Mastering Building Science

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Antifreeze in Geothermal Ground Loops: Selection Protocol

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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
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
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
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 exposure 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.
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?