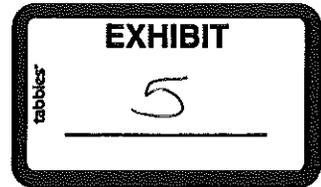


EARTH LINKED  
TECHNOLOGIES

Infinite Energy for Heating and Cooling

JUN 08 2009



June 6, 2009

Mr. Gary Berner  
Department of Consumer Protection  
State Office Building  
165 Capitol Avenue, Room 103  
Hartford, CT 06106  
*[via email Gary.Berner@ct.gov]*

RE: Direct Exchange Geothermal Information Session, June 8, 2009

Dear Mr. Berner:

I am writing to address the specific issues raised in the attachment to Commissioner Farrell's letter of May 15, 2009, in regard to Direct Geoexchange heat pump systems. We support the promulgation of appropriate and reasonable regulations for the protection of the public and the groundwater of the state, and wish to provide information on those subjects.

EarthLinked Technologies, Inc (ETI) is the global technology leader in direct geoexchange systems with 29 years experience, consultation with four universities, nine patents received and two pending, monitoring by US EPA, the Florida Solar Energy Center, nine electric utilities (including Connecticut Light and Power), and systems operating in 47 states and 16 countries, from Australia to Alaska, with over 100,000,000 hours in service.

Connecticut has a substantial heating load, is one of the states that EPA had determined "contributed substantially to non-attainment . . . of national ambient air quality standards . . .,"<sup>1</sup> thus the need to improve air quality, the highest residential electric rates in the 48 contiguous states as of April, 2009,<sup>2</sup> and large luxury homes are being added to the system at a time when electric generating and distribution facilities are constrained. To reduce the cost of heating and cooling, the emission of pollution and greenhouse gases, and the need for additional generation, it is desirable to use every available clean energy technology. The U.S. EPA and DOE have determined that geothermal heat pumps are the most energy efficient heating systems and the most environmentally clean in most applications.

The State of Connecticut promotes the installation of Direct Geoexchange heat pump systems. Through the Connecticut Energy Efficiency Fund, a \$500 per ton incentive (maximum incentive is

<sup>1</sup> Federal Register, Vol. 73, No. 16, January 24, 2008.

<sup>2</sup> [http://www.eia.doe.gov/cneaf/electricity/epm/table5\\_6\\_a.html](http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_a.html)

\$3,000) for the installation of ARI-rated Direct Geexchange systems is offered by Connecticut Light & Power and United Illuminating Company<sup>3</sup>. All geothermal systems must be performance-tested in order to qualify for the incentive.

The EarthLinked<sup>®</sup> system (Attachments #1 and #2) is a direct geexchange heat pump that circulates refrigerant for heat exchange in small copper tubes buried in the upper 100 feet of the earth's surface. The system is used to heat and cool residential and small commercial buildings and to heat water. What ETI requires to assure good heat transfer in the earth also serves to protect ground water, i.e., small diameter/shallow bore holes that only displace a minimal amount of earth; grout the entire hole with thermally enhanced grout and prohibit the use of sand as a backfill in the bore hole.

The system has been the subject of 10 electric utility monitoring projects from southern to northern climates, including CT. Consumers Power Company of Jackson, Michigan conducted an 18 month field test and reported that the system is 25% more efficient than water-based geothermal heat pump systems (Attachment #3). That efficiency reduces the use of electric power and the resulting emissions in the generation of electricity or on-site burning of fossil fuels. In fact, EarthLinked systems have replaced many oil fired furnaces in New England, which posed a hazard to groundwater through oil spills and tanks leaks.

There is regulatory precedent in the states of Florida, Michigan, Wisconsin, North Carolina and Colorado for the use of direct geexchange systems. In many other states and countries, they are permitted under general drilling regulations without specific regulation. As the number of installed units increases, there is growing proof of the benefits and the absence of risks.

In 2006, the US EPA completed 15 months monitoring the performance of an EarthLinked<sup>®</sup> Commercial Water Heating unit in a nursing home. The EPA report states that the system saved 75% of the electrical energy that would otherwise be required to heat water. It resulted in avoiding the emission of 7,100 lbs of CO<sub>2</sub> and 15 lbs of NO<sub>x</sub> per ton of capacity per year. That equates to 42,600 lbs of carbon dioxide and 90 pounds of nitrous oxides annually by a 6 ton system, which is equal to not burning 3,642 lbs of gasoline or 74 barrels of oil each year. More detail is provided in a summary attached (Attachment #4).

An EPA position letter concerning direct geexchange heat pumps is attached (Attachment #5).

The development of this technology has led to 1) the issuance of nine U.S. patents for heat pump innovations and two more are pending; 2) infrastructure including small bore drilling equipment, and

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<sup>3</sup> Connecticut Light & Power:

- <http://www.cl-p.com/clmres/energy/geothermal.asp>
- [http://www.cl-p.com/clmres/energy/VIP\\_Direct\\_DX\\_Worksheet.xls](http://www.cl-p.com/clmres/energy/VIP_Direct_DX_Worksheet.xls)

United Illuminating Company:

- <http://www.uinet.com/uinet/connect/UINet/Top+Navigator/Your+Home/UI+Products+&+Services/Geothermal+Heat+Pumps/>
- [http://www.uinet.com/uinet/resources/file/ebd4f90ec8e6458/VIP\\_Direct\\_DX\\_Worksheet.xls](http://www.uinet.com/uinet/resources/file/ebd4f90ec8e6458/VIP_Direct_DX_Worksheet.xls)



3) specialized small bore drillers who are trained and equipped to install and grout small bore earth loops in limited space.

#### **Heat Transfer Media:**

- Water wells are typically at least 6" in diameter, and are drilled to a depth that connects them with an underground water supply. Water-based closed loop geothermal wells are typically 6" in diameter and are drilled to depths of 200 to 500 feet. Direct geexchange heat pump bore holes are typically 3" to 4" in diameter and are drilled to a maximum depth of 100 feet. They do not need to connect to underground water. The majority of EarthLinked bore holes are 35 to 71 feet in depth and they displace only 11% of the soil displaced by a typical water-based geothermal bore hole (of 6" x 250'), thus the potential for impact on groundwater is minimal in comparison.
- In 1984 EarthLinked Technologies (formerly ECR Technologies, Inc) applied to the State of Florida for a blanket drilling permit for installations in Florida. As a condition for action on that request, the Department of Environmental Regulation required environmental and metallurgy studies.
- The environmental study (Attachment #6) was conducted by an environmental engineering professor at the University of South Florida. As a result of those studies and their own analysis, the Department issued its Declaratory Statement granting the request (Attachment #7). That favorable Declaratory Statement was reaffirmed and updated in 2007 (Attachment #8).
- The Manufacturer's Safety Data Sheets (MSDS) on Refrigerant-22 (Attachment #9) and R-407C (Attachment #10) are appended. They show that these refrigerants are non-toxic and not soluble in water. Because they are not explosive, flammable or hazardous, and have very low toxicity, they are not a risk to homeowners. However, just as the anti-freeze used in water based geothermal heating/cooling systems, heating oil, and natural gas are not intended for human consumption, these refrigerants are not classified as "food grade". As reported in the report by Dr. Murphy referred to earlier, they have low toxicity to plant and animal life.

#### **Construction Materials:**

- The EarthLinked Installation and Start-Up Manual requires that these small diameter holes be filled with an earth loop and completely grouted with thermally enhanced grout to assure good thermal contact and preclude a direct conduit to groundwater. This is done promptly after boring the hole to avoid its collapse or contamination of ground water. The Manual also requires 24-hour pressure testing of the loops with Nitrogen at 400 psi, which is 200% of operating pressure.
- The materials used in the installation of earth loops for heat transfer in the ground consist of copper tubes, 15% silver brazing solder and grout. Clean builders sand is used to cushion the manifold near the surface. ETI has never experienced the loss of a production earth loop due to corrosion. As explained in the technical paper, "Copper Tubing in Soils" (Attachment #11), copper is a noble metal that resists corrosion in most soils. ETI offers a non-sacrificial Cathodic Protection System that emits a small amount (milliamps) of impressed electrical current that precludes corrosion even in harsh environments. ETI did extensive research in its early years on



the subject of “rust inhibitors” and determined that they do not offer a complete solution, as does the Cathodic Protection System.

- Grouting of the entire hole is essential to prevent voids and assure good heat transfer and avoid cross contamination of ground water. The recommended grout is Geo SuperGrout™, a thermally conductive, bagged material specifically developed for geothermal bore hole sealing. When water is added it takes on a liquid form that can be poured or pumped into the hole to form a solid seal and heat transfer medium. It has a pH of 12-13 in water, thus is protective of copper. It is approved by NSF International under Standard 60 as a well sealant (Attachment #12), thus is safe for use in connection with drinking water. The MSDS (Attachment #13) describes the material as non-hazardous.

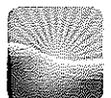
#### **Permitting and Licensing Issues:**

- Precaution is taken to avoid drilling into underground structures or pipes by inquiring of the property owner and calling “Dig Safe”, or the local equivalent to identify underground wires, pipes and structures.
- Grouting is discussed above.
- Borehole permitting. We suggest that the proposed regulations must not restrain trade in direct geexchange systems in Connecticut or create a monopoly for a segment of the drilling industry that only operates water well drilling equipment that is not needed for the small bore holes required for Direct Exchange systems. That equipment cannot access most of the small spaces available for urban residential retrofit installations now served by DX, is more expensive to employ, drills a larger hole that reduces heat transfer, and increases the amount of grout required.
- Training and experience to be required of drillers. ETI is currently working to establish a national association for the Direct Geexchange industry that will include installer qualification standards, training and installation standards (which ETI currently provides). We will be pleased to consult with the appropriate Department in the State of Connecticut to draft such standards.
- In the event of an accident, property owners are protected by the installing company’s legal liability and its insurance carrier.

#### **Summary:**

In summary, the greatest protection of groundwater is achieved with the smallest hole possible for the system being installed, which also reduces the amount of excavated material and the energy required to excavate it. As stated in Attachments #6-10: 1) the loops do not inject and are not reasonably expected to inject any fluid into the soil; 2) are not expected to contaminate the soil because the refrigerant has very low toxicity, is largely insoluble in water; and 3) any released refrigerant would immediately vaporize.

The MSDS’s state that the refrigerants are low in toxicity; ingestion is unlikely because of the physical properties (evaporates above -40.8°F) and are not expected to be hazardous. They have very low solubility in water; they not a hazardous waste; and 5) the MSDS on the mineral oil lubricant,

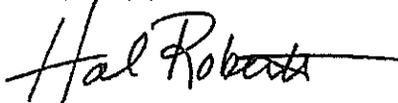


SUNISCO 3GS REFRIGERANT OIL, states that it is not soluble in water and describes the Health Hazards as possible irritation to the eyes and gastrointestinal tract, if ingested.

We respectfully suggest that the major environmental and energy saving benefits of the EarthLinked system eclipses the extremely remote risk of a cross-connection of surface water and groundwater being created by the installation of an EarthLinked system; or refrigerant or a few ounces of mineral oil being released in the soil if an earth loop were breached.

To simplify and clarify the proposed Regulations for the benefit of government officials, the industry and consumers, we would request that the Regulations be separated into different sections that address direct geexchange bore holes separately from the licensing requirements for other types of bore holes.

