



# FOCUS



# HVAC

TIPS FROM THE DOW CHEMICAL COMPANY ON  
SYSTEM DESIGN AND PERFORMANCE WINTER 95

## Good Water Quality Plays Crucial Role In System Maintenance And Fluid Dilution

Occasionally, after filling a system with an inhibited glycol concentrate and water, HVAC operators may find a pink, green, or brown slimy film in their system. In one extreme case, less than two months after filling a new, 2,000-gallon HVAC system with a glycol and well water solution, the system was so contaminated with a slimy film that the entire system had to be drained and refilled.

In some cases, operators may initially conclude that this slimy film deposit is caused by the heat transfer fluid. The true culprit in most cases, however, is poor quality water, or water that is too hard.

In this article we will review the content of good quality water, ways to measure water quality, the effects of poor quality water on system components, sources of good quality water and the importance of fluid maintenance. As you will see, good quality water plays an important role in reduced system maintenance and saves time and money over the long term.

### What Exactly Is Good Quality Water?

Pure water provides the best heat transfer efficiency. However, most HVAC systems operate with a 30–50% glycol concentration in water, consistent with the need for proper freeze protection and corrosion control.

Unfortunately, not all water used to dilute glycol-based heat transfer fluids is created equal. Some contains *dissolved solids*, which cause scale deposits and fouling, and *corrosive ions*, such as chloride and sulfate. Although these culprits are soluble in water, they can lead to sediment formation and corrosion attack. Water from wells is especially suspect in this regard.

The easiest and surest way to avoid potentially costly problems is to use demineralized (deionized or distilled) water when diluting glycol-based heat transfer fluids. It makes little sense to invest in a high quality glycol fluid and then mix it with poor quality water from a tap or a well. In cases where good quality water is not readily available, Dow can supply pre-diluted solutions which contain demineralized water. Many Dow distributors also have this capability—so contact them if you need this type of assistance.

High quality dilution water is essential for efficient system performance and long coolant life. But, exactly what constitutes good quality water? And, how can you be sure your water quality is good enough?

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### The POSitive Difference You Get Only From Dow

At Dow, we know that if we don't meet your heat transfer fluid needs, someone else will. That's why with Dow you not only get a complete choice of fluids, but also all the support you need to...

- Protect your system
- Optimize your process
- Secure your bottom line

We call it *The POSitive Difference...* a difference only Dow customers enjoy. If you aren't currently using a Dow fluid, we hope you'll call on us for assistance with your next project. Our experts are equipped to support you every step of the way, from system design through fluid installation and maintenance. We're confident you'll be pleased with the difference we can make.

Just call toll-free: 1-800-447-4369 for technical or sales assistance, or for the name of your nearest Dow fluids distributor.

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# New Traffic Courts TES System Reduces Energy Costs

*The Sacramento Traffic Courts TES system was designed by Garry Rose of Engineered Mechanical, Inc., St. Helena, California.*



A new thermal energy storage (TES) system installed at California's Sacramento County Traffic Courts building allows the county to shift much of its electricity consumption to nighttime when off-peak rates are as much as 50 percent lower. In addition, by reducing its peak hour elec-

trical demand, the county qualifies for significant utility company rebates.

The TES system uses four-inch plastic water-filled spheres, known as ICE BALLS<sup>†</sup>, and Dow's DOWFROST\* inhibited propylene glycol-based heat transfer fluid. At night, the ice balls are frozen solid by being bathed in a 28 percent solution of DOWFROST chilled to 25 degrees F. During the day, the glycol solution is warmed by heat from the building and passed over the ice balls. The warm solution melts the ice and is cooled in the process. It is then recirculated to cool the building.

"This system provides economic benefits for all concerned," said Victor Ott, president of Cryogel, Inc., which markets the TES system. "The public utility benefits from a more balanced energy load and the county and taxpayers benefit from reduced operating costs." ■

*†Trademark of Cryogel*

## Q&A Corner

### 1. What is the best method for testing water quality before diluting a glycol-based fluid?

We recommend calling your county or city water department to find out the specification of your local water supply. If the water contains less than 100 ppm of hardness, it can be used to dilute your glycol-based heat transfer fluid. Another option would be to test the water yourself. To do this, fill a small sample bottle with 50% glycol and 50% water. Let it stand for 8–12 hours, shaking it occasionally. If any whitish sediment forms, the water is too hard and should not be used to dilute the fluid.

### 2. What field instrument should I use to measure the concentration of the glycol/water mixture before installing it in my HVAC system? Where can I get this instrument?

An accurate measurement of the concentration of ethylene glycol or propylene glycol in a fluid can be accomplished by using a hand-held refractometer. This instrument is portable, requires only a few drops of fluid, and needs no adjustment for fluid temperature.

An appropriate unit, Model No. 7084 (°F) or Model No. 7064 (°C) Misco Products, will test glycol concentrations from 0 to 55% directly. More concentrated solutions may be tested following dilution. Instructions are available with the instrument. Contact Misco Products at 1-800-358-1100 and ask for the Dow discount.

