Ground Loop In The Vineyard?

Tuesday, March 14, 2017
Commercial – CT2 – Steamboat (11:00am)
Learning Objectives

• Understand which characteristics of a site are important for a closed-loop ground loop system
• Understand the influence of water inside and outside of the ground loop pipe.
• Be able to specify testing for both soil and water site-specific properties for ground loop system design.
Acknowledgements

• University of California, Davis Extension
• David Everett, Las Positas Community College, Livermore, CA
• Andy Kleinschmidt, Don McClure, “Introduction to Soils.”
Outline/Agenda

- Site characterization
- Soil properties
- The important role of water
- Ground loop in the vineyard?

Holly’s Hill Vineyards
Placerville, CA
Site Characterization

- Size and shape of the land or project site and its geology
- Topography
- Trees and overhead services
- Extent and location of surface water resources
- Location of existing and planned structures
Site Characterization

- Location of existing and planned wells and septic systems
- Existing and planned hardscape and landscape
- Easements, setbacks, legal requirements or limits (i.e. depth) for using the land
- State or local ground water regulations
Geology and Drilling Methods for Ground-Source Heat Pump Installations: *An Introduction for Engineers*

Harvey M. Sachs
Vineyard Site Selection

- Topography
- Orientation
- Soil Profile
- Climate (Eto)
- Availability of water (rain, surface water, ground water)
- State or local ground water regulations

Rheingau Region
Soil Formation Properties for Ground Loop Design

- Thermal conductivity
- Deep earth temperature
- Daily temperature swing (horizontal loops)
- Thermal diffusivity
- Chemistry
Where is this information found?

- Drilling logs
- Driller, experience
- Formation thermal conductivity (TC) test
- Geotech reports

Bore Information:

<table>
<thead>
<tr>
<th>Completed Depth:</th>
<th>400'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bore Diameter:</td>
<td>10&quot; 0 - 40' 7&quot; 40 - 400'</td>
</tr>
<tr>
<td>Loop Diameter:</td>
<td>1&quot;</td>
</tr>
<tr>
<td>Grout:</td>
<td>CGPlus 120 1.2</td>
</tr>
</tbody>
</table>

Drilling Log:

<table>
<thead>
<tr>
<th>Start</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>35</td>
</tr>
<tr>
<td>35</td>
<td>67</td>
</tr>
<tr>
<td>67</td>
<td>87</td>
</tr>
<tr>
<td>87</td>
<td>200</td>
</tr>
<tr>
<td>200</td>
<td>400</td>
</tr>
</tbody>
</table>

Formations:

- Clay
- Sandy clay, gravel & sandstone ledges
- Sandy clay
- Silty sandy clay
- Clay ledges with decomposed sandstone layer

Courtesy of Ohlone College
Test Results

- Thermal conductivity
- Thermal diffusivity
- Deep earth temperature

- Test results DO NOT specify lf/ton
Thermal Conductivity Testers

Courtesy of GRTI

Courtesy of CM Engineering
Depth and Temperature Daily Swing

- Required information for horizontal loop design
- Varies by geographical location
- Varies by depth

**FIGURE 1.2: Annual Soil Temperature Variation, Stillwater, Oklahoma**
Design Guide for Residential and Light Commercial
Soil properties for a Vineyard

- Structural
- Biological
- Chemical
Zone of highest organic matter content. The ‘p’ denotes that this soil has been plowed.

A layer of accumulation of iron and clays. Blocky structure is readily seen in this layer.

Unconsolidated material. Outside the zone of major biological activity and is not affected by soil forming processes.
Biological Properties

• Soil Organic Matter
• Earthworms
• Micro-organisms (fungi, bacteria, actinomycetes)
Chemical Properties

• Soil pH
• Salinity
• Sodicity
• Slaking and Dispersion
The important role of water

- Outside the loop
- Inside the loop
2016 IGSHPA Standards
Section 3 - Source Water Piping, Circulation, Antifreeze, Water Quality and Treatment.
Inside the loop

• 3A Circulations System
• 3B Water Quality
• 3C Water Treatment and Monitoring
• 3D Heat Transfer Fluids
• 3E Source Water System Start-up
Inside the loop

- Follow equipment manufacturer’s recommendations for water quality

<table>
<thead>
<tr>
<th>Material</th>
<th>pH</th>
<th>Acidity/Alkalinity</th>
<th>Copper (pH 7 - 9)</th>
<th>90/10 Cupronickel (pH 7 - 9)</th>
<th>316 Stainless Steel (pH 7 - 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scaling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium and Magnesium Carbonate</td>
<td></td>
<td>Total Hardness less than 350 ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogen Sulfide</td>
<td></td>
<td>Less than 0.5 ppm (rotten egg smell appears at 0.5 ppm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfates</td>
<td></td>
<td>Less than 125 ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorine</td>
<td></td>
<td>Less than 0.5 ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorides</td>
<td></td>
<td>Less than 20 ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td></td>
<td>Less than 50 ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td></td>
<td>Less than 2 ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia Chloride</td>
<td></td>
<td>Less than 0.5 ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia Nitrate</td>
<td></td>
<td>Less than 0.5 ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia Hydroxide</td>
<td></td>
<td>Less than 0.5 ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonia Sulfate</td>
<td></td>
<td>Less than 0.5 ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Dissolved Solids (TDS)</td>
<td></td>
<td>Less than 1000 ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSI Index</td>
<td></td>
<td>+0.5 to -0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron, Fe²⁺ (Ferrous Iron Potential)</td>
<td></td>
<td>&lt; 0.2 ppm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron Oxide</td>
<td></td>
<td>Less than 1 ppm, above this level deposition will occur</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erosion</td>
<td></td>
<td>Less than 10 ppm and filtered for max. of 600 micron size</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Threshold Velocity (Fresh Water)</td>
<td></td>
<td>&lt; 6 ft/sec</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Ground Loop In The Vineyard?
Vineyard in Calistoga, CA

• Pond Loop
• Process water for winemaking and barrel storage
• Radiant in-floor heating
• HVAC for winetasting room
Vineyard Irrigation Santa Rosa, CA

Courtesy of Air Connection
Vineyard in Sonoma, CA

- Vertical Loop
- Chilled water for wine storage
- Domestic Hot Water
Vineyard in Acampo, CA

- Horizontal Loop
- Radiant in-floor heating
- Chilled water fan coils
- Domestic Hot Water
Review Learning Objectives

• Understand which characteristics of a site are important for a closed-loop ground loop system
• Understand the influence of water inside and outside of the ground loop pipe.
• Be able to specify testing for both soil and water site-specific properties for ground loop system design.
Conclusion

• Take the time to review and understand site specific conditions (in addition to project requirements)
• Understand the role water plays in the project design
• Support your local wine grower!
Questions?

Lisa Meline, P.E.
lisa@meline.com