Very truly yours,



HAL ROBERTS, CEO

HR/ph

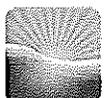
Attachments (13)

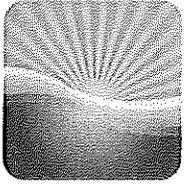


## **Index to Attachments**

*(click on links below to display attachment)*

1. **EarthLinked<sup>®</sup> Geoexchange Heating and Cooling Systems fact sheet**
2. **EarthLinked<sup>®</sup> Geoexchange Commercial Water Heating fact sheet**
3. **Consumers Power Company report summary**
4. **EPA report summary (2006)**
5. **EPA position letter re. direct geoexchange heat pumps (2003)**
6. **USF environmental study (by R. Jerry Murphy, Ph.D.)**
7. **Florida blanket drilling permit (1987)**
8. **Florida blanket drilling permit update (2007)**
9. **MSDS on R-22**
10. **MSDS on R-407C**
11. **Copper Tubing in Soils paper**
12. **NSF Listing on Geo SuperGrout<sup>™</sup>**
13. **MSDS on Geo SuperGrout<sup>™</sup>**





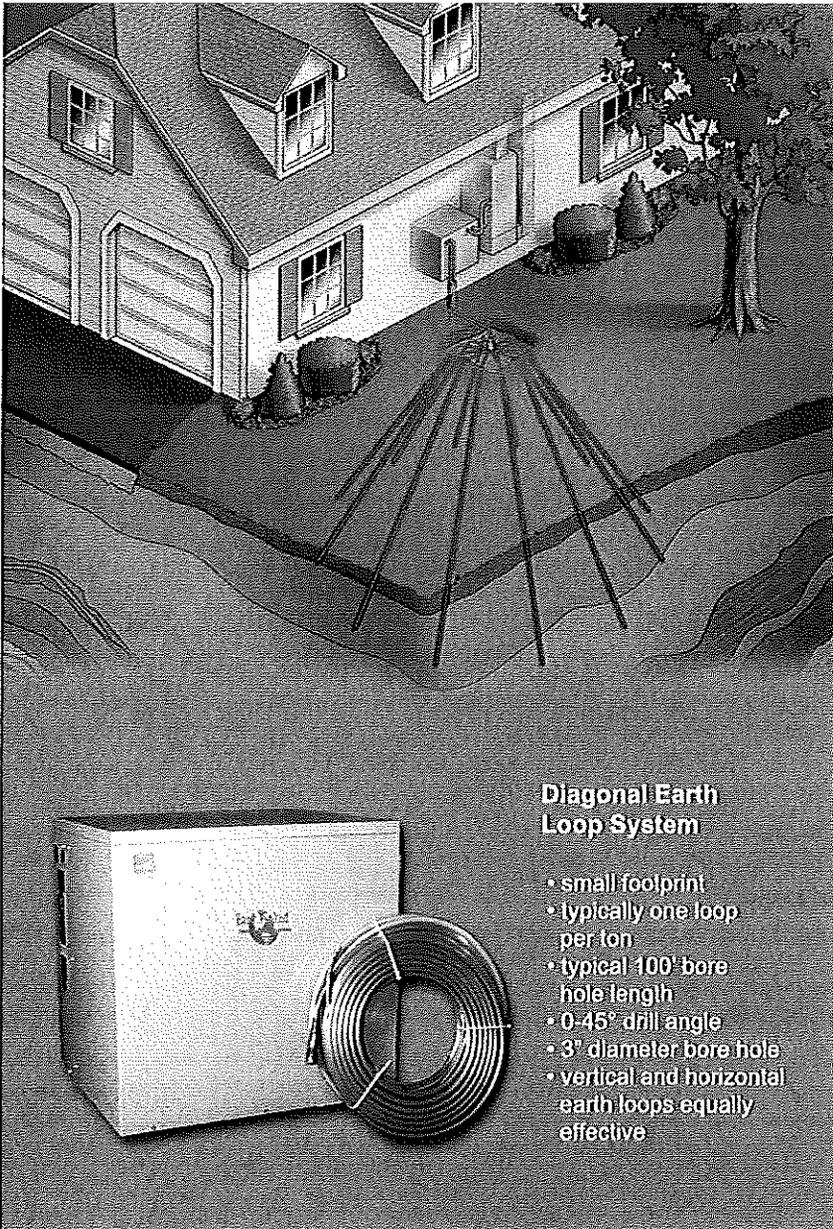
# EarthLinked<sup>®</sup> Heating and Cooling Systems With Optional Water Heating

## 40-60% Savings in Operating Cost

### Solar Energy from the Shallow Earth

Reduced fossil fuel consumption, reduced emissions and increased comfort result from the use of renewable solar energy stored in the shallow earth. These benefits are delivered by the EarthLinked<sup>®</sup> heat pump system.

Almost half of the sun's energy that reaches the earth is stored in the ground, resulting in a solar battery that can be used for heating anytime, anywhere that people live. The constant and favorable temperature of the earth also makes it a favorable heat sink to receive unwanted heat in the cooling season.



### Diagonal Earth Loop System

- small footprint
- typically one loop per ton
- typical 100' bore hole length
- 0-45° drill angle
- 3" diameter bore hole
- vertical and horizontal earth loops equally effective

The EarthLinked system is a heat pump that uses the refrigeration cycle to move heat from one location to another, like an air conditioner that can also operate in reverse. It's a unique heat pump because the patented refrigerant flow controls enable it to directly connect with small earth loop tubes that can be installed vertically, diagonally or horizontally in 3" bore holes 50 to 100 feet (15 to 30 m) in length. Typically, the earth loops are 100 feet per ton (12,000 BTU) of capacity.

The diagonal loop configuration exchanges heat in a large subsurface area but impacts a small six foot diameter area at the surface during installation. The system, the earth loops and the boring equipment are small, so the installed footprint is small and the system is very adaptable for retrofit installations.

Because of its efficient use of the favorable earth temperature as a heat source/heat sink and its direct heat exchange method, the EarthLinked system is more efficient than an air source heat pump (ASHP) and other geothermal heat pump (GHP) units that must circulate water for heat exchange.

### One System, Multiple Uses

Whether you live in Australia or Alaska, the EarthLinked system is the simple solution to a comfortable environment throughout your home. A single unit can provide space heating and cooling, and water heating, no matter the climate conditions. Because of its small size and mechanical simplicity the system is convenient, reliable and easy to maintain.

### Space Heating and Cooling

Thousands of property owners in North America and around the world use EarthLinked to heat or cool buildings. The system delivers a stable, comfortable temperature all year round. In summer there is a greater dehumidification because of colder refrigerant coils and longer run cycles. In winter there are no blasts of hot air as with a furnace, and the heated air is warmer than with an air source heat pump because the earth is a warmer heat source. For maximum winter comfort and efficiency, the EarthLinked system can also be coupled with a radiant hydronic system.

### Water Heating Option

You can use the EarthLinked system to heat water up to 125°F (52°C), optimizing your energy consumption and saving money. The system uses waste heat given off in the air-conditioning mode in summer or natural heat stored in the ground and harvested by the heating mode in winter. Either way, you can reduce your water-heating costs by as much as 75% compared to electric resistance heating.

### Swimming Pool Heating

No matter the size of your pool, the EarthLinked system can quietly heat the water to a comfortable temperature without harmful combustion byproducts—all with the highest efficiency.

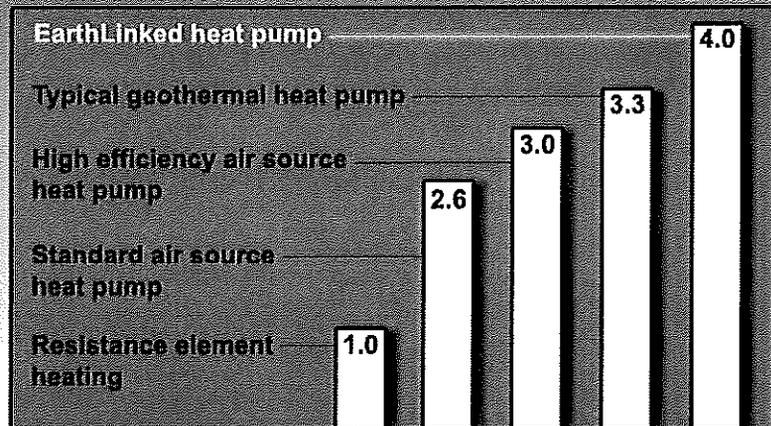
## EarthLinked Advantages Over High Efficiency ASHPs

- Saves 40-60% in operating costs on an annual basis.
- Increases comfort by efficiently using the favorable earth heat source to provide greater than 100°F supply air.
- Does not lose efficiency as ambient air temperature drops, as an ASHP does.
- Achieves high efficiency without having to utilize variable speed compressors or multi-speed fans.
- Can be located in a utility room or basement because of the elimination of the need to circulate air over the exterior evaporator/condenser.
- Quiet operation resulting from total system enclosure and elimination of an exterior fan.
- Exterior condenser/evaporator unit (fan coil in ASHP) is buried out of sight, protected from damage or theft.
- Approximately one-half the size of a typical ASHP unit.
- No anti-freeze; not subject to freezing; no defrosting required.
- Has greatly improved reliability and serviceability.
- Eliminates the exterior condenser/evaporator coil, fan, fan motor and capacitor, defrost timer, and ancillary wiring, making it mechanically and electrically simpler.
- Extends compressor life by reducing compressor run temperature.
- Continues to operate even when evaporator surface (earth loop) is enveloped in ice.

## EarthLinked Advantages Over Typical GHPs

- Controls assure more efficient operation of compressor, evaporator and condenser.
- Eliminates large closed-loop plastic piping system, with its inefficient intermediate heat transfer. (GHP earth loops must be purchased in parts, assembled on site, installed, filled with antifreeze and water, and pumped constantly while system is operating.)
- Mechanically simpler and more reliable; easier to service.
- Utilizes bore holes 3" in diameter in contrast to 6" bore holes of water-based systems.
- Less drilling equates to lower installed cost.

## Comparative Efficiencies



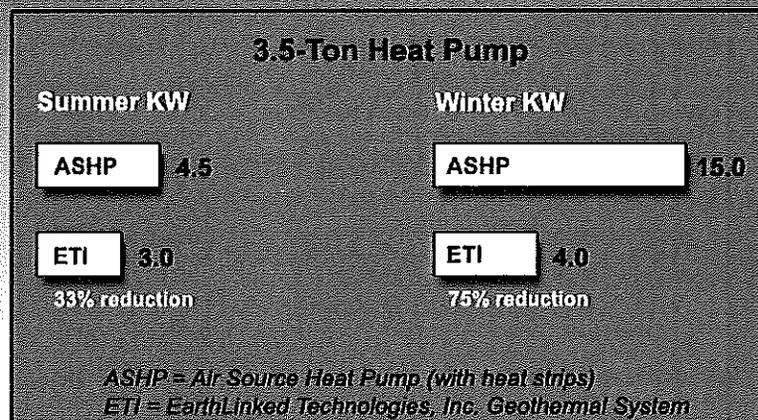
## Consumer Benefits of EarthLinked vs. Typical ASHPs

- Greater comfort from favorable constant temperature of the earth.
- 40-60% operating cost savings.
- 60% sound reduction; 50% size reduction.
- Reduced cost of maintenance and service.
- Competitively priced.
- Less than 60-month payback.

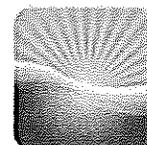
## EarthLinked Advantages to Electric Utility

- Weather sensitive winter peak demand reduction of approximately 60%.
- Weather sensitive summer peak demand reduction of 30%.
- Gain in winter load share by replacing on-site fossil fuel firing.
- Improvement in load factor.
- 100% green energy potential with wind and photovoltaic energy.

## Maximum Electric System Demand



Contact Your EarthLinked Dealer



**EARTHLINKED**  
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4151 S. Pipkin Road  
Lakeland, FL 33811  
tel. 863-701-0096  
[www.earthlinked.com](http://www.earthlinked.com)

**EPA verified savings up to 75% using renewable energy**

# EarthLinked® Commercial Water Heating

The EarthLinked® Water Heating system delivers the highest efficiency of any powered water heating system. It is a heat pump that harvests abundant renewable energy directly from the earth. The systems have been heating water since 1983, primarily as an optional feature of heat pumps for space heating and cooling.

The system's most economic water heating application is to heat or preheat water for large users such as motels, multi-family dwellings, healthcare facilities, food processors and restaurants.

Field testing by U.S. EPA verified up to 75% energy savings and avoidance of the emission of up to 7,000 pounds of CO<sub>2</sub> and 50 pounds of NO<sub>x</sub> per ton of heat pump capacity each year, as compared to electric resistance water heating (up to 42,000 pounds of CO<sub>2</sub> and NO<sub>x</sub> each year by a 6 ton system).

## How the System Works

EarthLinked® transfers heat by circulating ozone friendly refrigerant in copper earth loops that are trenched or bored into the earth. The liquid refrigerant transfers heat from the constant temperature of the ground, through a patented flow control device to the compressor.

The compressor raises the refrigerant pressure and temperature, and routes the hot vapor to a heat exchanger. The refrigerant vapor, passing through sealed channels, transfers heat to circulating water. The water is heated and delivered to the hot water storage tank.

## Application of the EarthLinked® System

The most economic application of the EarthLinked® system is to preheat large quantities of cold water. Typically, the system provides preheated water to standard 120-gallon water heater tanks. As hot water is used, the preheated water is transferred to one or more commercial water heaters that further heat the water to the required use temperature, maintain that

level, and provide redundancy. EarthLinked® thus becomes a powerful hybrid that increases system capacity and reliability.

## Environmental Benefits

Burning fuels to create heat wastes diminishing natural resources and can never achieve 100% efficiency. The process pollutes the environment with carbon dioxide and nitrogen oxides that are greenhouse gases. The U.S. EPA and DOE have determined that, in most applications, geothermal heat pumps are the most energy efficient and environmentally clean heating systems.

## Constantly Available Renewable Energy Source

The constant earth heat source is always available and is not dependent upon sunlight hours or temperate climate. This creates the ability to use heat pumps to deliver heat in cold climates, shift demand off-peak and thereby use lower electric rates for water heating, including pools, radiant hydronic heating and thermal storage.

