	27.7	6.7	30	29.4	9.2
35	32.6	-0.2	35	34.4	2.4

Figure 3: Glycol Concentration Requirements for Freeze Protection

For example, in order to ensure coils will not freeze at 0°F temperatures, glycol concentration levels need to be nearly 35 percent. This high level of concentration translates to significant initial and operating costs for this system.

To further complicate matters, choosing the right concentration level is difficult. To illustrate this point, assume a mixing box provides 40 percent mixing effectiveness. This means when the outdoor air is at 25 percent, the minimum temperature at the coil will remain above 35°F until the outdoor air temperature reaches 22°F. If a glycol system was installed with less than 15% (mass), then the glycol will be offering no more protection than what the mixing box is already providing.

Air Blender System. In contrast, an Air Blender mixer applied in the above system would increase the mixing effectiveness from 40 percent to 79 percent. The mixing provided by the Air Blender essentially eliminates the need for glycol to be included in the system. In this case, the Air Blender mixer would allow the system to operate in economizer down to –15°F outside air without the freeze stat tripping.

With the installed cost of the Air Blender mixer being roughly the same as the initial costs of glycol, the additional freeze protection provided by the Air Blender makes this design more attractive. Further, because the Air Blender requires no maintenance and has a minimal pressure loss, the operating costs of an Air Blender are less than an average water system with glycol.

Unlike glycol the Air Blender application provides additional benefits other than freeze protection at no added cost. Uniform temperature and velocity profile across mixed air sensor will improve control system response allowing the heating and cooling coils to be properly controlled. Furthermore, these uniform profiles will enhance coil efficiency. An even velocity profile will also provide even particulate loading, maximizing filter life. The Air Blender installation will also provide a uniform concentration of outside air and return air. This will ensure that fresh outside air is distributed evenly throughout the occupied areas helping to meet IAQ standards.

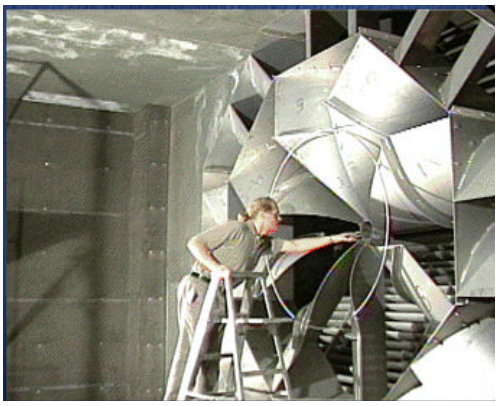

Figure : Air Blender mixer provides most efficient method of freeze protection

Conclusion

Glycol has long been viewed as a safety net to protect against frozen coil repair and replacement cost. However, as owners continually pressure design engineers to reduce equipment cost without reducing system functionality, using an Air Blender is an excellent option. Unlike glycol, the Air Blender serves to reduce both initial and operating costs of the system, to provide a higher level of freeze protection, and to address other issues related to air stratification.

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