Water Quality Recommendations

Water quality in hydronic systems plays an important role in the life and efficiency of your system. Water of the wrong quality can cause a decrease in heat transfer ability and eat away at the system causing leaks. Ensuring the proper water quality is a key step in the installation and maintenance of your system.

Before any water is added to a new system, ensure that the system has been properly flushed (see Technical Section 3, specifications).

HeatLink Canada recommends the following parameters for a low maintenance system:

Parameter	Optimal Conditions	Comments
Glycol Freeze Protection Protected Areas SnowMelt/Unprotected	 30% 50%	Below 20% can promote the growth of bacteria. Concentrations higher than 50% will dramatically reduce the heat transfer ability. Glycol seepage can occur at o-rings and seals.
Corrosion Inhibitor Molybdate Inhibitor **or** Nitrite Inhibitor	 100-150ppm 800-1200ppm	Without the addition of Nitrite or Molybdate inhibitors, corrosion of the metallic components will begin and eventually lead to leaks. HeatLink Canada recommends the use of Molybdate (see note on page 29.2).
pH	9-10.5 pH units	A pH below 9.0 will allow the corrosion of steel and above 10.5 will allow the corrosion of brass and copper.
Conductivity	700-3200µS/cm	Conductivity above 3500µS/cm will cause the water to become physically abrasive and damage the o-rings. Addition of chemicals to the water will raise the conductivity.
Hardness	100-300ppm 5.8-17.5 Grains/USG	Artificially soft water can be aggressive to the system. The use of unsoftened water is recommended. Do not use distilled or purified water.
Bacteria/Mold	No Bacteria or Mold	The growth of bacteria will cause erosion of seals and the deposit of a bacterial slime will clog the system. Bacteria can attack the o-rings and cause premature failure. Glycol above 20% will kill any bacteria.

Deviations from these optimal conditions can cause problems with the system and void the warranty of system components and boilers.

HeatLink Canada offers laboratory testing of water quality for $60.00/sample as well as advice on your project. For approved sample bottles please contact your HeatLink representative.

If you have any questions regarding the water quality in your system or require assistance please contact your HeatLink representative.

It is important to understand what each of the parameters of water quality mean, and how a deviation from the recommended range will cause damage to your system. The following pages explain in more detail each of the above parameters.

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Glycol Freeze Protection

Glycol, either ethylene (EG) or propylene (PG), is used to prevent the freezing of systems that are exposed to low temperature environments, such as the SnowMelt systems. If glycol is required in a system, it is recommended that the concentration of glycol be above 20% and no more than 50%. Below 20%, glycol becomes a nutrient for the growth of bacteria, which can infect the system. Once a bacterial infection gets into a system, it is very difficult to remove. A glycol concentration above 50% makes the water too viscous and will cause damage to a variety of components and moving parts. Also, glycol concentration causes the system to lose some heat transfer ability and decrease the system efficiency, this decrease is dramatic in mixtures that are above 50%. The life of EG can be up to 10 years and PG can have a life up to 9 years.

Addition of glycol to a system will cause a drop in the pH (see pH section). Buffers are usually mixed with the glycol to combat a drop in pH. When glycol breaks down it causes acidic products to be formed which can also lower the pH. The use of UV water filters in glycol systems is not recommended because the UV radiation will degrade the glycol. PG is recommended for systems because it is more environmentally friendly and less toxic than EG.

Corrosion Inhibition

Corrosion in systems can come in many forms. The most common form known to most people is corrosion that is caused by oxygen in the water. This corrosion is called oxidative corrosion. Other types of corrosion include galvanic corrosion, caustic corrosion and acidic corrosion. To combat corrosion, many different methods are used such as control of pH (see pH section), use of chemical corrosion inhibitors and effective monitoring and control.

There are many chemical corrosion inhibitors available on the market today. However, for closed loop hydronic heating systems, only two types are recommended. Molybdate and nitrite corrosion inhibitors are film forming inhibitors and protect against all forms of corrosion. Molybdate is recommended over nitrite because it is required at a lower concentration, it is less toxic and does not promote the growth of bacteria. The nitrite works by reacting with ferrous hydroxide and forming a passive layer of magnetite. The molybdate works in a similar manner by converting "red rust" into the same passive layer of magnetite.

The concentration of molybdate inhibitor should be between 100-150ppm (parts per million) and between 800-1200ppm for the nitrite inhibitor. Concentrations above 150ppm Molybdate are not a concern and can be used as an effective pre-operational cleaner if a side stream filter is in use. Concentrations above 1200ppm of Nitrite will cause an increase in conductivity above the upper limit and should be avoided.