## Benefits of EarthLinked® Over Electric Water Heating

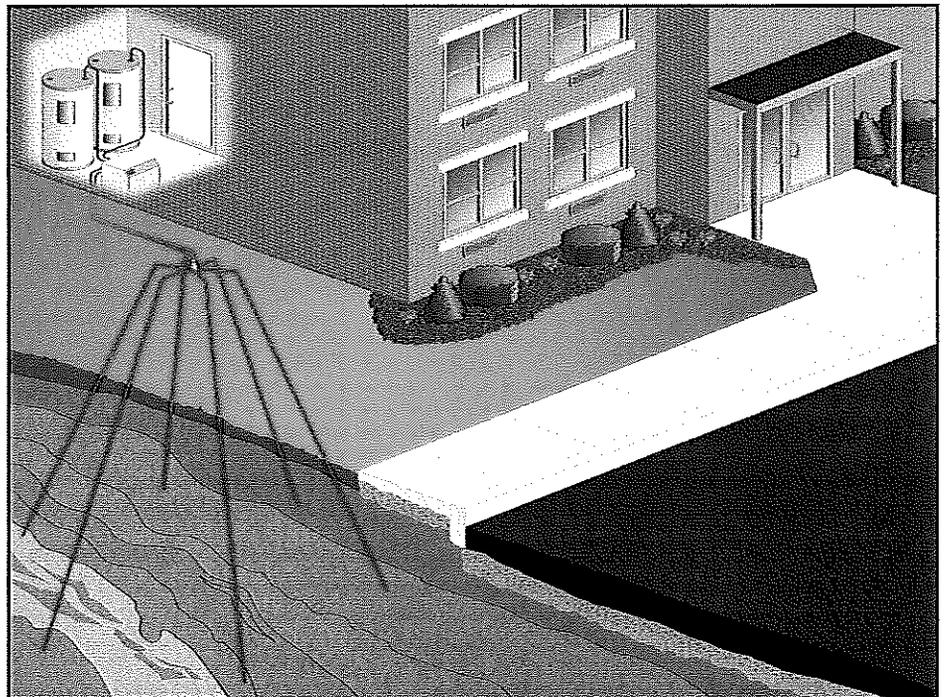
- Up to 75% energy savings due to reduced electricity consumption
- Reduced emissions of greenhouse gases
- Reduced electric demand and possible reduced demand charge
- Decreased energy dependence

## Benefits of EarthLinked® Over Air Source Heat Pump Water Heating

- Higher efficiency due to constantly favorable earth heat source
- Can be located in mechanical room because of no need to circulate air over an exterior coil
- Quiet operation resulting from total system enclosure and elimination of exterior fan and motor
- Eliminates the exterior coil, fan, fan motor and capacitor, defrost timer, and ancillary wiring, making it mechanically and electrically simpler
- Has greatly improved reliability and service life because of its simplicity and stable temperature source

## Benefits of EarthLinked® Over Gas Water Heating

- Reduce operating cost up to 50%
- No on-site fossil fuel firing
- No combustion air supply needed
- No flue gas venting
- No explosion or asphyxiation hazard
- No gas main needed



EarthLinked® delivers up to 400% efficiency compared to 80% for commercial gas water heating. For every Watt of electricity consumed by the EarthLinked® compressor, the system delivers three to four times that amount of heat energy to the water tank because it is primarily transporting renewable energy.

**Rapid Cost Recovery**

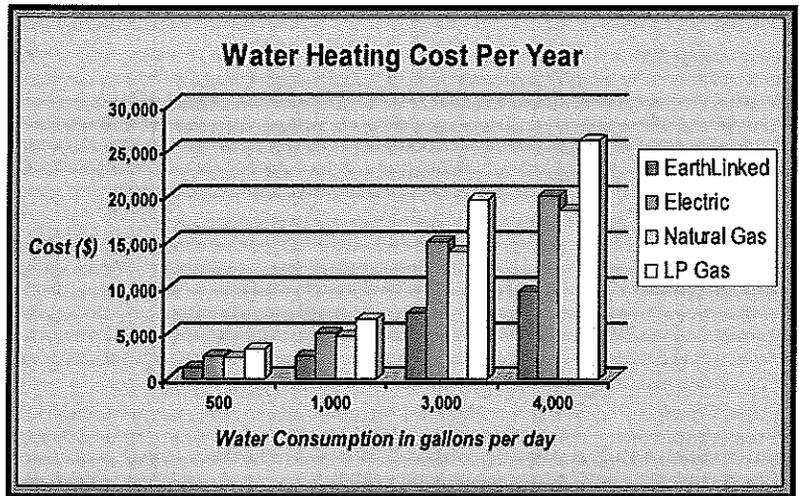
EarthLinked® delivers up to 400% electrical efficiency. For every Watt of electricity consumed by the EarthLinked® compressor, the system delivers three to four times that amount of heat energy to the water tank because it is primarily transporting renewable energy.

Even though the installed cost of the EarthLinked® heat pump system is greater than traditional water heaters, the monthly energy savings in commercial applications are so large that the system quickly pays for itself.

A commercial user with an EarthLinked® water heating system installed at a cost of \$15,000, using 2,000 gallons of hot water per day, an electric rate of \$0.10/kWh, an earth temperature of 65°F where the EarthLinked® system raises the water temperature to 115°F and the electric resistance element raises it to 125°F, in comparison with an electric water heater saves \$6,681 annually.

The cost recovery period in that case is 2.2 years, for a Return On Investment of 45.4%. Even if the installation cost was \$20,000, payback would be within 3 years and Return On Investment would be 33.9%.

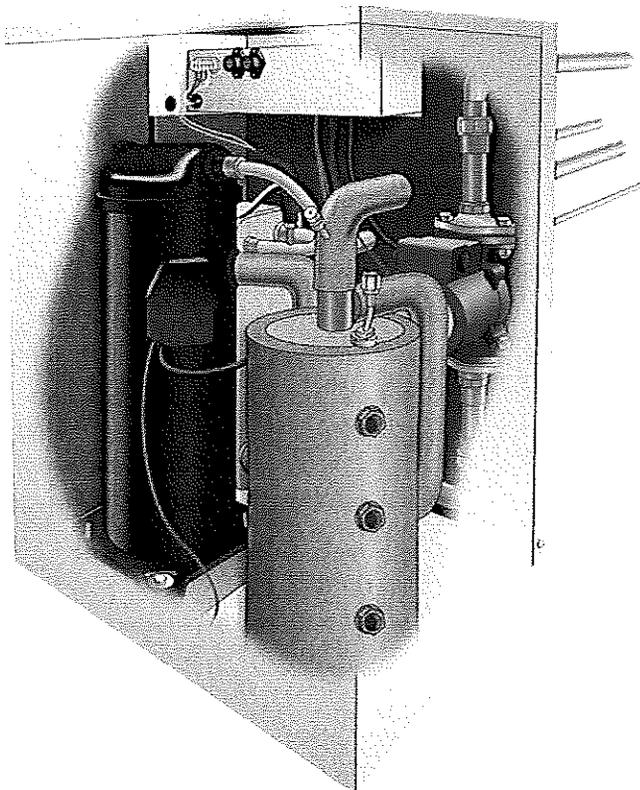
**Commercial Leasing Options** are available to eliminate cash investment and payments are made from savings.



**Features**

- Independently documented hot water heating savings up to 75%.
- Powerful hybrid increase Efficiency, Capacity and Reliability.
- Patented refrigerant flow control assembly.
- Warranty: 5-year limited warranty on compressor unit, and limited lifetime warranty on earth loops.

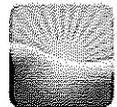
<b>Compressor Type</b>	Copeland Scroll™
<b>Voltage</b>	208-230/460/575
<b>Phase</b>	Single or Three-phase
<b>Power Supply</b>	60Hz
<b>Ozone Friendly Refrigerant</b>	R-407C
<b>Dimensions</b>	17"D x 21" W x 28" H
<b>Heating Capacity</b>	4-ton and 6-ton



EarthLinked® CWH systems are specially designed for commercial water heating. The unit includes the compressor, heat exchanger and water circulating pump in one cabinet.

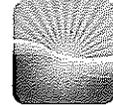
The system can raise the temperature of water up to 125°F. When operating as a hybrid system, a traditional gas or electric water heater can then raise the temperature to any desired level and provide a backup heating source. The standard water heater thermostat controls the ultimate delivered temperature in the customary manner.

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Tel. 863-701-0096 • [www.earthlinked.com](http://www.earthlinked.com)



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## Summary of Field Test of EarthLinked® Heat Pump by Consumers Power Company



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**Project Year: 1989-1990**

**Location: Jackson, Michigan U.S.A.**

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Consumers Power Company conducted a one-year field monitoring test of a 2.5-ton EarthLinked® direct exchange earth coupled heat pump in a single-family residence to determine seasonal efficiency in the heating and cooling modes, to assess system capability to provide total heating needs in cold climates and to assess operating and maintenance characteristics.

Data collection on air-side and refrigerant-side (for dual data verification, which showed  $\pm 2\%$  variation) was performed with thermocouples, pressure transducers, kWh meters with pulse output, a data logger, a disc data recorder, humidity sensors, and a PC software program to retrieve and calculate COP values.

Results were sorted by month and outdoor temperature in 5°F bins. With 6,855 heating degree days, the system recorded a high COP of 3.71, a low of 2.98, and a seasonal COP of 3.29, which exceeded by 25% the seasonal heating performance of other ground source heat pumps previously tested. With a 2.5-ton Copeland compressor, the heat output rate averaged 30,360 BTU/hr., except in May when it increased to 32,575 BTU/hr. The system required no supplemental heat down to ambient 5°F, and averaged 3.0 COP at 5-10°F, gradually increasing to 3.5 at 40°F, and declining to 2.3 with supplemental heat at -10°. For cooling, the cumulative EER was 15.7 (a COP of 4.6).

"Strictly from a performance point-of-view, the ECR (now "EarthLinked") ground-source heat pump is highly recommended. From an economics point-of-view, if installation costs are competitive with other high efficiency systems, the system is not only recommended, but seen as having great potential for increasing electric space heating customers. Its highly efficient air conditioning performance is an added sales advantage." (See Page 15 of the report.)

[It should be noted that when last checked, the system was still performing well 18 years later.]

**Reference:** J. B. Gilbert, Department Head

"ECR Technologies Ground-Coupled Heat Pump Field Evaluation," August 1, 1990; Engineering Evaluations, Consumers Power Company.

*(A complete copy of the report is available from EarthLinked Technologies, Inc. at [www.earthlinked.com](http://www.earthlinked.com).)*

## Summary of U.S. EPA Report on the Testing of EarthLinked® Commercial Water Heating System



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Conducted by: U.S. EPA Greenhouse Gas Technology Center

Project Year: 2005-2006

Location: Sun City Center, Florida U.S.A.

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The U.S. Environmental Protection Agency's Greenhouse Gas Technology Center completed a 15-month test of the EarthLinked® Commercial Water Heating system in September 2006. The system includes: 1) an EarthLinked direct geoechange heat pump, 2) an earth loop cluster that circulated non-ozone depleting refrigerant (R-407 C) in standard copper refrigeration tubing to extract heat from the shallow earth; and 3) a double-wall refrigerant-to-water heat exchanger.

The test was conducted in an assisted living facility in Sun City Center, Florida. The system was connected to a standard electric water heater tank that stores the heated water. Although the heating element in the tank is capable of providing supplemental heat, it was never required to do so during the test.

As hot water is used in the building, city water enters the system, passes through the heat exchanger and is stored in the standard tank. The temperature of the city water entering the system is 72°F. The return temperature to the heat exchanger from the continuous building circulation system is 94°F, and the delivered water temperature is limited to 110°F. That temperature was selected by the owner to comply with governmental regulation. Short-term tests were conducted to monitor system capacity and efficiency, taking the temperature to 130°F. Comparative tests were conducted using the standard electric resistance elements of the water tank exclusively. Then long-term testing of the EarthLinked system was conducted for many months.

The EPA report verifies 75% saving of electrical energy by the EarthLinked system in comparison with electric resistance water heating. By avoiding the generation of that amount of electricity, a typical EarthLinked unit avoids the emission of 7,100 pounds of carbon dioxide and 15 pounds of nitrous oxide per ton of capacity annually, which amounts to 42,600 pounds of CO<sub>2</sub> and 90 pounds of NO<sub>x</sub> each year by a typical 6-ton capacity EarthLinked unit.

[It should be noted that in northern climates, although the earth temperature is cooler, so is the incoming water temperature. This enables the high efficiency EarthLinked system to replace more energy that is otherwise required of electric or fossil-fuel fired systems, thus the rate of savings is not diminished. Any temperature above -40°F is sufficient to evaporate the refrigerant, and the EarthLinked system can harvest energy through ice.]

*(A complete copy of the report is available from EarthLinked Technologies, Inc. at [www.earthlinked.com](http://www.earthlinked.com).)*



March 19, 2003

To Whom It May Concern:

Please find below the text (edited to remove specific company references) of a letter I wrote several years ago. The information in this letter is still valid.

I understand that your company, \_\_\_\_\_, is a manufacturer of Direct-Exchange (DX) geothermal heat pumps (GHPs). I also understand that you often encounter confusion about environmental issues related to this technology. I hope this letter will help to clarify some of these issues.

As you may know, EPA recognized GHPs as the most cost-effective and environmentally friendly technology for heating and cooling homes in most climates in its 1993 report, Space Conditioning: The Next Frontier. We at the Atmospheric Pollution Prevention Division (APPD) at the Environmental Protection Agency (EPA) look quite positively on the potential of DX GHPs. The use of refrigerant in copper pipes as a heat exchanger appears to have an inherent efficiency advantage over antifreeze solutions in plastic pipe, making them even more attractive from an energy-efficiency standpoint than traditional GHPs.

