

## Descaling Geothermal Heat Exchangers and Boilers

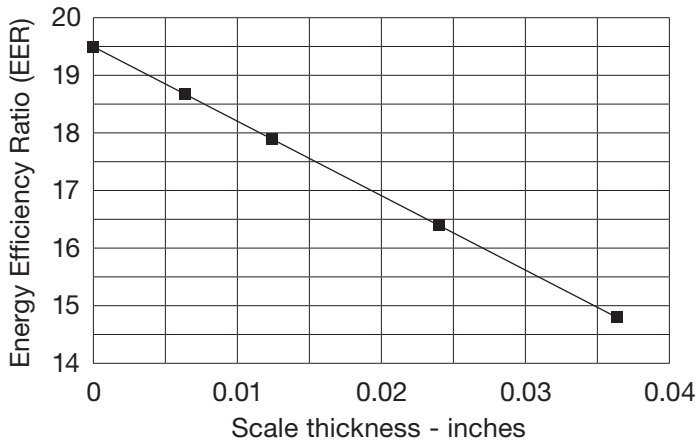


Internal cleaning of boilers and geothermal heat exchangers is sometimes necessary to remove mineral deposits (scale) that accumulate during the operation of the equipment. For boilers, a descaling program may need to be implemented with process equipment where scale-forming make-up water is continually added to the system.

For geothermal systems, both closed loop and open loop designs are used since each offer advantages. For open loop systems, the primary benefit is the lower energy cost since there is a less loss in heat transfer when compared to a closed loop system as the water (via lake, river or well) is being pumped directly from the source through the heat exchanger within the dwelling and then back to its source. A major disadvantage to open loop systems is that the heat exchanger can become quickly fouled with both scale deposits and suspended matter (dirt, sand, etc.). For closed loop systems, this usually is a non-factor, but corrosion and subsequent deposition of corrosion deposits can occur. To illustrate the impact of scale on a ground source heat pump, figure 1 shows how performance drops dramatically as scale forms.

Figure 1

**Impact of Scale on Performance**  
cooling mode - 55°F Entering Water Temperature



Source: U.S. Department of Energy  
Contract No. DE-FG07-90ID

Geothermal systems can be equipped with an auxillary coil to supplement heating hot water for a dwelling. In areas of hard water, this coil can be fouled with minerals eliminating the benefit of 'free heat' from the refrigeration cycle of the heat pump system. If the coil can be isolated, it can be revitalized by the removal of lime scale from time to time to maintain it's benefit.

## Descaling Guidelines

Note: With any descaling procedure, wear goggles, gloves and other protective wear. Always descale in a well-ventilated area. Also, have the device or circuitry properly vented to prevent the build-up of pressure from carbon dioxide gas formed as a byproduct of the descaling process.

### Boilers:

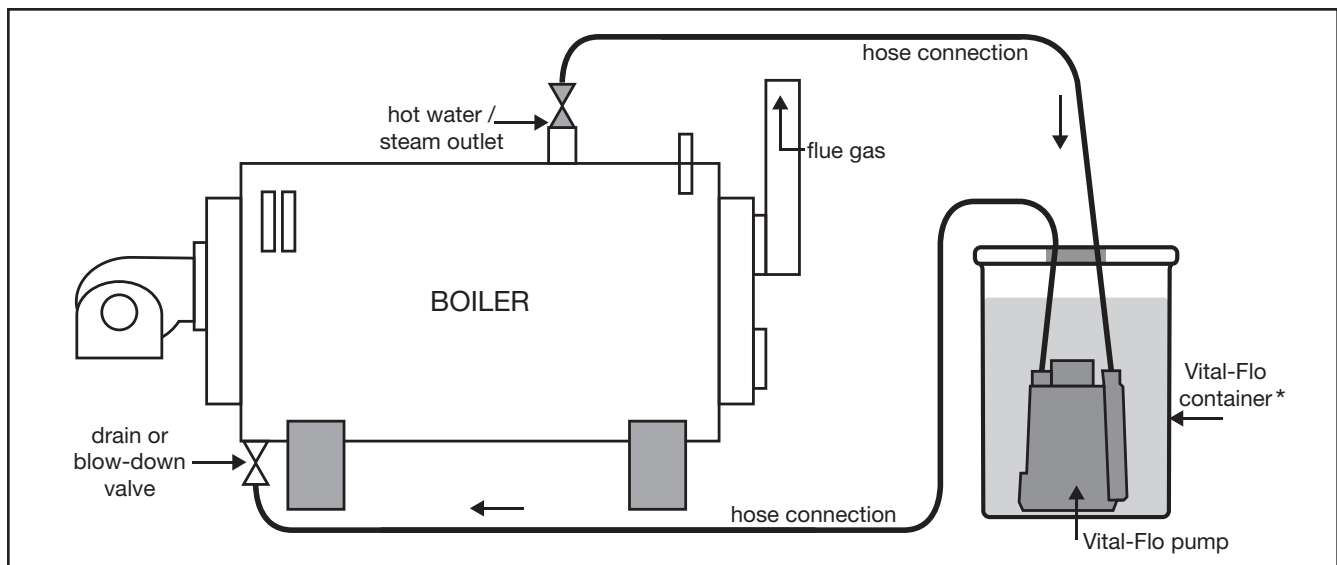
**Soak Method:** The boiler must be isolated during the descaling process to ensure the Eco-Lyme or dissolved Season Start solution does not come into contact with the pump, vent, relief valve or other components.

