# Understanding Your Heat Transfer Fluid

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*Posted: July 1, 2007*

*Knowing what type of fluid to use and how to maintain it properly can help you ensure efficient, trouble-free operation of your process cooling equipment.*

One of the most frequently encountered problems in process cooling operations is equipment component failure due to the use of incorrect or improperly maintained heat transfer fluids. Using the right fluid and implementing a regular analysis and maintenance program are therefore essential to ensuring efficient equipment operation.

The most common heat transfer fluids used in process cooling are water, brine, alcohol, ethylene glycol and propylene glycol. All of these fluids have advantages and disadvantages. The selection usually depends on the type of equipment, the operating temperature range, the geographic location and cost.

- Water is inexpensive and provides the best heat transfer properties; however, it is limited by its temperature range. It is used in many southern locations where freeze protection is not generally a concern.

- Brines provide good heat transfer but are extremely corrosive and tend to form scale. Brines have high maintenance costs and are not recommended for use with copper or aluminum.

- Alcohols provide good freeze protection and have a low viscosity at low temperatures. Methanol and ethanol are the most commonly used types and need to be blended with water. Alcohols are flammable and have low flashpoints, and the vapors can be toxic.

- Propylene glycol has low toxicity and can be used where incidental food contact could occur or where a spill could contaminate drinking water. Propylene glycol is a less efficient heat transfer medium and a less effective a freeze point dispersant compared to ethylene glycol. Propylene glycol can become viscous at low temperatures.

- Ethylene glycol is an efficient freeze point dispersant, has a high boiling point, provides excellent heat transfer properties and requires a minimum amount of makeup. Ethylene glycol is toxic when ingested and should not be used where contact with food or potable water is possible.

- Oils generally are used in applications where the temperature exceeds 300°F (149°C). They have lower heat transfer coefficients and generally are viscous; as a result, when compared to other fluids, they require more horsepower — and higher operating costs — to pump the fluid.

With all of the available options, selecting the right fluid can be difficult. It is usually best to consult an experienced heat transfer fluid manufacturer to obtain the correct recommendation.

No matter what type of fluid you choose, make sure it is of high quality and manufactured to meet the industry standards for that particular fluid. Most heat transfer fluids are mixtures containing water and corrosion inhibitors. Fluids always should be prepared with deionized or distilled water to eliminate the introduction of chloride or sulfate, which are corrosive to metals under certain conditions. Using deionized or distilled water also avoids problems due to calcium and magnesium deposits, which can form scale and reduce cooling system efficiency, thereby increasing energy costs. Corrosion inhibitors should be engineered to protect multiple metals, provide buffering against acid formation and be compatible with the base fluid.

All heat transfer fluids are not created equal. Be sure to purchase your fluid from an experienced, reputable manufacturer.

## Maintenance Considerations

Aside from fluid selection, heat transfer fluid maintenance is probably one of the most overlooked but most important process cooling equipment considerations. Neglecting fluid maintenance is one of the leading causes of corrosion, freezing, inefficient operation and system failure.

A fluid maintenance program should include a periodic, thorough analysis of the fluid to determine its condition and identify any adverse conditions that could be present. Many manufacturers and suppliers of heat transfer fluids provide maintenance programs that generally include fluid analysis services. Characteristics that should be examined during a routine analysis, depending on the type of fluid, include:

- **General condition,** which includes the base fluid concentration and freeze point. This analysis can determine whether a leak might have occurred and the freeze point is no longer adequate.
- **Appearance of the fluid,** which is generally obtained through a visual inspection, to detect particulate matter or separation.
- **Fluid pH,** which indicates the pH condition and can help identify degradation.
- **Reserve alkalinity,** which is a measure of the buffering capacity. Buffers enable the fluid to withstand the corrosive effects of acid formation.
- **Level of corrosion inhibitors,** which are added to most heat transfer fluids to protect the metals in process cooling equipment but can be depleted over time. If the levels are too low, additional corrosion inhibitors can be added to extend the fluid life. Corrosion inhibitors are chemically engineered to be compatible with the base stock of the fluid and should only be added when suggested by the fluid manufacturer.

The routine analysis also should screen for the following problems:

- **Degradation products** such as iron, copper or zinc, which could indicate that corrosion is occurring or that an inferior water supply has been used.
- **Scale promoters** such as calcium or magnesium in the liquid.
- **Contaminants** such as lead or arsenic, which could cause the fluid to be classified as a hazardous substance should disposal be required. Silica could indicate the use of automotive antifreeze and could cause the formation of silica gels that might foul the heat exchanger.
- **Corrosive ions** such as chloride and sulfate, which are introduced by the use of poor-quality water.
- **Acids,** which will form in many fluids as they deteriorate and can contribute to system corrosion.
- **Fluid degradation,** which will create acid harmful to the construction materials of most cooling systems. Ethylene glycol and propylene glycol fluids are negatively affected by unintentional exposure to excessive heat and oxygen. Fluid degradation can be detected in a fluid analysis and corrected before it causes serious damage to the fluid or equipment.
- **Erosion corrosion,** which can be caused by circulation of any type of particles in the fluid. Particulate matter can come from many sources, including improper cleaning when the system is commissioned, rust and corrosion in older systems, improperly inhibited fluids, and poor-quality water. If this condition is detected, a side stream filter can be installed to improve fluid quality and extend its life and that of the equipment in which it is used.

A fluid maintenance program also should include inspecting the cooling system regularly for leaks and operation problems, as well as periodically cleaning filters and strainers. These steps can help you identify and correct problems before they can harm the fluid or equipment.

In conclusion, a high-quality heat transfer fluid is essential to ensuring the efficient operation and long life of any process cooling system. Always follow the fluid manufacturer’s recommended use and maintenance suggestions, and your equipment will be less likely to surprise you with unexpected problems.

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