Our only potential concern with DX GHPs is that they use R-22, as do virtually all other large-scale heat pump technologies on the market. Since R-22 contributes to ozone depletion, it is being phased out over the next three decades in accordance with the Montreal Protocol. DX GHPs do not appear to use appreciably more R-22 than air-source heat pumps, and EPA is not discouraging their use either. One of the key reasons R-22 has been such a widely used refrigerant for more than 50 years is that it is a nontoxic, inert gas that poses no direct health dangers to humans, and therefore could be used with confidence by HVAC manufacturers and installers. Since R-22 poses no direct health threat to humans—nor to ground water—there is no reason why it cannot also be used with confidence in underground heat exchangers as part of a DX system.

EPA does regulate the use of R-22, however. Only licensed persons may install and service systems that use the refrigerant, and they must follow EPA guidelines regarding reclamation and recycling of the refrigerant. For more information about R-22 regulations, please call 1-800-296-1996.

I hope this information is helpful to you. Please call me if you have any questions or if I can be of any further assistance.

Sincerely,

Stephen J. Offutt  
Atmospheric Pollution Prevention Division

TECHNICAL REPORT  
EVALUATION OF THE ENVIRONMENTAL FATE  
OF REFRIGERANT 22 & 502 IN ECR  
HEAT TRANSFER SYSTEM

By

R. Jerry Murphy, Ph.D., P.E.\*  
Consulting Engineer

January, 1986

\*Resume attached

EVALUATION OF ENVIRONMENTAL FATE  
OF REFRIGERANT 22 & 502 IN ECR  
HEAT TRANSFER SYSTEM

I. Introduction: ECR Technologies, Inc. of Lakeland, Florida has developed a heat exchange technology for application to residential and commercial hot water heating, space heating and cooling, pool and spa heating, etc. (see process description in Appendix A.) The key aspects of the system involve recirculating refrigerant in a closed pipe system into the sub-surface of the ground in a drilled bore to a depth less than 100 feet and returning the refrigerant to exchange heat in a system at the ground surface. The purpose of this report is to evaluate this technology and its application for potential adverse environmental effects. Such an evaluation encompasses defining the impact of the technology on soil, water or the air media that could adversely affect terrestrial life.

II. Discussion:

A. Problem Definition. The chemical substances of interest in this study are Refrigerant 22 and 502. Specifically, the Refrigerant 22 (R22) is monochlorodifluoromethane ( $\text{CHClF}_2$ ). Refrigerant 502 (R502) is mixture of fluorocarbons; 48.8% R22 and 51.2% R115, by weight. Properties of these chemicals pertinent to this study are specified in Appendix B and C.

B. Evaluation Methodology. Chemical substances in the environment are evaluated based on their properties that may contribute to their ability to separate into the various environmental compartments (air, soil, water); their movement or transport in these compartments at specific concentrations; their change or transformation that may occur in the compartments or during

transport; and finally the toxic effects that the substance's concentration has on aquatic, plant, animal, and human life. Consequently, the specific chemicals' toxicity, magnitude of concentration at release and its related properties that permit prediction of contamination potential of air, water and soil provide the salient means for evaluation.

The critical properties of a chemical substance that lead to predicting its environmental fate are principally the chemicals' water solubility and its vapor pressure (1). Since, of the two Refrigerants of interest, R22 has properties which could have the more severe environmental consequences (i.e. R22 has greater solubility), it will be the focus of this evaluation.

### III. Findings:

A. Evaluation of R22 and R502 as potential environmental contaminants has been greatly simplified since there have been significant studies of the compounds that have confirmed that the materials are quite chemically stable. They are principally an upper atmosphere (stratosphere) contaminant and have no significant impact on local air or water quality (2,3). In the context of fluorocarbons as a stratospheric contaminant, interest here lies in Refrigerant production facilities that represent the principal source for potential mass release of fluorocarbons. Small operational facilities such as those designed by ECR Technologies minimize any further environmental risk since: first, they are closed loop contained facilities recycling Refrigerants; second, the volume of Refrigerant in use at each installation will be extremely small (on the order of 5 to 15 lb per installation); and third, the worst case scenario for Refrigerant release would be at the system's maximum depth below the ground surface where the technology's temperature and pressure are such that the Refrigerant, if released, would

remain in or instantaneously change to the vapor phase. This would also be true at any lesser depth including ground surface level.

B. Substantiation of points previously enumerated can be made based on the properties of the substance. Since the solubility of R22 (worse case Refrigerant) is 285 milligrams per liter (mg/l), the implication of water contamination is evidently low. For example, if one pound of R22, or any greater amount, leaked into 10 gallons water, the maximum amount that would go into solution is a total mass of 0.024 pounds. The remainder (97.6%) would migrate to the atmosphere. The small component of R22 that could evolve into the water phase would rapidly dilute as it moved through the groundwater and in any case, the highest concentration of R22 possible is well below any potential toxic effect levels (aquatic, plant, animal or human) specified for the substance (4.5). Soil sorption is directly related to the concentration of the substance in the water phase. It obviously follows that since the concentration in the water phase is low, any concentration that could be sorbed in the soil would be insignificant.

The remaining component of Refrigerant that escapes into the immediate atmosphere, which is the bulk of the substance, is also of no environmental concern. The material has long been used in virtually all modes of residential locations and in enclosed human living areas. This application has been fostered by the substance's negligible toxicity and its classification of flammability as only slight by the National Board of Fire Underwriters (6).

At any temperature, depth and pressure used in this technology either Refrigerant, if accidentally released, would remain in or instantaneously change into the a vapor phase. Consequently, there is minimal opportunity for

the Refrigerants to react to form secondary chemical compounds in the local environment.

#### IV. Conclusions

Evaluation of the environmental impact of ECR Technologies application of Refrigerants indicates that there will be negligible hazard to humans or the environment with these substances since:

- A. Documentation that Refrigerants have extremely low toxicity and limited flammability.
- B. The mass or amount of Refrigerants used in the process are small, used in a closed-recycled system, will be widely distributed spatially outdoors, and subject to significant dilution if leaked.
- C. Should a leak occur, the properties of the Refrigerants indicate that they would not comprise a hazard from water/soil migration or in the local atmosphere.
- D. The potential for generation of secondary chemical compounds through reaction is minimal since the Refrigerants remain in a vapor phase.

## References

1. Conway, R.A., Editor, Environmental Risk Analysis for Chemicals, Van Nostrand Reinhold Co., New York, N.Y. (1982).
2. Molina, M.J., Row and F.S., "Stratosphere Sink for Chlorofluoromethanes: Chlorine atomic-Atalysed Destruction of Ozone", Nature Vol. 249, (Jun 1974)
3. Howard, H; Hanchett, A.; "Chloro Fluorocarbon Sources of Environmental Contamination," Science, 189, (Jul 1975).
4. Registry of Toxic Effects of Chemical Substances, Nat'l Technical Information Service, National Institute of Occupational Health and Safety, PB 266-295, (1976).
5. Gosselin, Ed., etal, Clinical Toxicology of Commercial Products, 4th ed., Williams & Wilkins Co., Baltimore, MD (1976)
6. Jennings, B.H., Environmental Engineering Analysis and Practice, International Textbook Co., Scranton, PA (1970).
7. Threlkeld, J.L., Thermal Environmental Engineering, Prentice-Hall, Inc., Englewood Cliffs, N.J. (1970).
8. Tressler, D.K. etal, The Freezing Preservation of Foods, Volume I, Refrigeration and Equipment, ANI Publishing Co., Westport, Conn. (1968)
9. Elonka, S.M., Mitch, Q.W., Standard Refrigeration and Air Conditioning, Questions and Answers, McGraw-Hill Book Co., New York, N.Y., (1983)
10. Hodgman, M.S., Editor, Handbook of Chemistry and Physics, 41st Ed. Chemical Rubber Publishing Co., Cleveland, OH (1959).

# Energy conservation research results in new water heating technology.

The ECR-80A water heater is an energy efficient water heater unequalled in performance by any other water heater, including solar. It is a heat pump water heater designed to extract the abundant renewable energy from the earth, in contrast to other heat pump systems, which extract heat from the air.

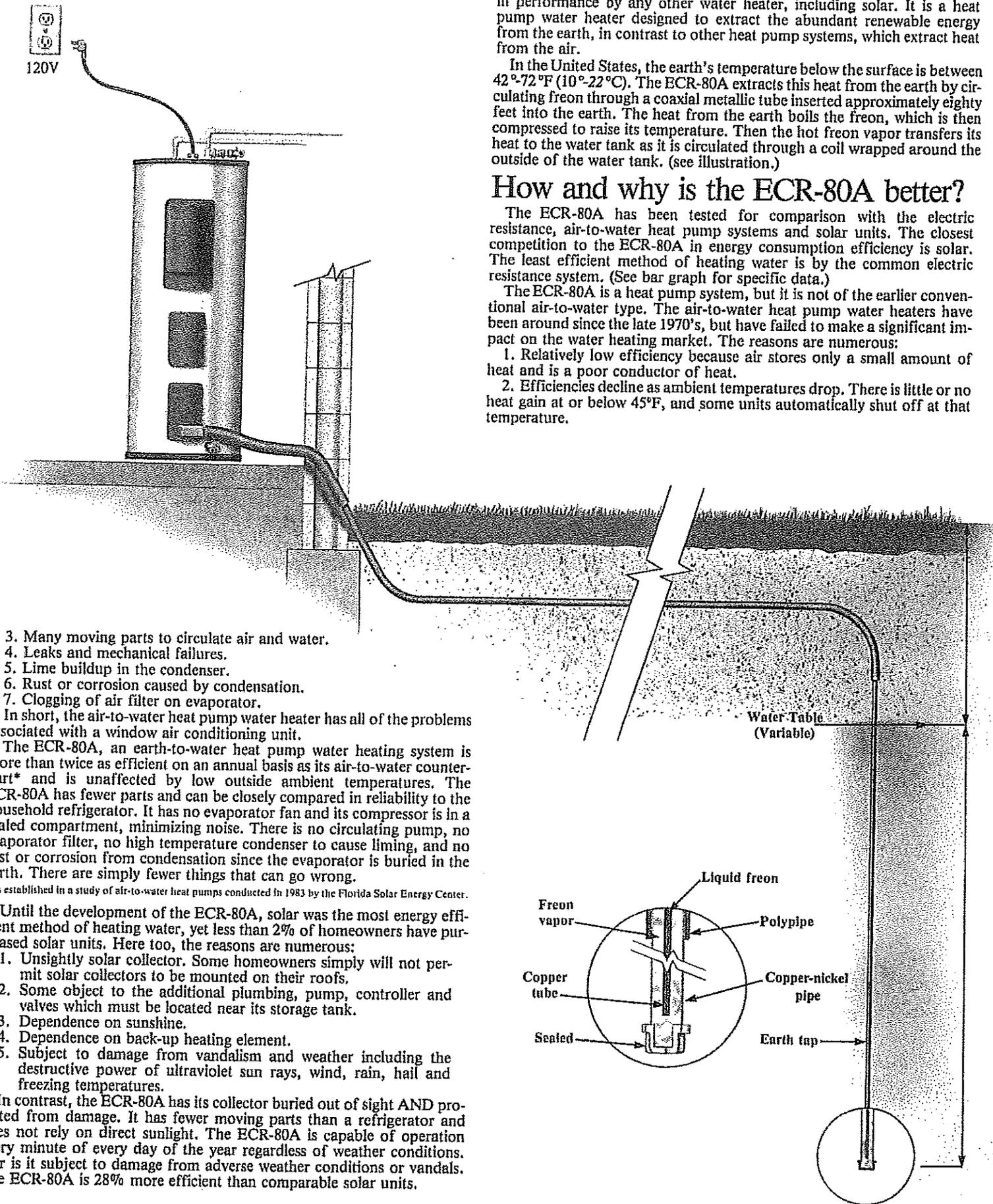
In the United States, the earth's temperature below the surface is between 42°-72°F (10°-22°C). The ECR-80A extracts this heat from the earth by circulating freon through a coaxial metallic tube inserted approximately eighty feet into the earth. The heat from the earth boils the freon, which is then compressed to raise its temperature. Then the hot freon vapor transfers its heat to the water tank as it is circulated through a coil wrapped around the outside of the water tank. (see illustration.)

## How and why is the ECR-80A better?

The ECR-80A has been tested for comparison with the electric resistance, air-to-water heat pump systems and solar units. The closest competition to the ECR-80A in energy consumption efficiency is solar. The least efficient method of heating water is by the common electric resistance system. (See bar graph for specific data.)

The ECR-80A is a heat pump system, but it is not of the earlier conventional air-to-water type. The air-to-water heat pump water heaters have been around since the late 1970's, but have failed to make a significant impact on the water heating market. The reasons are numerous:

1. Relatively low efficiency because air stores only a small amount of heat and is a poor conductor of heat.
2. Efficiencies decline as ambient temperatures drop. There is little or no heat gain at or below 45°F, and some units automatically shut off at that temperature.