As mentioned above, doubling the molybdate corrosion inhibitor concentration to approximately 300ppm, in conjunction with a side stream filter, is an effective pre- and post-operational cleaner. The molybdate will remove oils and minor debris from the system and it will collect in the filter. Without the filter, the cleaning properties of this method will not be effective.

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pH

A pH measurement is a logarithmic determination of the hydrogen concentration. The lower the pH reading the more acidic the solution and the higher the pH the more basic the solution. The pH scale ranges from 1 to 14 with a pH of 7 being neutral.

The pH of a system has a huge effect on the life of the system. Variations in pH can indicate a variety of problems and cause damage to the system components. The ideal pH is between 9 and 10.5 pH units. Systems should be maintained in this range because a pH less than 9 will corrode steel and a pH higher than 10.5 will corrode brass and copper. A high pH will also cause the precipitation of iron from the water that will cause corrosion in the system. Buffers in the inhibitors can help maintain the proper pH range.

A drop in pH can indicate a variety of problems. First, a bacterial infection can produce acidic byproducts which will drop the pH. This can be combated by the addition of a biocide (see Bacteria/Mold section). Also, as glycol degrades, it produces acidic byproducts that can drop the pH. The pH of the system can be maintained by monitoring the pH with a pH meter or pH test strips and making adjustments if required.

Conductivity

Conductivity is an indirect measurment of Total Dissolved Solids (TDS) in the water (TDS = 0.62 x Conductivity). Conductivity is a test of how easily the water can conduct an electrical current. The more dissolved solids in the solution the higher the conductivity. Domestic tap water has a conductivity of about 300μS/cm (with variances depending on your particular region). Conductivity can also be used as a secondary indication of the amount of chemicals in the water. As an example, the concentration of nitrite in a solution should be approximately 1/3 the conductivity reading.

The conductivity in a closed loop hydronic heating systems should be between 700 and 3200μS/cm depending on which additives are in the water. The addition of glycol, nitrite and even soft water will have an effect on the conductivity reading. Conductivity above 3500μS/cm indicates a high level of dissolved solids and the water becomes physically aggressive and will breakdown the o-rings. In systems where the conductivity is approaching or above 3500μS/cm the system should be flushed and refilled with fresh water, glycol (if required) and corrosion inhibitors.

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Hardness

Water hardness is a term that describes the amount of calcium and magnesium bicarbonate in the water. These ions have the ability to precipitate out of water as calcium carbonate and magnesium carbonate when the water is heated. This can be seen on a daily basis if you have a white/yellow scale on your kitchen sink faucet. These precipitated particles have the ability to cause leaks by getting behind o-rings and allowing water to escape. Also, the precipitation of these substances onto mechanical parts can cause improper functioning of the part.

Hardness is usually measured in "Grains of Hardness" or in parts per million of $CaCO_3$. Converting between the two units is simple using the ratio of 1 grain/USG = 17.1ppm. We will be using ppm in our discussion.

The old school of water quality recommended the use of soft water in closed loop systems. This was because it was thought that the precipitation of $CaCO_3$ needed to be controlled. The new school of thought is that hard water can be used in closed loop systems. The reason for the change is that softened water has had the natural mineral balance disturbed. The disturbed water will then try to re-balance itself by leaching the required minerals from the metals in the water. The leaching of minerals from the metal will cause a higher rate of corrosion. To help combat the precipitation of $CaCO_3$ without softening the water, dispersants are included in the corrosion inhibitor mixtures that keep the $CaCO_3$ in the water. Water hardness will vary depending on the region you live in. For example, water in Saskatchewan, Canada has a hardness of about 490ppm and Nova Scotia has a hardness of about 45ppm.

The only concern that arises with respect to hardness is the use of well water. Well water has a reputation of being very hard. In some cases the hardness can be above 60 grains/USG or 1026ppm. If well water is being used for a system, it should be evaluated for hardness. If it is found to be unsuitable for the system, city water should be shipped in.

Bacteria and Mold

There are different types of bacteria that can infect a system. Bacterial infections are not often seen but occasionally appear. As mentioned before, bacteria can thrive in a glycol environment that has less than 20% glycol. This is because at a low concentration, the glycol is no longer toxic to the bacteria and the bacteria can feed off of the residual glycol in the solution. The bacteria can leave a slime residue that can interfere with proper operation of the system (the excrement of the bacteria can be highly corrosive, often indicated by "pin-hole" leaks in the heating system).

Microbiological organisms can enter a system through the make-up water. A certain amount can also enter the water through air dissolving into the water. Testing for bacterial and mold infections can be done using agar dip slides. If an infection is found, the easiest way to remove the organisms is to add dispersants and biocide to the system. Both products can be bought at any pool supply store.

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