### 3. What is the difference between ethylene glycol- and propylene glycol-based fluids? What conditions dictate installing one fluid over the other?

In most heat transfer applications, ethylene glycol-based fluids are a good choice because of their superior heat transfer efficiency. This efficiency is largely due to the lower viscosity of ethylene glycol solutions. Lower viscosity allows these fluids to operate at lower minimum temperatures as well.

Propylene glycol-based fluids are lower in acute oral toxicity than ethylene glycol-based fluids. They are most commonly used for freeze protection where incidental contact with drinking water is possible. Generally recognized as safe (GRAS) by the FDA, propylene glycol-based DOWFROST fluid can be used in immersion freezing of wrapped foods and other food applications where ethylene glycol is not permitted. ■

# (Water Quality Continued)

For long-term maintenance-free HVAC operation, Dow recommends using demineralized water that has been *distilled, deionized, or passed through a reverse osmosis (RO) process to remove certain minerals and salts*. Good quality water contains:

- Less than 50 ppm of calcium
- Less than 50 ppm of magnesium
- Less than 100 ppm (or 5 grains) of total hardness
- Less than 25 ppm of chloride
- Less than 25 ppm of sulfate

To check the content of your local water supply, call your county or city water department. If you wish to check the condition of your well water, have it analyzed by a water treatment firm.

## What Happens If You Use Poor Quality Water?

Poor quality water eventually can have three basic detrimental effects on an HVAC system. All of these decrease heat transfer efficiency. They are:

- Sediment or deposit formation
- Inhibitor depletion
- Corrosion attack

If water containing excessive hardness is used in a heat transfer fluid, the first and most easily identifiable problem likely to occur is the formation of a precipitate or solid which makes the fluid appear hazy or cloudy. This occurs when one of the fluid's inhibitors reacts with calcium and magnesium ions in the water. When water containing less than 50 ppm of each ion is used, a very slight amount of solid material is formed, and this can be resolubilized upon heating the fluid. However, when the water contains higher than recommended concentrations of calcium and magnesium, enough precipitate is formed to interfere with the volume of flow through small diameter coils—decreasing the heat transfer efficiency of the system.

Calcium and magnesium in hard water can also tie up (and deactivate) a significant amount of fluid inhibitor. This, in turn, reduces the buffering or inhibiting action designed into the fluid to control corrosion. An analysis of the

fluid will show whether you need to re-inhibit the fluid. But keep in mind that, in any case, the sediment still needs to be removed from the system. With less inhibitor in the system, and especially at higher than ambient temperatures, the fluid becomes more acidic and, therefore, more corrosive. Dow recommends that fluid be changed when the pH falls below seven. Fluid pH is best measured with a field pH meter. This method gives a more accurate reading than the well-known pH paper strips. These can be difficult to read in poor light or when a similar color dye is mixed in the fluid.

Since glycols feel slippery to the touch (similar to glycerine), the deposits formed in hard water will also have a "slimy" feel. And, because of the dyes in the fluid, rust in the system, or other types of metal contamination, the slimy deposits are likely to appear as a greenish, pinkish or brownish film, which is frequently mistaken for algae or bacterial action on the fluid. Such living systems, however, do not survive in glycol/water solutions at the concentrations used in the average HVAC system.

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# On The Regulatory Front: Ethylene Glycol- And Propylene Glycol-Based Heat Transfer Fluids

Whether you choose DOWFROST propylene glycol-based heat transfer fluids or an ethylene glycol-based DOWTHERM\* heat transfer fluid, there are important regulatory guidelines to consider.

In addition to the national regulations listed below, there is also state and local legislation governing the use and disposal of ethylene glycol- and propylene glycol-based fluids. Through future issues of HVAC FOCUS, Dow will offer its heat transfer fluid customers periodic updates and select reviews of regulations affecting the use and disposal of its entire line of heat transfer fluids. For more information, call our Customer Information Group at 1-800-447-4369.

## Superfund Amendments And Reauthorization Act (SARA)

Ethylene glycol and propylene glycol, found in DOWTHERM and DOWFROST heat transfer fluids respectively, do not appear on the EPA list of "hazardous substances" or "extremely hazardous substances." Ethylene glycol, by virtue of its acute oral toxicity, is classified as a "toxic chemical" under SARA, Title III, Section 313.

## The Comprehensive Environmental Response, Compensation And Liability Act (CERCLA)

Neither ethylene glycol nor propylene glycol appears on the CERCLA list of "extremely hazardous substances," however, ethylene glycol, due to its listing as a "haz-

ardous air pollutant" (HAP) under the Clean Air Act, does have a reportable quantity (RQ) for spills of one pound. Dow and the Chemical Manufacturers Association are working with the EPA to get the RQ for ethylene glycol raised to 5,000 pounds. Changes in these reporting requirements should be forthcoming.