- Prepare an initial dosage of descaler solution by mixing one part Eco-Lyme with one part water or prepare dissolving 1 lb. of Season Start per 5 gallons of water.
- Fill the boiler with diluted Eco-Lyme or Season Start solution and allow to soak until chemical activity stops (Eco-Lyme) or changes color (Season Start). The soak method is the simplest and is often used on smaller units. However, it usually is not as thorough as the circulation method described below.
- Continually to inspect the Eco-Lyme solution for chemical activity (outgassing) or color change with Season Start as it removes scale.
  - **Eco-Lyme:** If chemical activity stops, check using pH paper that is supplied with each bottle of Eco-Lyme. If the pH paper shows the color red, the solution is at working strength indicating all of the scale has been removed. If the pH paper is orange/yellow, the active ingredient in Eco-Lyme has been consumed. In this case, add additional Eco-Lyme to the solution and repeat the observation process and validate behavior with pH strips. Continue to monitor until Eco-Lyme maintains its working strength for 30 minutes in the to ensure all scale is removed.
  - **Season Start:** Continually observe the color of the solution. If it changes purple from a green or light blue color, more Season Start is required. Continue to repeat the process until dissolved Season Start maintains a green or light blue color for 30 minutes to ensure all the scale is removed.

**Circulating Method:** The boiler must be isolated during the descaling process to ensure the Eco-Lyme does not come in contact with the pump, vent, relief valve or other components.

- Prepare an initial dosage of descaler solution by mixing one part Eco-Lyme with one part water.
- Fill the boiler and half fill a Nu-Calgon Vital-Flo container with diluted Eco-Lyme solution.
- Submerge the Vital-Flo submersible pump into container and turn on pump.
- Continually monitor chemical activity of the circulating solution with pH paper as detailed in the soak method. If the chemistry has been consumed, continue to replenish spent solution with additional Eco-Lyme.
- Repeat process until chemical activity stops while a working strength solution for 30 minutes. This wait period will ensure all the scale has been removed.

Note: Season Start could be used by dissolving an initial dosage of 1 lb. per 5 gallons of water.



\* A larger acid resistant container should be used for larger systems to hold more descaler solution.

For both methods, care should be taken not to leave the acid in the boiler any longer than necessary to descale the device. In many situations, descaling can be accomplished within an hour or two. Never leave Eco-Lyme solution in boiler beyond six hours or Season Start solution beyond 24 hours. Never use Eco-Lyme on any galvanized surface. When descaling is complete, the unit must be thoroughly flushed with water to remove any descaler residuals. Dispose the cleaning solution following local regulations.