3. Many moving parts to circulate air and water.
4. Leaks and mechanical failures.
5. Lime buildup in the condenser.
6. Rust or corrosion caused by condensation.
7. Clogging of air filter on evaporator.

In short, the air-to-water heat pump water heater has all of the problems associated with a window air conditioning unit.

The ECR-80A, an earth-to-water heat pump water heating system is more than twice as efficient on an annual basis as its air-to-water counterpart\* and is unaffected by low outside ambient temperatures. The ECR-80A has fewer parts and can be closely compared in reliability to the household refrigerator. It has no evaporator fan and its compressor is in a sealed compartment, minimizing noise. There is no circulating pump, no evaporator filter, no high temperature condenser to cause liming, and no rust or corrosion from condensation since the evaporator is buried in the earth. There are simply fewer things that can go wrong.

\*As established in a study of air-to-water heat pumps conducted in 1983 by the Florida Solar Energy Center.

Until the development of the ECR-80A, solar was the most energy efficient method of heating water, yet less than 2% of homeowners have purchased solar units. Here too, the reasons are numerous:

1. Unsightly solar collector. Some homeowners simply will not permit solar collectors to be mounted on their roofs.
2. Some object to the additional plumbing, pump, controller and valves which must be located near its storage tank.
3. Dependence on sunshine.
4. Dependence on back-up heating element.
5. Subject to damage from vandalism and weather including the destructive power of ultraviolet sun rays, wind, rain, hail and freezing temperatures.

In contrast, the ECR-80A has its collector buried out of sight AND protected from damage. It has fewer moving parts than a refrigerator and does not rely on direct sunlight. The ECR-80A is capable of operation every minute of every day of the year regardless of weather conditions. Nor is it subject to damage from adverse weather conditions or vandals. The ECR-80A is 28% more efficient than comparable solar units.

## What else should I know about the ECR-80A?

The installed cost of the ECR-80A is comparable to an 80 gallon solar system with a 4' x 10' collector, but provides more than four times the volume of hot water. Installation of the ECR-80A is simpler than solar, since no additional plumbing, valves, circulating pumps or controllers are needed.

The electric energy load demand of the typical resistance and solar water heaters (with electric resistance back-up element) is seven times greater than the ECR-80A. This is especially important during a utility system's peak load period. This is the reason that many electric utilities have adopted incentive rates, low interest loans or cash grants to encourage and assist their customers to purchase efficient water heating systems.

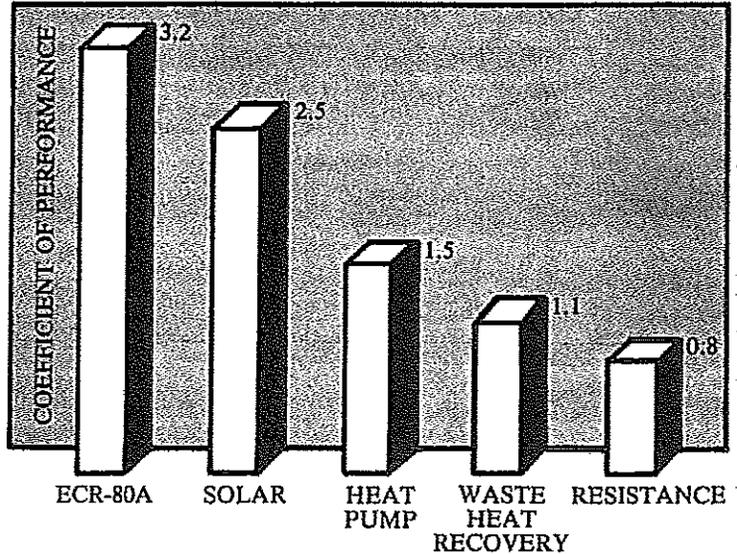
The average recovery rate of the ECR-80A is over 7,000 BTU's per hour. The average recovery rate of a solar unit (without resistance element back-up) is 3,500 BTU's per hour, if the sun is shining. The typical resistance element water heater recovers at a rate of 15,000 BTU's per hour. However, the cost of such rapid recovery is far greater than the ECR-80A.

The ECR-80A then, when compared with solar:

1. Is competitive in price.
2. Is simpler to install.
3. Is easier to maintain.
4. Provides more than twice the daily volume of hot water.
5. Places one-seventh the load demand on the supplying electric utility even during peak load periods.
6. Recovers twice as many BTU's per hour.
7. Is more reliable.
8. And, is 28% more energy efficient.

## System efficiencies:

	GALLONS	PER	DAY
	79.00	103.00	156.00
COP of ECR-80A	3.33	3.60	3.48
COP of resistance heater	0.73	0.77	0.85



Determined by separate tests performed by the Florida Solar Energy Center in 1983 and 1984.

## SPECIFICATIONS

Voltage .....	120V 60 hertz
Watts .....	620 Average
Amps .....	6.0 Average
Storage Capacity .....	80 Gallons
Dimensions .....	.66' high, 26' diameter
Weight .....	185 lbs. (approx.)
BTU's per hour .....	7,000 (average)
Insulation Value .....	R-20
Water Temperature Range .....	120°F to 132°F
Average Water Temperature .....	125°F

## NOTES

Appendix B

Properties of Refrigerant 22

Name: Chloro Difluoromethane (CHClF<sub>2</sub>)

Synonyms: Freon, F22, Isotron 22, UCON 22

Molecular Weight: 86.47

Water Solubility at 25°C: 285 mg/l

Water Solubility at 0°C (% by weight): 0.060

Vapor Pressure at 25°C: 10 Atmospheres (7600 mmHg)

Standards and Regulations: DOT - Non-Flammable Gas

LABEL- Non-Flammable Gas

Toxicity: Aquatic: TL<sub>m</sub> 96 - over 1000 ppm

Toxic dose: Inhalation - RAT LCLo, 250,000 ppm/4 hours

Inhalation - Dog LCLo, 70 pph

No specific occupational exposure limits by the U.S. Occupational Safety and Health Standards or the American Conference of Government Industrial Hygienists.

Appendix C

Properties of Refrigerant 502

Chemical Formulae:  $\text{CHClF}_2/\text{CClF}_2\text{-CF}_3$  (48.8% R22 and 51.2% R115)

Synonyms: Freon 502

Molecular Weight: 111.6

Water Solubility at 0°C (%by weight): 0.022

Standards & Regulations: Same as R22

Toxicity: Same as R22

NAME: Robert J. Murphy

PRESENT RANK: Associate Professor  
Department of Civil  
Engineering and  
Mechanics  
College of Engineering  
University of South  
Florida  
Tampa, FL 33620

PLACE OF BIRTH: Raton, New Mexico  
January 1, 1936

EDUCATION:

A.A. - Pre-Engineering - Kemper Military Junior College, Booneville,  
Missouri, 1955  
B.S.C.E. - Civil - New Mexico State University, University  
Park, New Mexico, 1958  
M.E. - Environmental - University of Oklahoma, Norman, Oklahoma,  
1965  
Ph.D. - Environmental - University of Oklahoma, Norman, Oklahoma,  
1971

PROFESSIONAL EXPERIENCE:

August 1984 to present: Associate Professor, Dept. Of Civil Engineering  
and Mechanics, University of South Florida. Courses: fluid mechanics, Air  
Pollution Control, environmental engineering processes lab, environmental  
engineering design.

August 1979 - August 1984: Associate Professor, Dept. of Civil Engineering  
and Environmental Science, the University of Oklahoma, Norman, OK.  
Primary teaching role in Safety Management and Engineering, Industrial  
Hygiene Engineering, Air Pollution Control, Noise Control in graduate  
programs; and Engineering Investigation Procedures in undergraduate  
program. Director of an OSHA New Direction Grant in developing training  
and technical support programs for petroleum exploration/development  
industry. Total grant funding allocation through August 1984, \$367,000.  
Program encompasses defining work place hazards in petroleum production,  
provide technical transfer of hazard control techniques to the industry  
through technical bulletins/assistance; and development of  
information/training program. Defined a longterm (8 years @ \$12 million)  
RDT&E program for resolution of structural, noise and air pollution  
abatement problems in U.S. Navy Jet Engine Test facilities. Public  
Service activities involved acting as advisor to the State of Oklahoma's  
Dept. of Health in defining problems and controlling asbestos in public  
schools and the Oklahoma Corporation Commission on developing guidelines  
for petroleum emergency field situations (release of hydrogen sulfide gas,  
fire, and oil spills). Co-principal investigator on a research grant from  
USEPA to evaluate technology for land treatment of ignitable/corrosive  
hazardous waste. University service has involved serving on the Nuclear  
Reactor Safety Committee and providing a program guide for the development  
of a University occupational safety and health program.

April 1978 - August 1979: Lt. Colonel, Extramural Research Coordinator/Acting Division Chief, Environmental Protection Research Division, U.S. Army Medical Bioengineering R&D Lab, Ft. Detrick, MD. Planned, managed and coordinated conduct of contracted and in-house research to support Army's requirement for criteria, associated analytical methods and waste treatment technology relative to occupational health exposure, environmental emissions and hazardous waste disposal. Staff included interdisciplinary professionals including chemistry and biological scientists and engineers. Level of effort for FY79 included administering approximately 50 contracts at a funding level of \$5 million.

Feb. 1974-April 1978: Lt. Colonel, Chief Air Pollution Engineering Div., U.S. Army Environmental Hygiene Agency, Aberdeen Proving Grd., Md. Program, manage and supervise principal Department of Army technical resource providing worldwide support of Army facilities on air pollution abatement matters. Resources include interdisciplinary professionals (chemists; chemical, sanitary and mechanical engineers; statisticians; meteorologist), and complete equipment/instrumentation to assess all critical and numerous hazardous pollutants. Specific division operations included: characterizing air pollution emission and air quality at Army facilities; coordinating with regulatory authorities, interpreting standards or developing emission criteria for performance of abatement equipment; identifying research requirements and monitoring contractor progress on air pollution abatement problems; developing impact statements; training installation personnel in conducting emission inventories, fulfilling permit applications and procedural requirements inherent to air pollution with U.S., Europe, and Japan regulation agencies. Annual division workload included: 18-20 source survey, 10 ambient air or special studies, and 100 field consultations.

July 1971-Feb. 1974: Maj., Chief Ambient Air Branch, Air Pollution Engineering Div., U.S. Army Environmental Hygiene Agency, Aberdeen Proving Grd., MD. Planned and supervised air quality studies, supportive services and engineering consultations for Department of Army facilities, worldwide. Resources included: chemical and sanitary engineers, meteorologist, statistician and electronic technicians, and analytical equipment to assess all criteria air pollutants as well as numerous hazardous pollutants associated with operation of industrial processes to demilitarize toxic war gases (nerve and mustard gas). Developed air quality data and reported details to support environmental impact statements for sensitive Department of the Army missions or operations. Acted as principal consultant in procurement and installation of 50 ambient air monitoring stations for employment at 20 Army facilities. Conducted inventory, evaluated standards and compliance of Army stationary air pollution sources in Hawaii, Okinawa and Japan. Annual field workload of branch involved 10 special/ambient air studies and 50 consultations.

Jan. 1971-July 1971: Maj., Staff Sanitary Engineer, Surgeon's office, HQ 1st U.S. Army, Ft. Meade, MD. Planned, coordinated and implemented environmental pollution/occupational health support for Army installations in multi-state Northeast USA. Had staff directive control on technical program development and monitored execution of environmental engineering support affected by 6 sanitary engineers (officers) and 10 technicians to provide surveys related to air resources, wastewater treatment,

industrial hygiene and environmental sanitation at Army installations in the for mentioned area. Acted as principal coordinator for First US Army to implement environment engineering support for flood disaster area in Buffalo Creek, West Virginia.

June 1966-Sept. 1969: Maj., Deputy Director for Enlisted training, Dept. of Health and Environmental, U.S. Army Medical Field Service School. Programmed, managed, and supervised training program for military environmental health technicians in two courses (basic course of 8 weeks duration and advance course of 10 weeks duration). Developed and implemented programs of instruction, course content and objectives; formulated and presented lesson plans for both officer and enlisted classes on a spectrum of subjects relative to environmental pollution and sanitation. Supervised, on an annual basis, training of 6 basic technician classes (100 students per class) and 3 advanced technician classes (30 students per class). Courses included lecture, laboratory and field practical exercises. The field practical exercises entailed supervision of logistical and training aspects for student deployment during one-week field exercise. Acted as consultant in formulating personnel and equipment requirements for field Army environmental health teams to be deployed during combat.

July 1965-June 1966: Capt., Staff Sanitary Engineer, U.S. Army Military Asst. Cmd., Vietnam. Staff sanitary engineer for Joint US Command (Army, Navy, and Air Force) and principal advisor on environmental matters to the Vietnam Armed Forces (ARVN). Responsibilities on Joint staff included staff coordination on engineering aspects of siting medical facilities and consultant to Directorate of Military construction on multi-base planning activity relative to design and construction of water supply and wastewater treatment. Concept was ultimately adopted for all fixed bases in Southeast Asia area of operations. Duties as advisor included developing ARVN personnel to implement country-wide policy and action on matters related to environmental sanitation, water supply, insect and rodent control and epidemic control relative to such vectors of disease. Training concept of enlisted trainees on environmental sanitation was implemented at all ARVN training centers.

