

## DOWFROST™ GEO 20: Optimized to meet the performance, safety and environmental requirements of geothermal heat pumps

DOWFROST™ GEO 20 heat transfer fluid, part of a new generation of application-specific heat transfer fluids from The Dow Chemical Company, was developed to provide geothermal heat pump installers and their customers with greater confidence and peace of mind. It is designed to overcome the drawbacks of alternative fluids, providing greater assurance that geothermal systems will repay their initial investment costs in energy savings and in years of reliable, safe and economical operation.

### Dispelling Fluid Myths

As the market for geothermal systems continues to expand, the importance of choosing the right heat transfer fluid has

also increased. Choosing the wrong fluid can create major safety, environmental and reliability issues. In order to appreciate the advantages of DOWFROST™ GEO 20, it is necessary to dispel the myths that can cloud fluid decision making:

**Myth:** Alcohols offer low viscosity and require reduced pumping energy requirements.

**Fact:** Only methanol offers significantly lower viscosity when used at concentrations having the same freezing point as DOWFROST™ GEO 20 inhibited propylene glycol (PG). Equivalent freezing solutions of ethanol provide no significant advantage versus DOWFROST™ GEO 20.

**Myth:** Ethanol represents a reduced fire hazard compared to methanol.

**Fact:** Both ethanol and methanol have low flash points (54°F and 55°F, respectively) and are subject to RCRA regulation. DOWFROST™ GEO 20 has no measureable flash point and is not subject to RCRA regulation.

**Myth:** Unlike methanol, ethanol is not toxic.

**Fact:** Ethanol is often denatured using toxic substances such as toluene, pyridine or methanol, whereas DOWFROST™ GEO 20 is based on low toxicity (USP grade) propylene glycol.

**Myth:** Alcohols are not corrosive.

**Fact:** Tests show methanol and ethanol both cause excessive corrosion of steels, cast iron, and other metals commonly used for geothermal system components like recirculation pumps, main headers and the heat pump itself. DOWFROST™ GEO 20 protects all common metals against corrosion.

**Myth:** The quality of corrosion protection provided by all inhibited propylene glycol fluids is the same.

**Fact:** Testing has also shown that many PG-based fluids are improperly inhibited and do not provide the same level of protection as DOWFROST™ GEO 20.



### **Choose the Optimum Fluid**

Once the drawbacks of other fluids are clearly understood, the advantages of using DOWFROST™ GEO 20 inhibited propylene glycol-based fluid become clear. DOWFROST™ GEO 20 is a ready-to-use solution which is fully formulated to deliver reliable, long-term performance in residential and commercial geothermal systems. Supplied as a 20% by volume concentration, the fluid has a recommended operating range of 23°F to 212°F with an 18.5°F freeze point, ideal for geothermal service where minimal freeze protection is needed. The relatively low concentration reduces pumping costs while providing higher heat transfer efficiency compared to other glycol formulations.

DOWFROST™ GEO 20 also provides an excellent environmental and safety profile as well as effective, reliable corrosion protection, offering system designers and installers an attractive alternative to alcohols and other fluids that have significant safety and corrosion performance drawbacks.

### **Low Toxicity, Readily Biodegradable**

Low toxicity and biodegradability are important criteria in the selection of geothermal fluids because the fluids circulate underground, near residential and commercial structures; in proximity to people, pets or drinking water supplies; and where wildlife, ground and surface water, and the surrounding natural environment, could be exposed to fluid leaks or spills.

The advantages of DOWFROST™ GEO 20 fluid start with its chemistry. It is a propylene glycol (PG)-based fluid and, like other Dow PG-based heat transfer fluids, DOWFROST™ GEO 20 is low in toxicity and readily biodegradable. In contrast, methanol is high in toxicity and ethanol is often denatured with chemicals that can increase its toxicity.

Although federal, state/provincial and local regulations governing heat transfer fluids used in geothermal systems can vary and continue to evolve, propylene glycol-based fluids are among the most universally accepted fluids under current U.S. state and Canadian provincial legislation.<sup>1</sup>

<sup>1</sup> Users are responsible for understanding of, and compliance with, regulations in their area. Please contact Dow for assistance.

### **An Increased Margin of Safety**

DOWFROST™ GEO 20 fluid does not have a measurable flash point and is not subject to RCRA regulation. Compared to methanol and ethanol, it significantly reduces the risk of fire which can endanger buildings and their occupants as well as installers and maintenance personnel.

Methanol has a flash point of just 54°F and is subject to RCRA regulation as a hazardous waste, even when diluted to 20% concentration (by volume). Ethanol's flash point is 55°F and it is also subject to RCRA regulation at the same concentration.

The flammability of ethanol became a heightened issue in Canada in 2010 when a residential fire led the Infrastructure Health & Safety Association in Ontario to issue an advisory<sup>2</sup> cautioning contractors and workers to be aware of the hazard of working with ethanol and ethanol/water mixtures in geothermal loops. The Association noted that the National Fire Protection Association (NFPA) classifies ethanol/water mixtures as low as 20% as Class IC flammable liquids and that the Ontario Fire Code also classifies Class IC liquids as flammable.

<sup>2</sup> Infrastructure Health & Safety Association in association with the Ontario Ministry of Labour, December 2010.