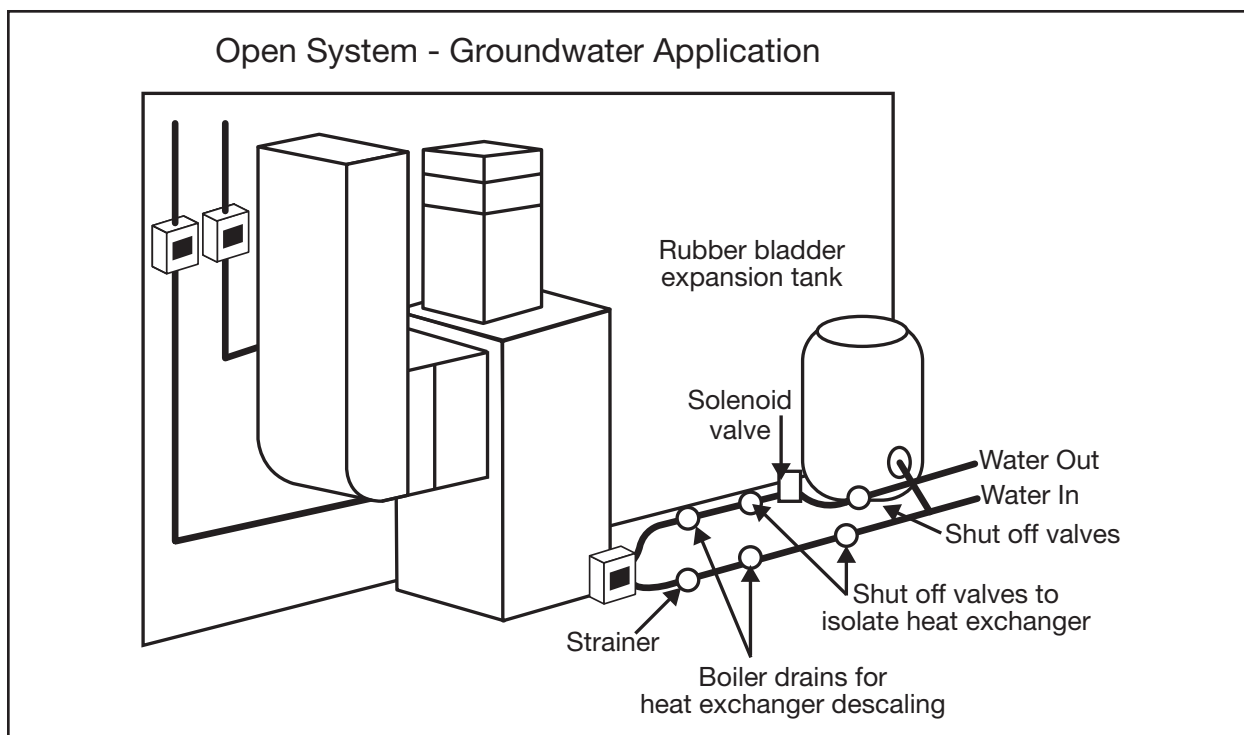
## Geothermal Systems

**Open Loop Systems:** The secondary heat exchanger must be isolated during the descaling process to ensure the Eco-Lyme or Season Start solution does not come in contact with water pump or other components in the water circuit.

- Prepare initial dosage of Eco-Lyme solution by mixing one part Eco-Lyme per one part water.
- Fill half the Vital-Flo container with diluted Eco-Lyme.
- Add the Vital-Flo submersible pump in the diluted Eco-Lyme and connect pump to isolated heat exchanger.
- Turn on pump and continually monitor chemical activity of the circulating solution with pH paper.
  - If the pH paper remains red, the solution is at a working strength. If the pH paper remains orange/yellow, the activity chemistry in Eco-Lyme has been consumed and more is needed.
  - If the chemistry is consumed, replace neutralized solution with additional diluted Eco-Lyme and resume descaling and frequently check working solution of circulating solution (every 15-20 minutes). Repeat process until Eco-Lyme solution maintains its working strength (pH paper is red) for 30 minutes to ensure coil is fully descaled.

Note: Follow above guidelines for closed loop systems if deemed the heat exchanger must be cleaned.

Also, Season Start could be used by dissolving an initial dosage of 1 lb. per 5 gallons of water.



