



Mastering Building Science

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Antifreeze in Geothermal Ground Loops: Selection Protocol

NORTHEAST REGIONAL GEOTHERMAL WORKSHOP
U.S. EPA New England Regional Laboratory
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Types of Antifreeze Used

- Methanol
- Ethanol
- Propylene Glycol



Methanol

- ▣ Very good from a performance standpoint
 - The best performing antifreeze
- ▣ Very poor from an environmental standpoint
 - High toxicity
 - Flammable

Ethanol

- ▣ **Very good from a performance standpoint**
 - Almost as good as methanol

- ▣ **Good from an environmental standpoint**
 - Denaturing agent only concern



Propylene Glycol

- ▣ **Poor from a performance standpoint**
 - Significantly worse than any other antifreeze
 - Perfect growth medium for bacteria
- ▣ **Very good from an environmental standpoint**
 - Food grade not appropriate for geothermal



Which One to Use?

- ❑ Methanol too toxic for me
- ❑ Propylene has too low of a performance for me
- ❑ Ethanol has the combination of low toxicity and good performance I am looking for in an antifreeze

In What Concentration?

- ▣ The standard in the NE has become using 30% propylene glycol and a 20°F loop temperature
 - This creates a very poor performing system
- ▣ I try to never use more than a 10% concentration of Ethanol, which minimizes the performance degradation caused by any antifreeze
- ▣ Never use an automatic feeder
 - It can create an environmental mess

Water

My preferred closed loop fluid

- ▣ Excellent from a performance standpoint
- ▣ Excellent from an environmental standpoint
- ▣ Most expensive to install due to longer loop lengths
- ▣ Lowest energy use of any closed loop system
- ▣ Vertical wells only



Direct use of Water

- ▣ **Very good from a performance standpoint**
 - Higher pumping energy needed
 - Higher efficiency
- ▣ **Very good from an environmental standpoint**
 - Water should be returned to the same aquifer it is taken from
 - Contamination risk low

POE Oil MSDS

III. POTENTIALLY HAZARDOUS INGREDIENTS

None

IV. HEALTH HAZARD DATA

INCLUDES AGGRAVATED MEDICAL CONDITIONS, IF ESTABLISHED

THRESHOLD LIMIT VALUE: **5.00 mg/m³ Suggested for Oil Mist**

EFFECTS OF OVEREXPOSURE: **Not hazardous except as oil mist. Prolonged or repeated overexposure to oil mists may lead to chronic pulmonary inflammation, in rare instances.**

V. EMERGENCY AND FIRST AID PROCEDURES FOR PRIMARY ROUTES OF ENTRY

EYE CONTACT: Flush eyes for 15 min, with large amounts of water. If material is hot, treat for thermal burns and take victim to the hospital immediately.

SKIN CONTACT: Remove contaminated clothing. If material is hot, submerge injured area in cold water. If victim is severely burned take to a hospital for burn treatment.

INHALATION: This material has a low vapor pressure and is not expected to present an inhalation exposure at ambient temperatures.

INGESTION: May act as laxative. Do not induce vomiting.

Why Efficiency Matters

- ▣ **Electricity used as fuel**
 - Electric production creates environmental contamination such as mercury
 - Higher peak use
 - The loop field will last for more than a century
 - The extra electricity use caused by inefficient antifreeze selection will always be present.
 - With Net-Zero Energy buildings the extra solar panels are more expensive than the extra loop length.

Questions?