Nov. 1963-June 1964: Capt., Sanitary Engineer, U.S. Army Walter Reed Army Medical Center, Washington, D.C. Supervised and directly operated aspects of occupational health and environmental sanitation/pollution program for all activities (housing, physical plant, research, inpatient and outpatient facilities) of major activity with work population of approximately 3000. Responsibilities included providing program documentation, developing equipment requirements, budgeting and operations, and conducting routine, as well as, special studies for program execution. Complete occupational hazard inventory was accomplished of facilities and program for sanitizing mobile food carts used to deliver inpatient hospital meals was developed using non-residual chemicals.

July 1950-Nov. 1963: Lt., Environmental Engineering Section Leader, 485th Prev. Med. Unit; Ludwigsburg, W. German. Supervised 10 enlisted technicians in support of Army division and corps sized (12,000 to 36,000 strength) tactical training maneuvers, in addition to evaluating garrison

facilities. Responsibilities included planning, coordinating and executing support requirements on matters related to evaluation and control of environmental sanitation, water supply and waste disposal. Lead officer on special assignment to conduct field evaluations of prototype membrane filter kit for bacteriological examination of drinking water that led to conventional kit standardization of the same configuration as those now commercially available. Planned and executed environmental engineering support in leading a 10-man team to provide disaster relief in Iran after earthquake in 1962.

#### RESEARCH INTERESTS:

Hazardous Waste Control, treatment & disposal;  
Air Pollution Control Systems  
Integrated Engineering Control of Workplace and Environmental Hazards

#### HONORS, ACHIEVEMENTS:

Member, Scientific Review Panel, National Hazardous Substance Data Base, maintained by National Library of Medicine and supported by USEPA and Dept. of Defense.  
Sigma Xi  
Diplomate American Academy of Environmental Engineers (No. 724)  
Dept. of the Army awards: Medal, Meritorious Service Medal, Air Medal, US Army Commendation Medal, Legion of Merit, Bronze Star

#### CONSULTATION/PROJECTS:

3M Company; Hazardous waste disposal.  
Texaco, Inc; Engineering evaluation of ventilation systems.  
U.S. Navy Civil Engineering Laboratory; RDT&E acquisition plan for jet engine test facilities.  
State of Oklahoma; Control of asbestos in public buildings.  
Biocide Chemical Co. Norman, OK; Product research and market development for stabilized chlorine dioxide.  
Oklahoma City/County Health Dept; Environmental health and engineering consultation.  
University of Oklahoma Continuing Education Center; Development and teaching of Supervision and Safety training courses for field supervisors in the oil/gas drilling industry.  
Director, OSHA New Direction Grant, Safety and Health in Oil/Gas Production Industry.  
Magic Bait Co., Oklahoma City, OK. Design of industrial ventilation and air cleaning system.  
Big Chief Roofing Co., Ardmore, OK. Design of industrial ventilation and air cleaning system.  
Co-Principal Investigator, USEPA research grant, "Land Treatment of Ignitable/Corrosive Hazardous Waste".

#### PUBLICATIONS:

"Optimum Water Well Drilling Equipment for Remote Areas," 1971, Ph.D. dissertation, University of Oklahoma.

"Evaluation Performance and Selection of Automated Instrumentation," presented at 1975 American Industrial Hygiene Association Annual Meeting.

"Optimum Selection and Performance of Ambient Air Instrumentation," presented 68th Annual Meeting of the Air Pollution Control Association (1975).

"Air Pollution Aspects of Hazardous Waste Disposal," presented at the 1977 American Industrial Hygiene Association Annual Meeting.

"The Army's Ambient Air Monitoring Program," presented at the 71st Annual Meeting of the Air Pollution Control Association (1978).

"Air Pollution Aspects of Hazardous Material Disposal," Proc. 7th Annual Industrial Pollution Conference, p. 163, June 1979.

"RDT&E Program, Jet Engine Test Facilities," Aug. 1980, Naval Civil Engineering Laboratory, Port Hueneme, CA.

"General Safety Practices," Technical Education Research Center, May, 1981; Module prepared for general industrial workers under OSHA sponsorship, Waco, TX.

Course Manual; Safety Short Course for drilling Supervisors, August 1982, University of Oklahoma.

Course Manual; Accident Prevention for Drilling Management Groups, August 1982, University of Oklahoma.

Contributor to Course Manual; Hydrogen Sulfide Safety for Drilling Crews, July 1982, University of Oklahoma.

"An Effective Training Program," Energy Bureau, Inc., National Conference on Oilfield Equipment and Productivity, October 1982, Houston, TX

"Guyline Anchor Design Keys Rig Stability," Oil & Gas Journal, Sept. 19, 1983.

"Feasibility of Landfarming Oily Waste Sludge at Navy Facilities ," project report to Navy Civil Engineering Laboratory, Port Hueneme, CA, March 1984.

"Wet Scrubber Design for Odor Control", Journal of Environmental Engineering ASCE, p. 1002, Vol 110, No. 5 Oct. 1984.

GUEST LECTURER: Subject: Air Pollution, Pennsylvania State University, University of Oklahoma, Hood College, US Army Ballistic Research Laboratory, US Naval and Air Force Academy.

LECTURER: PAHO sponsored, West Indies School of Public Health (1976); OSHA Regional IV Compliance Officer Training 1982.

PEER REVIEW:

Conducted documented Peer Review on following USEPA publications:

"Ambient Air Monitoring at Hazardous Waste Disposal Sites, Volume I", Dec. 1980.

"Emission Limits for Variable Sources by Use of Multipoint Rollback", March 1981.

"A Summary of EPA National Source Performance Audit Program-1980", July 1981.

"Validation of Samplers for Inhaled Particulate Matter", July, 1982.

ORGANIZATIONS:

Member, National Society of Professional Engineers  
Registered Professional Engineer (No. 7653) State of Oklahoma  
Member, American Society of Civil Engineers  
Member, Air Pollution Control Association

STATE OF FLORIDA  
DEPARTMENT OF ENVIRONMENTAL REGULATION



TWIN TOWERS OFFICE BUILDING  
2600 BLAIR STONE ROAD  
TALLAHASSEE, FLORIDA 32399-2400

BOB MARTINEZ  
GOVERNOR  
DALE TWACHTMANN  
SECRETARY

October 20, 1987

Mr. J. H. Roberts, Jr.  
Post Office Box 177  
Lakeland, Florida 33802

RE: ECR Technologies, Inc.: Declaratory Statement

Dear Mr. Roberts:

The purpose of this letter is to provide you with the assurance that the corrected Declaratory Statement issued to you became final as of the date it was entered by this agency's clerk. That date is July 21, 1987. (See copy of order with date of entry noted, attached hereto). No further action is necessary by the Department to effectuate the terms of the order. In addition, the times for either an administrative or judicial challenge have passed and no third party may now protest the order's terms.

Sincerely,

Cynthia K. Christen

CKC/pm  
cc: Martha Harrell Hall

*Protecting Florida and Your Quality of Life*



extremely low toxicity, has limited flammability, and is largely insoluble in water. It would not react with other substances to cause contamination from secondary compounds. There is little expectation for ground water contamination even if the freon manages to leak.

6. ECR has agreed to notify the Department in writing of a system installation within 30 days after such installation occurs. Latitude, longitude and approximate depth at which the earth tap was installed will be included in the notice. Such notice is required under Section 403.061(13), Florida Statutes.

7. In case of leaks or other failure, ERC will notify the Department in writing within 30 days after ERC becomes aware of such failure. In this way the Department can keep an inventory of these systems as it needs to do for all Class V UIC wells.

#### CONCLUSION OF LAW

8. These systems include boreholes which are wells according to the definition in Florida Administrative Code Rule 17-28.120(59), which states that a well "means a bored, drilled, or driven shaft, or dug hole, which has a depth greater than the diameter of the largest surface dimension."

9. These boreholes are also principally for the "emplacement of fluids" in that the pipes put freon into place which then draws or disperse heat from or into the ground.

10. Therefore, these systems are Class V underground injection wells because they replace non-hazardous fluids into or above formations that contain underground sources of drinking water, and unless exempted pursuant to Florida Administrative Code Rule 17-4.040(11), would require a Department permit in accordance with 17-28.610, F.A.C.

11. For all of the above reasons, the Department concludes that ECR Technologies, Inc. is exempted from a UIC permit pursuant to Florida Administrative Code Rule 17-4.040, because the closed loop earth tap pump is an activity which does not cause the issuance of air or water contaminants in sufficient quantities, as to contribute to the pollution problems within

the State. For that reason, regulation of this activity is not reasonably justified, pursuant to Florida Administrative Code Rule 17-4.040(11).

Therefore it is ordered that:

Pursuant to Chapter 120.565, Florida Statutes, and Florida Administrative Code Rule 17-103.500, the State of Florida Department of Environmental Regulation hereby issues this Declaratory Statement that:

1. ECR is exempt from obtaining a UIC permit,
2. ECR shall submit the information as referenced in paragraphs 6 and 7 above.

The Department shall notify the Environmental Regulation Commission in writing of the determination that a permit is not necessary with the reasons therefor, pursuant to Florida Administrative Rule 17-4.040(11).

This Corrected Declaratory Statement supplants the statement issued June, 23, 1987 on the same matter.

Persons whose substantial interest are affected by this Order have a right, pursuant to Section 120.57, Florida Statutes, to petition for an administrative determination (hearing) on it. The Petition must conform to the requirements of Chapter 17-103 and 28-5, FAC, and must be filed (received) with the Department's Office of General Counsel, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400, within fourteen (14) days of receipt of this notice. Failure to file a petition within the fourteen (14) days constitutes a waiver of any right such person has to an administrative determination (hearing) pursuant to Section 120.57, F.S.

This Order is final and effective on the date filed with the clerk of the Department unless a petition is filed in accordance with this paragraph. Upon the timely filing of a petition this Order will not be effective until further Order of the Department.

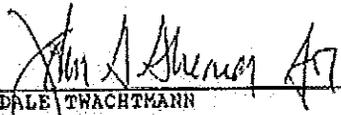
When the Order is final any party to the Order has the right to seek judicial review of the Order pursuant to Section 120.68, Florida Statutes by the filing of a Notice of Appeal

pursuant to Rule 9.110, Florida Rules of Appellate Procedure, with the clerk of the Department in the Office of General Counsel, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400; and by filing a copy of the Notice of Appeal accompanied by the applicable filing fees with the appropriate District Court of Appeal. The Notice of Appeal must be filed within 30 days from the date the Final Order is filed with the clerk of the Department.

DONE AND ENTERED this 20<sup>th</sup> day of July, 1987, in Tallahassee, Florida.

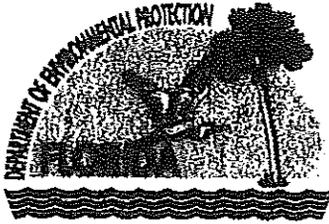
FILING AND ACKNOWLEDGEMENT  
FILED on this date, pursuant to §120.52 Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

C. Hutchins      7-21-87  
Clerk                      Date

  
DALE TWACHTMANN  
Secretary

STATE OF FLORIDA DEPARTMENT  
OF ENVIRONMENTAL REGULATION

Twin Towers Office Building  
2600 Blair Stone Road  
Tallahassee, Florida  
32399-2400  
Telephone (904)488-9730



# Florida Department of Environmental Protection

Marjory Stoneman Douglas Building  
3900 Commonwealth Boulevard  
Tallahassee, Florida 32399-3000

Charlie Crist  
Governor

Jeff Kottkamp  
Lt. Governor

Michael W. Sole  
Secretary

November 29, 2007

Michael P. Donaldson  
Carlton Fields P.A.  
PO Drawer 190  
Tallahassee, FL 32302-0190

Dear Mr. Donaldson:

You asked me whether a permit under the underground injection control program is needed for the earth-coupled (closed loop) thermal exchange systems now used by ECR Technologies.

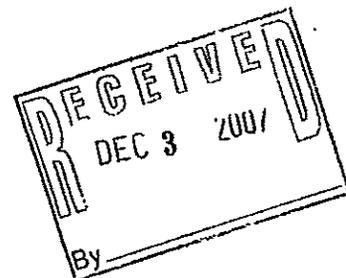
As you stated in your memorandum to me, the changes to the systems since the Department issued its declaratory statement in 1987, that stated no underground injection control permit was needed, are the depth and diameter of the piping. No additives are released into the ground water or subsurface. As such, no underground injection control permit is needed now, either.

I am hopeful that this adequately answers the issue and provides the needed assurance for your client.