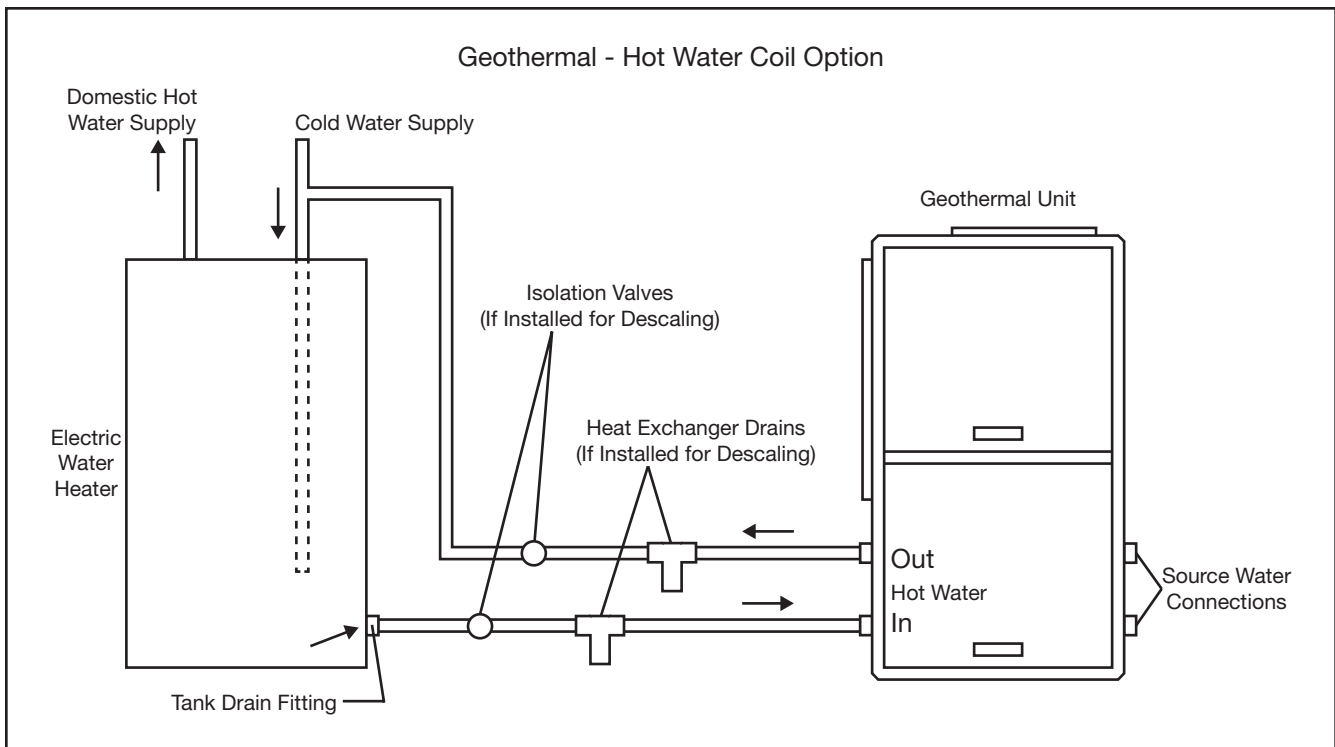
### Hot Water Coil Option:

If the geothermal system is equipped with an auxiliary hot water coil to supplement heating water in the dwelling, the coil can be fouled with mineral deposits from the supply of scale-forming water. If the water circuit from the geothermal unit to the water heater was installed with isolation valves/drains at installation, it is possible to isolate and revitalize the auxiliary hot water coil by removing scale.

- Isolate the hot water coil during descaling to ensure the Eco-Lyme or Vital-Flo solution does not flow into the water heater/buffer tank or be in contact with other components in the circuit.
- Fill half the Vital-Flo container with either Eco-Lyme (one part Eco-Lyme, two parts water dilution) or with the Vital solution (one 8 fl. ounce bottle per two gallon water dilution).

- Add the Vital-Flo submersible pump in the diluted chemical solution, connect pump circuit to isolated heat exchanger through hose bibs and turn on pump.
- Continually monitor chemical activity of the circulating solution with pH paper.
- If the pH paper remains red, the solution is at a working strength. If the pH paper remains orange/yellow, the active chemistry in Eco-Lyme or Vital-Flo has been consumed and more is needed. If the chemistry is consumed, add more Eco-Lyme or Vital-Flo solution in Vital-Flo canister.
- Resume descaling until chemical activity stops while a working strength solution has been maintained for 30 minutes, by validating with pH paper. This indicates all the scale has been removed. If a third addition of descaler is required, properly discard the spent solution in the container and start anew with a fresh solution. However, in most situations the coil can be descaled within 45 minutes.

In both cases, care should be taken not to leave the descaling chemistry in the heat exchanger any longer than necessary. When descaling is complete, the unit must be thoroughly flushed with water to remove any descaler residuals from the heat exchanger. Dispose the cleaning solution following local regulations.



**For additional information on Eco-Lyme consult Nu-Calgon Bulletin 3-43 or request Bulletin 3-14 for Season Start. For information on Vital-Flo, refer to Bulletin 3-7.**

