Glycol Treated Closed Loops

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In recent years the industry has seen an increased use of glycol for freeze protection in many closed loop applications. Whether closed loop systems are completely filled with glycol and water or coils are just treated for protection; problems still occur in these systems.

Three types of glycols have been used for closed loops. The two major types now used are Ethylene and Propylene. Automotive anti-freeze has also been used but is not recommended for this type of application.

Ethylene glycols are used for most HVAC applications. These glycols are used because they offer the most efficient heat exchange media. In general a 20% ethylene glycol solution will result in a 6% loss of heat transfer where as a 40% glycol solution will result in a 14.5% loss of heat transfer. Ethylene glycol should not be used where it could contaminate potable water, food processing or other products meant for human consumption.

Propylene glycol was developed to replace ethylene glycol where possible contact with potable water and food could occur. Propylene glycol does not have the heat transfer efficiency that ethylene glycol has. It also takes slightly more propylene glycol to provide the same freeze protection as ethylene glycol.

It should be realized that all glycols oxidize when exposed to air and heat. When this occurs an organic acid is formed. If not properly inhibited, this fluid is very corrosive. Inhibitors are added to the glycol to act as buffers preventing low pH attack on system metals. Certain types of inhibitors also passivate the metal surfaces protecting them from corrosion. These inhibitors can be tested for activity level with a basic test called Reserve Alkalinity. This test checks the buffering capacity of the inhibitor. If complete breakdown has not occurred fresh inhibitor can be added to restore corrosion protection.

Glycol based automotive anti-freeze is different because it is inhibited with silicates. This type of inhibitor is excellent for protection of aluminum at high temperatures and where an agitated environment is present. In a HVAC system where circulation is low and copper and steel are present, it can gel causing loss of heat transfer and system plugging. It is designed to be changed every three to four years which cannot be done in most HVAC systems.

Besides inhibitor breakdown, biological fouling can also occur. Bacterial slime will grow by feeding on the organic carbohydrates of the glycol. Certain inhibitors also provide nutrients for bacterial growth. Once a bacterial slime starts system corrosion will increase.

In systems where a glycol solution is maintained on a continuous basis an extra corrosion inhibitor such as borate-nitrite and molybdate should still be added. This extra protection will help prevent corrosion if basic inhibitor breakdown occurs. This system should be monitored for freeze protection, reserve alkalinity, inhibitor level and biological contamination on a routine basis.

In systems where coils need to be drained and glycol flushed through to protect low areas against freezing, more serious problems tend to occur. In most cases the main loop becomes contaminated with glycol that has broken down when spring start-up occurs. Even if the glycol is properly inhibited at the start, exposure to air for 4 to 6 months will result in oxidation of the glycol. Not only will this glycol have broken down to form an organic acid but bacterial contamination is more likely. Before the spring start-up, each coil should be flushed with fresh water at least three times to remove as much of the residual glycol as possible.

If the system is started up and glycol contamination occurs resulting in a low pH excursion and biological contamination, the system should be drained and flushed if possible. If this is not possible because of the size or design of the system further steps need to be taken. A by-pass filter system should be installed to remove the corrosion by-products. Filters as low as one micron maybe required to remove contaminants.

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An appropriate biocide such as isothiazalone should be slug fed to provide biological control. The system pH should be gradually brought up to at least 8.5 with the addition of an alkalinity builder. If the pH is brought up too quickly or too high the iron in solution may precipitate and cause system plugging. Your corrosion inhibitor should be brought up to maximum strength. Continued monitoring is required to make sure recontamination doesn't occur.

Closed loop systems cannot be neglected. It is just as important that they be maintained corrosion and foulant free as it is with open condenser systems.