Sincerely,

Cynthia K. Christen  
Senior Assistant General Counsel

cc: Richard J. Deuerling, Jr.,  
UIC Program, MS 3530



## Material Safety Data Sheet

### Genetron® 22

#### 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**PRODUCT NAME:** Genetron® 22  
**OTHER/GENERIC NAMES:** R-22, HCFC-22  
**PRODUCT USE:** Refrigerant  
**MANUFACTURER:** Honeywell  
101 Columbia Road  
Box 1053  
Morristown, New Jersey 07962-1053

**FOR MORE INFORMATION CALL:**  
(Monday-Friday, 9:00am-5:00pm)  
1-800-522-8001

**IN CASE OF EMERGENCY CALL:**  
(24 Hours/Day, 7 Days/Week)  
CHEMTREC 1-800-424-9300 or 703-527-3887

#### 2. COMPOSITION/INFORMATION ON INGREDIENTS

<u>INGREDIENT NAME</u>	<u>CAS NUMBER</u>	<u>WEIGHT %</u>
Chlorodifluoromethane	75-45-6	100

Trace impurities and additional material names not listed above may also appear in Section 15 toward the end of the MSDS. These materials may be listed for local "Right-To-Know" compliance and for other reasons.

#### 3. HAZARDS IDENTIFICATION

**EMERGENCY OVERVIEW:** Colorless, volatile liquid with ethereal and faint sweetish odor. Non-flammable material. Overexposure may cause dizziness and loss of concentration. At higher levels, CNS depression and cardiac arrhythmia may result from exposure. Vapors displace air and can cause asphyxiation in confined spaces. At higher temperatures, (>250°C), decomposition products may include Hydrochloric Acid (HCl), Hydrofluoric Acid (HF) and carbonyl halides.

#### POTENTIAL HEALTH HAZARDS

**SKIN:** Irritation would result from a defatting action on tissue. Liquid contact could cause frostbite.

**EYES:** Liquid contact can cause severe irritation and frostbite. Mist may irritate.

**INHALATION:** Genetron 22 is low in acute toxicity in animals. When oxygen levels in air are reduced to 12–14% by displacement, symptoms of asphyxiation, loss of coordination, increased pulse rate and deeper respiration will occur. At high levels, cardiac arrhythmia may occur.

## MATERIAL SAFETY DATA SHEET Genetron® 22

**INGESTION:** Ingestion is unlikely because of the low boiling point of the material. Should it occur, discomfort in the gastrointestinal tract from rapid evaporation of the material and consequent evolution of gas would result. Some effects of inhalation and skin exposure would be expected.

**DELAYED EFFECTS:** None known

Ingredients found on one of the OSHA designated carcinogen lists are listed below.

<u>INGREDIENT NAME</u>	<u>NTP STATUS</u>	<u>IARC STATUS</u>	<u>OSHA LIST</u>
No ingredients listed in this section			

### 4. FIRST AID MEASURES

**SKIN:** Promptly flush skin with water until all chemical is removed. If there is evidence of frostbite, bathe (do not rub) with lukewarm (not hot) water. If water is not available, cover with a clean, soft cloth or similar covering. Get medical attention if symptoms persist.

**EYES:** Immediately flush eyes with large amounts of water for at least 15 minutes (in case of frostbite water should be lukewarm, not hot) lifting eyelids occasionally to facilitate irrigation. Get medical attention if symptoms persist.

**INHALATION:** Immediately remove to fresh air. If breathing has stopped, give artificial respiration. Use oxygen as required, provided a qualified operator is available. Get medical attention. Do not give epinephrine (adrenaline).

**INGESTION:** Ingestion is unlikely because of the physical properties and is not expected to be hazardous. Do not induce vomiting unless instructed to do so by a physician.

**ADVICE TO PHYSICIAN:** Because of the possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, should be used with special caution and only in situations of emergency life support. Treatment of overexposure should be directed at the control of symptoms and the clinical conditions.

### 5. FIRE FIGHTING MEASURES

#### FLAMMABLE PROPERTIES

**FLASH POINT:** Gas, not applicable per DOT regulations

**FLASH POINT METHOD:** Not applicable

**AUTOIGNITION TEMPERATURE:** Unknown

**UPPER FLAME LIMIT (volume % in air):** None\*

**LOWER FLAME LIMIT (volume % in air):** None\*

\*Based on ASHRAE Standard 34 with match ignition

**FLAME PROPAGATION RATE (solids):** Not applicable

**OSHA FLAMMABILITY CLASS:** Not applicable

#### **EXTINGUISHING MEDIA:**

Use any standard agent – choose the one most appropriate for type of surrounding fire (material itself is not flammable)

## MATERIAL SAFETY DATA SHEET Genetron<sup>®</sup> 22

### **UNUSUAL FIRE AND EXPLOSION HAZARDS:**

Genetron 22 is not flammable at ambient temperatures and atmospheric pressure. However, this material will become combustible when mixed with air under pressure and exposed to strong ignition sources.

Contact with certain reactive metals may result in formation of explosive or exothermic reactions under specific conditions (e.g. very high temperatures and/or appropriate pressures).

### **SPECIAL FIRE FIGHTING PRECAUTIONS/INSTRUCTIONS:**

Firefighters should wear self-contained, NIOSH-approved breathing apparatus for protection against possible toxic decomposition products. Proper eye and skin protection should be provided. Use water spray to keep fire-exposed containers cool.

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### **6. ACCIDENTAL RELEASE MEASURES**

#### **IN CASE OF SPILL OR OTHER RELEASE:**

(Always wear recommended personal protective equipment.)

Evacuate unprotected personnel. Protected personnel should remove ignition sources and shut off leak, if without risk, and provide ventilation. Unprotected personnel should not return until air has been tested and determined safe, including low-lying areas.

Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding reporting requirements.

---

### **7. HANDLING AND STORAGE**

#### **NORMAL HANDLING:**

(Always wear recommended personal protective equipment.)

Avoid breathing vapors and liquid contact with eyes, skin or clothing. Do not puncture or drop cylinders, expose them to open flame or excessive heat. Use authorized cylinders only. Follow standard safety precautions for handling and use of compressed gas cylinders.

Genetron 22 should not be mixed with air above atmospheric pressure for leak testing or any other purpose. See Section 5: Unusual Fire and Explosion Hazards

#### **STORAGE RECOMMENDATIONS:**

Store in a cool, well-ventilated area of low fire risk and out of direct sunlight. Protect cylinder and its fittings from physical damage. Storage in subsurface locations should be avoided. Close valve tightly after use and when empty.

---

### **8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

#### **ENGINEERING CONTROLS:**

Provide local ventilation at filling zones and areas where leakage is probable. Mechanical (general) ventilation may be adequate for other operating and storage areas.

#### **PERSONAL PROTECTIVE EQUIPMENT**

##### **SKIN PROTECTION:**

Skin contact with refrigerant may cause frostbite. General work clothing and gloves (leather) should provide adequate protection. If prolonged contact with the liquid or gas is anticipated, insulated gloves constructed of PVA, neoprene or butyl rubber should be used. Any contaminated clothing should be promptly removed and washed before reuse.

## MATERIAL SAFETY DATA SHEET Genetron<sup>®</sup> 22

### EYE PROTECTION:

For normal conditions, wear safety glasses. Where there is reasonable probability of liquid contact, wear chemical safety goggles.

### RESPIRATORY PROTECTION:

None generally required for adequately ventilated work situations. For accidental release or non-ventilated situations, or release into confined space, where the concentration may be above the PEL of 1,000 ppm, use a self-contained, NIOSH - approved breathing apparatus or supplied air respirator. For escape: use the former or a NIOSH-approved gas mask with organic vapor canister.

### ADDITIONAL RECOMMENDATIONS:

Where contact with liquid is likely, such as in a spill or leak, impervious boots and clothing should be worn. High dose-level warning signs are recommended for areas of principle exposure. Provide eyewash stations and quick-drench shower facilities at convenient locations. For tank cleaning operations, see OSHA regulations, 29 CFR 1910.132 and 29 CFR 1910.133.

### EXPOSURE GUIDELINES

<u>INGREDIENT NAME</u>	<u>ACGIH TLV</u>	<u>OSHA PEL</u>	<u>OTHER LIMIT</u>
Chlorodifluoromethane	1000 ppm TWA (8hr)	1000 ppm TWA (8hr)	None

\* = Limit established by Honeywell.

\*\* = Workplace Environmental Exposure Level (AIHA).

\*\*\* = Biological Exposure Index (ACGIH).

### OTHER EXPOSURE LIMITS FOR POTENTIAL DECOMPOSITION PRODUCTS:

Hydrogen Fluoride: ACGIH TLV = 3 ppm ceiling

## 9. PHYSICAL AND CHEMICAL PROPERTIES

**APPEARANCE:** Clear, colorless liquid and vapor

**PHYSICAL STATE:** Gas at ambient temperatures

**MOLECULAR WEIGHT:** 86.45

**CHEMICAL FORMULA:** CHClF<sub>2</sub>

**ODOR:** Faint ethereal odor

**SPECIFIC GRAVITY (water = 1.0):** 1.21 @ 21.1°C (70°F)

**SOLUBILITY IN WATER (weight %):** 0.3 wt% @ 25°C and 1 atmosphere

**pH:** Neutral

**BOILING POINT:** -40.8°C (-41.40°F)

**FREEZING POINT:** -160°C (-256°F)

**VAPOR PRESSURE:** 136.1 psia @ 70°F

311.4 psia @ 130°F

**VAPOR DENSITY (air = 1.0):** 3.0

**EVAPORATION RATE:** >1

**COMPARED TO:** CCl<sub>4</sub> = 1

**% VOLATILES:** 100

**FLASH POINT:** Not applicable

## MATERIAL SAFETY DATA SHEET

### Genetron<sup>®</sup> 22

(Flash point method and additional flammability data are found in Section 5.)

#### 10. STABILITY AND REACTIVITY

##### **NORMALLY STABLE? (CONDITIONS TO AVOID):**

The product is stable.

Do not mix with oxygen or air above atmospheric pressure. Any source of high temperature, such as lighted cigarettes, flames, hot spots or welding may yield toxic and/or corrosive decomposition products.

##### **INCOMPATIBILITIES:**

(Under specific conditions: e.g. very high temperatures and/or appropriate pressures) – Freshly abraded aluminum surfaces (may cause strong exothermic reaction). Chemically active metals: potassium, calcium, powdered aluminum, magnesium and zinc.

##### **HAZARDOUS DECOMPOSITION PRODUCTS:**

Halogens, halogen acids and possibly carbonyl halides.

##### **HAZARDOUS POLYMERIZATION:**

Will not occur.

#### 11. TOXICOLOGICAL INFORMATION

##### **IMMEDIATE (ACUTE) EFFECTS:**

LC<sub>50</sub>: 4 hr. (rat) - ≥300,000 ppm

Cardiac Sensitization threshold (dog) – 50,000 ppm

##### **DELAYED (SUBCHRONIC AND CHRONIC) EFFECTS:**

Subchronic inhalation (rat) NOEL - 10,000 ppm

Not teratogenic

Not mutagenic in *in-vitro* or *in-vivo* tests

##### **OTHER DATA:**

Lifetime exposure of male rats was associated with a small increase in salivary gland fibrosarcomas.

#### 12. ECOLOGICAL INFORMATION

**Degradability (BOD):** Genetron 22 is a gas at room temperature; therefore, it is unlikely to remain in water.

**Octanol Water Partition Coefficient:** Unknown

#### 13. DISPOSAL CONSIDERATIONS

##### RCRA

Is the unused product a RCRA hazardous waste if discarded?

Not a hazardous waste

If yes, the RCRA ID number is: Not applicable

## MATERIAL SAFETY DATA SHEET

### Genetron<sup>®</sup> 22

#### **OTHER DISPOSAL CONSIDERATIONS:**

Disposal must comply with federal, state, and local disposal or discharge laws. Genetron 22 is subject to U.S. Environmental Protection Agency Clean Air Act Regulations Section 608 in 40 CFR Part 82 regarding refrigerant recycling.

The information offered here is for the product as shipped. Use and/or alterations to the product such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

#### **14. TRANSPORT INFORMATION**

**US DOT HAZARD CLASS:** US DOT PROPER SHIPPING NAME: Chlorodifluoromethane  
US DOT HAZARD CLASS: 2.2  
US DOT PACKING GROUP: Not applicable

**US DOT ID NUMBER:** UN1018

For additional information on shipping regulations affecting this material, contact the information number found in Section 1.

#### **15. REGULATORY INFORMATION**

##### TOXIC SUBSTANCES CONTROL ACT (TSCA)

**TSCA INVENTORY STATUS:** Listed on the TSCA inventory

**OTHER TSCA ISSUES:** None

##### SARA TITLE III/CERCLA

"Reportable Quantities" (RQs) and/or "Threshold Planning Quantities" (TPQs) exist for the following ingredients.

<u>INGREDIENT NAME</u>	<u>SARA/CERCLA RQ (lb.)</u>	<u>SARA EHS TPQ (lb.)</u>
No ingredients listed in this section		

Spills or releases resulting in the loss of any ingredient at or above its RQ requires immediate notification to the National Response Center [(800) 424-8802] and to your Local Emergency Planning Committee.

**SECTION 311 HAZARD CLASS:** IMMEDIATE  
PRESSURE

##### **SARA 313 TOXIC CHEMICALS:**

The following ingredients are SARA 313 "Toxic Chemicals". CAS numbers and weight percents are found in Section 2.