## Resource Conservation Recovery Act (RCRA)

Neither ethylene glycol nor propylene glycol is on the list of "hazardous wastes," and neither product exhibits any of the four RCRA characteristics of hazardous wastes as defined in 40 CFR 261.33. Conditions during the use of a product can impact whether a RCRA hazardous waste has been generated. Therefore, ethylene glycol and propylene glycol wastes should be tested before disposal to identify any hazardous content. ■

## (Water Quality Continued)

Sediment in the system also increases corrosion attack by reducing the efficacy of the metal inhibitor in the fluid. This occurs when the chloride and/or sulfate ions beneath the sediment attack the metal of the system. The benefit of the built-in metal inhibitor is lost when it cannot access this enclosed area. This type of corrosion usually takes place at these critical points where heat transfer is highest, such as the coil or the chiller. Finally, sediment build-up also increases wear on system components, leading to premature failure of pump seals.

Now let's examine potential damage to an HVAC system when the water also contains a high amount of chloride and/or sulfate—say well above 100 ppm.

It is recognized that chloride (and to a lesser extent sulfate) will cause extensive damage to most metal systems, even stainless steel. All you have to do is look at the unprotected metal on car bodies after a harsh winter when roads have been salted with rock salt (sodium chloride) or solutions of calcium chloride. The rust that quickly develops on the car body is a result of: 1) moisture in the air, 2) oxygen in the air, and 3) chloride ions.

Moisture and, to a certain extent, oxygen are present in HVAC systems. And even though the inhibitors in Dow's fluids protect against a certain amount of chloride and sulfate ions in the dilution water, the expected long useful life of these fluids can only be achieved when concentrations of these ions remain low—typically less than 25 ppm. If a greater amount is present, we recommend the system be drained and flushed properly to ensure the level of corrosive ions falls below our recommended maximum limits. Flushing the system with a 1–2% solution of trisodium phosphate in good quality water should do the job.

### Where Do We Get Good Quality Water?

You can buy pre-diluted solutions from Dow or from some of our distributors. Or, if your well or tap water is not suitable, demineralizers (also known as deionizers) can be purchased or rented. Newer technologies available in the last decade include reverse osmosis (RO) and nanofiltration (NF) using membranes. Both of these processes produce very good quality water.

One word of caution about the common practice of using softeners as a temporary fix when filling HVAC systems: resins typically used in these softeners will replace the calcium and magnesium ions with sodium ions. This, in itself, is fine. However, these resins do not sufficiently reduce high concentrations of chloride or sulfate ions. To accomplish the latter, another type of ion exchange resin must be used. Resins that remove calcium and magnesium ions are typically regenerated with a strong brine solution and the excess sodium chloride is flushed out as wastewater. This must be followed by thoroughly flushing the regenerated resin bed with water. Otherwise, an excess of chloride ions will be flushed into the so-called good quality water.

### Fluid Maintenance

After diluting the glycol concentrate with good quality water and installing it in your HVAC system, it should circulate for about 24 hours to ensure complete mixing. Within two to four weeks, a base-line sample of the fluid should be analyzed to make certain the specified mixture of glycol and water has been reached. Additional information from this analysis will indicate the presence of any installation problems, such as the wrong glycol concentration or poor quality dilution water.

After this initial test, plan to analyze your system once a year. Dow will conduct this analysis free of charge if the volume of inhibited glycol solution in your system exceeds 250 gallons. For smaller systems, a hand-held refractometer and a field pH meter, both readily available from companies such as Misco Products (1-800-358-1100), will give the operator sufficient information on the concentration and condition of the fluid. These analyses will help minimize system maintenance and repair costs, and will reduce the need for the frequent change-outs that are required when degradation is allowed to occur and corrosion products go untreated in the fluid.

### Conclusion

Proper cleaning of an HVAC system and diluting the glycol concentrates with good quality water are imperative for maintaining system efficiency and prolonging fluid life. With regular system maintenance and annual fluid analysis, Dow fluids have lasted for more than 20 years. The right water, combined with the corrosion inhibitors present in DOWTHERM and DOWFROST inhibited glycol-based heat transfer fluids will provide consistently high levels of corrosion protection and many years of trouble-free service. ■

For more information on HVAC system maintenance, call: 1-800-447-4369

**NOTICE:** The information and recommendations in this document are believed to be accurate and reliable as of December, 1994, and are given in good faith and supersede those given in any previous document. Because any information and recommendations furnished with reference to the proper use and disposal of these products is provided without charge, and because use conditions and disposal are not within its control, the Seller assumes no obligation or liability for such information and recommendations. Seller does not guarantee results from use of such products or other information and recommendations herein. NO WARRANTIES (INCLUDING, WITHOUT LIMITATION, IMPLIED WARRANTIES OF FITNESS OR MERCHANTABILITY) ARE MADE. No freedom from any patent owned by Dow or others is to be inferred. Because use conditions and governmental laws may differ from one location to another and may change with time, Buyer is responsible for determining whether products and the information and recommendations in this document are appropriate for Buyer's use, and ensuring that Buyer's workplace and disposal practices are in compliance with laws and other governmental enactments applicable in the jurisdiction(s) having authority over Buyer's operations.