## PG-based Fluids Reduce Risk

According to results of a University of New Mexico evaluation of heat transfer fluids for geothermal heat pump systems, propylene glycol-based products provide the required performance and system protection at lower risk than alternative fluids. The composite results shown in Table 1 below underscore the advantages of using a PG-based fluid like DOWFROST™ GEO 20 inhibited propylene glycol-based heat transfer fluid instead of methanol, ethanol or other non-PG fluids.

**Table 1 - Evaluation of Heat Transfer Fluids for Geothermal Heat Pump Systems<sup>3</sup>**

Category	Methanol	Ethanol	Propylene Glycol	Potassium Acetate	Aqueous Calcium Magnesium Acetate	Urea
Life Cycle Cost	3	3	2	2	2	3
Corrosion	2	2	3	2	2	1
Leakage	3	2	2	1	1	1
Health Hazard Risk	1	2	3	3	3	3
Fire Risk	1	1	3	3	3	3
Environmental Risk	2	2	3	2	2	3
Risk of Future Use	1	2	3	2	2	2

Key:

1 = Potential problems, caution in use is required  
 2 = Minor potential for problems  
 3 = Little or no potential for problems

<sup>3</sup> E.W. Heinonen, M.W. Wildin, A.N. Beall, and R.E. Tapscott, Anti-Freeze Fluid Environmental and Health Evaluation – an Update, The University of New Mexico, page 10.

## All PG-based Fluids Are Not Equal

Although most PG-based fluids can reduce flammability and toxicity hazards compared to alcohols, not all PG-based fluids provide the same level of corrosion protection as DOWFROST™ GEO 20. Corrosion and scaling within geothermal systems are hidden threats that can reduce heat transfer efficiency, restrict flow to increase pumping energy requirements, and lead to system failure or unplanned system shutdowns for costly maintenance or repairs.

Considering the investment in equipment and installation typical of geothermal systems – and the expectations of system

owners that their investment will be repaid over years of trouble free service – cutting corners on heat transfer fluid can be a serious mistake. It pays to install DOWFROST™ GEO 20, an inhibited PG-based fluid whose protection capabilities are well documented.

## Enhanced Corrosion Protection

DOWFROST™ GEO 20 fluid contains special inhibitors that satisfy ASTM D1384 requirements and provide long-term protection of common metals used in geothermal systems. When used at full strength, DOWFROST™ GEO 20 fluid does not sustain bio organism growth.

Thought by many to be non-corrosive, alcohols such as methanol and ethanol – as well as uninhibited PG formulations – represent greater corrosion risks in geothermal systems than properly inhibited PG-based fluids such as DOWFROST™ GEO 20. The corrosion threat posed by these fluids is shown in Figure 1 on the next page. Even if a PG-based fluid contains inhibitors, it may not provide the necessary protection against corrosion. Figure 2 shows that carbon steel and other metals will experience significant corrosion if the fluid is not properly inhibited. In contrast, DOWFROST™ GEO 20 provides highly effective protection.

While some competitive propylene glycol products claim equivalent protection, DOWFROST™ GEO 20 is a patented formulation and claims of equivalency are false or misleading. In fact, corrosion tests conducted with one competitive fluid showed corrosion of steel, cast iron and aluminum greatly exceeded ASTM limits (See Table 2).

**Figure 1 - Alcohols and Improperly Inhibited PG Pose a Corrosion Threat**



In the comparison above, carbon steel was exposed for two years to plain water, a 15% by volume alcohol formulation without corrosion inhibitors and a 15% by volume PG formulation without corrosion inhibitors. The fluid condition after the test shows that corrosion caused by the alcohol and the uninhibited PG was greater than that caused by water.

**Figure 2 - Two-year Corrosion Comparison**



The carbon steel pipe on the left was exposed for two years to an improperly formulated PG heat transfer fluid, while the carbon steel pipe on the right was immersed in DOWFROST™ GEO 20 for the same period of time. The difference in corrosion protection is significant.

**Table 2 - Corrosion Test Results for "Brand X" Inhibited PG Fluid**

Metal	Brand X Test Data	ASTM* Limit
Copper	1.6	10
Solder	9.2	30
Brass	3.7	10
Steel	199	10
Cast Iron	297	10
Aluminum	88	30

\*ASTM1384

**Consistency and Convenience**

Supplied at a 20% glycol concentration, DOWFROST™ GEO 20 is optimized to provide

excellent heat transfer efficiency and low viscosity to enhance pumpability and help minimize energy use. Because it is a fully formulated, ready-to-use fluid, its contents are consistent and documented so it provides reliable performance and protection. Other PG-based formulations may not offer the same consistency.

DOWFROST™ GEO 20 is easily installed with no need for on-site dilution or blending, eliminating dilution measurement errors and reducing the possibility of jobsite spills. Formulation consistency also ensures the accuracy of periodic fluid analysis so that system protection and efficiency can be maintained and fluid service life extended over time.

**A Right Choice for Today's Geothermal Customers**

DOWFROST™ GEO 20 fluid provides a total package of performance and protection, tailor-made to meet the needs of geothermal systems. To provide your customers with optimum performance, protection and the greatest peace of mind, choose DOWFROST™ GEO 20. To learn more about DOWFROST™ GEO 20 fluid, call, email or visit us online.

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