<u>INGREDIENT NAME</u>	<u>COMMENT</u>
Chlorodifluoromethane (HCFC-22)	None

## MATERIAL SAFETY DATA SHEET Genetron<sup>®</sup> 22

### STATE RIGHT-TO-KNOW

In addition to the ingredients found in Section 2, the following are listed for state right-to-know purposes.

<u>INGREDIENT NAME</u>	<u>WEIGHT %</u>	<u>COMMENT</u>
No ingredients listed in this section		

### **ADDITIONAL REGULATORY INFORMATION:**

Genetron 22 is subject to U.S. Environmental Protection Agency Clean Air Act Regulations at 40 CFR Part 82.

#### **WARNING:**

**Do Not vent to the atmosphere.** To comply with provisions of the U.S. Clean Air Act, any residual must be recovered. **Contains Chlorodifluoromethane**, an HCFC substance which harms public health and the environment by destroying ozone in the upper atmosphere. Destruction of the ozone layer can lead to increased ultraviolet radiation which, with excess exposure to sunlight, can lead to an increase in skin cancer and eye cataracts.

### **WHMIS CLASSIFICATION (CANADA):**

This product has been evaluated in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

### **FOREIGN INVENTORY STATUS:**

Canada – Listed on DSL  
EU – EINECS # 2008719

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### **16. OTHER INFORMATION**

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**CURRENT ISSUE DATE:** January, 2004  
**PREVIOUS ISSUE DATE:** February, 2003

### **CHANGES TO MSDS FROM PREVIOUS ISSUE DATE ARE DUE TO THE FOLLOWING:**

Section 3: Revised decomposition products

**OTHER INFORMATION:** HMIS Classification: Health – 1, Flammability – 1, Reactivity – 0  
NFPA Classification: Health – 2, Flammability – 1, Reactivity – 0  
ANSI/ASHRAE 34 Safety Group – A1  
UL Classified

#### Regulatory Standards:

1. OSHA regulations for compressed gases: 29 CFR 1910.101
2. DOT classification per 49 CFR 172.101
3. Clean Air Act Class II Substance

## Material Safety Data Sheet

### Genetron® 407C

#### 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**PRODUCT NAME:** Genetron® 407C  
**OTHER/GENERIC NAMES:** R-407C  
**PRODUCT USE:** Refrigerant  
**MANUFACTURER:** Honeywell  
101 Columbia Road  
Box 1053  
Morristown, New Jersey 07962-1053

**FOR MORE INFORMATION CALL:**  
(Monday-Friday, 9:00am-5:00pm)  
Product Safety Department  
1-800-707-4555

**IN CASE OF EMERGENCY CALL:**  
(24 Hours/Day, 7 Days/Week)  
1-800-707-4555  
CHEMTREC: 1-800-424-9300

#### 2. COMPOSITION/INFORMATION ON INGREDIENTS

<u>INGREDIENT NAME</u>	<u>CAS NUMBER</u>	<u>WEIGHT %</u>
Difluoromethane (HFC-32)	75-10-5	23
Pentafluoroethane (HFC-125)	354-33-6	23
1,1,1,2-Tetrafluoroethane (HFC-134a)	811-97-2	52

Trace impurities and additional material names not listed above may also appear in Section 15 toward the end of the MSDS. These materials may be listed for local "Right-To-Know" compliance and for other reasons.

#### 3. HAZARDS IDENTIFICATION

**EMERGENCY OVERVIEW:** Colorless, volatile liquid with ethereal and faint sweetish odor. Non-flammable material. Overexposure may cause dizziness and loss of concentration. At higher levels, CNS depression and cardiac arrhythmia may result from exposure. Vapors displace air and can cause asphyxiation in confined spaces. At higher temperatures, (>250°C), decomposition products may include Hydrofluoric Acid (HF) and carbonyl halides

#### POTENTIAL HEALTH HAZARDS

**SKIN:** Irritation would result from a defatting action on tissue. Liquid contact could cause frostbite.

**EYES:** Liquid contact can cause severe irritation and frostbite. Mist may irritate.

**INHALATION:** Genetron 407C is low in acute toxicity in animals. When oxygen levels in air are reduced to 12–14% by displacement, symptoms of asphyxiation, loss of coordination, increased pulse rate and deeper respiration will occur. At high levels, cardiac arrhythmia may occur.

## MATERIAL SAFETY DATA SHEET Genetron® 407C

**INGESTION:** Ingestion is unlikely because of the low boiling point of the material. Should it occur, discomfort in the gastrointestinal tract from rapid evaporation of the material and consequent evolution of gas would result. Some effects of inhalation and skin exposure would be expected.

**DELAYED EFFECTS:** None known

Ingredients found on one of the OSHA designated carcinogen lists are listed below.

<u>INGREDIENT NAME</u>	<u>NTP STATUS</u>	<u>IARC STATUS</u>	<u>OSHA LIST</u>
No ingredients listed in this section			

### 4. FIRST AID MEASURES

**SKIN:** Promptly flush skin with water until all chemical is removed. If there is evidence of frostbite, bathe (do not rub) with lukewarm (not hot) water. If water is not available, cover with a clean, soft cloth or similar covering. Get medical attention if symptoms persist.

**EYES:** Immediately flush eyes with large amounts of water for at least 15 minutes (in case of frostbite water should be lukewarm, not hot) lifting eyelids occasionally to facilitate irrigation. Get medical attention if symptoms persist.

**INHALATION:** Immediately remove to fresh air. If breathing has stopped, give artificial respiration. Use oxygen as required, provided a qualified operator is available. Get medical attention. Do not give epinephrine (adrenaline).

**INGESTION:** Ingestion is unlikely because of the physical properties and is not expected to be hazardous. Do not induce vomiting unless instructed to do so by a physician.

**ADVICE TO PHYSICIAN:** Because of the possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, should be used with special caution and only in situations of emergency life support. Treatment of overexposure should be directed at the control of symptoms and the clinical conditions.

### 5. FIRE FIGHTING MEASURES

#### FLAMMABLE PROPERTIES

**FLASH POINT:** Gas, not applicable per DOT regulations

**FLASH POINT METHOD:** Not applicable

**AUTOIGNITION TEMPERATURE:** Unknown for mixture

**UPPER FLAME LIMIT (volume % in air):** None\*

**LOWER FLAME LIMIT (volume % in air):** None\*

\*Based on ASHRAE Standard 34 with match ignition

**FLAME PROPAGATION RATE (solids):** Not applicable

**OSHA FLAMMABILITY CLASS:** Not applicable

#### **EXTINGUISHING MEDIA:**

Use any standard agent – choose the one most appropriate for type of surrounding fire (material itself is not flammable)

## MATERIAL SAFETY DATA SHEET

### Genetron<sup>®</sup> 407C

#### **UNUSUAL FIRE AND EXPLOSION HAZARDS:**

Genetron 407C is not flammable at ambient temperatures and atmospheric pressure. However, this material will become combustible when mixed with air under pressure and exposed to strong ignition sources.

Contact with certain reactive metals may result in formation of explosive or exothermic reactions under specific conditions (e.g. very high temperatures and/or appropriate pressures).

#### **SPECIAL FIRE FIGHTING PRECAUTIONS/INSTRUCTIONS:**

Firefighters should wear self-contained, NIOSH-approved breathing apparatus for protection against possible toxic decomposition products. Proper eye and skin protection should be provided. Use water spray to keep fire-exposed containers cool.

---

#### **6. ACCIDENTAL RELEASE MEASURES**

##### **IN CASE OF SPILL OR OTHER RELEASE:**

(Always wear recommended personal protective equipment.)

Evacuate unprotected personnel. Protected personnel should remove ignition sources and shut off leak, if without risk, and provide ventilation. Unprotected personnel should not return until air has been tested and determined safe, including low-lying areas.

Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding reporting requirements.

---

#### **7. HANDLING AND STORAGE**

##### **NORMAL HANDLING:**

(Always wear recommended personal protective equipment.)

Avoid breathing vapors and liquid contact with eyes, skin or clothing. Do not puncture or drop cylinders, expose them to open flame or excessive heat. Use authorized cylinders only. Follow standard safety precautions for handling and use of compressed gas cylinders.

Genetron 407C should not be mixed with air above atmospheric pressure for leak testing or any other purpose.

##### **STORAGE RECOMMENDATIONS:**

Store in a cool, well-ventilated area of low fire risk and out of direct sunlight. Protect cylinder and its fittings from physical damage. Storage in subsurface locations should be avoided. Close valve tightly after use and when empty.

---

#### **8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

##### **ENGINEERING CONTROLS:**

Provide local ventilation at filling zones and areas where leakage is probable. Mechanical (general) ventilation may be adequate for other operating and storage areas.

##### **PERSONAL PROTECTIVE EQUIPMENT**

###### **SKIN PROTECTION:**

Skin contact with refrigerant may cause frostbite. General work clothing and gloves (leather) should provide adequate protection. If prolonged contact with the liquid or gas is anticipated, insulated gloves constructed of PVA, neoprene or butyl rubber should be used. Any contaminated clothing should be promptly removed and washed before reuse.

## MATERIAL SAFETY DATA SHEET Genetron<sup>®</sup> 407C

### EYE PROTECTION:

For normal conditions, wear safety glasses. Where there is reasonable probability of liquid contact, wear chemical safety goggles.

### RESPIRATORY PROTECTION:

None generally required for adequately ventilated work situations. For accidental release or non-ventilated situations, or release into confined space, where the concentration may be above the PEL of 1,000 ppm, use a self-contained, NIOSH - approved breathing apparatus or supplied air respirator. For escape: use the former or a NIOSH-approved gas mask with organic vapor canister.

### ADDITIONAL RECOMMENDATIONS:

Where contact with liquid is likely, such as in a spill or leak, impervious boots and clothing should be worn. High dose-level warning signs are recommended for areas of principle exposure. Provide eyewash stations and quick-drench shower facilities at convenient locations. For tank cleaning operations, see OSHA regulations, 29 CFR 1910.132 and 29 CFR 1910.133.

### EXPOSURE GUIDELINES

<u>INGREDIENT NAME</u>	<u>ACGIH TLV</u>	<u>OSHA PEL</u>	<u>OTHER LIMIT</u>
Difluoromethane	None	None	**1000 ppm TWA (8hr)
Pentafluoroethane	None	None	**1000 ppm TWA (8hr)
1,1,1,2-Tetrafluoroethane	None	None	**1000 ppm TWA (8hr)

\* = Limit established by Honeywell.

\*\* = Workplace Environmental Exposure Level (AIHA).

\*\*\* = Biological Exposure Index (ACGIH).

### OTHER EXPOSURE LIMITS FOR POTENTIAL DECOMPOSITION PRODUCTS:

Hydrogen Fluoride: ACGIH TLV: 3 ppm ceiling

### 9. PHYSICAL AND CHEMICAL PROPERTIES

**APPEARANCE:** Clear, colorless liquid and vapor

**PHYSICAL STATE:** Gas at ambient temperatures

**MOLECULAR WEIGHT:** 86.2

**CHEMICAL FORMULA:** CH<sub>2</sub>F<sub>2</sub>, CF<sub>3</sub>CHF<sub>2</sub>, CH<sub>2</sub>FCF<sub>3</sub>

**ODOR:** Faint ethereal odor

**SPECIFIC GRAVITY (water = 1.0):** 1.16 @ 21.1°C (70°F)

**SOLUBILITY IN WATER (weight %):** Unknown

**pH:** Neutral

**BOILING POINT:** -43°C (-45.4°F)

**FREEZING POINT:** Not Determined

**VAPOR PRESSURE:** 156.2 psia @ 70°F

356.7 psia @ 130°F

**VAPOR DENSITY (air = 1.0):** 3.0

## MATERIAL SAFETY DATA SHEET

### Genetron<sup>®</sup> 407C

EVAPORATION RATE: >1 COMPARED TO: CCl<sub>4</sub> = 1  
% VOLATILES: 100  
FLASH POINT: Not applicable  
(Flash point method and additional flammability data are found in Section 5.)

#### **10. STABILITY AND REACTIVITY**

##### **NORMALLY STABLE? (CONDITIONS TO AVOID):**

The product is stable.

Do not mix with oxygen or air above atmospheric pressure. Any source of high temperature, such as lighted cigarettes, flames, hot spots or welding may yield toxic and/or corrosive decomposition products.

##### **INCOMPATIBILITIES:**

(Under specific conditions: e.g. very high temperatures and/or appropriate pressures) – Freshly abraded aluminum surfaces (may cause strong exothermic reaction). Chemically active metals: potassium, calcium, powdered aluminum, magnesium and zinc.

##### **HAZARDOUS DECOMPOSITION PRODUCTS:**

Halogens, halogen acids and possibly carbonyl halides.

##### **HAZARDOUS POLYMERIZATION:**

Will not occur.

#### **11. TOXICOLOGICAL INFORMATION**

##### **IMMEDIATE (ACUTE) EFFECTS:**

HFC-32: LC<sub>50</sub>: 4 hr. (rat) - 520,000 ppm  
Cardiac Sensitization threshold (dog) 350,000 ppm.  
HFC-125: LC<sub>50</sub>: 4 hr. (rat) - > 800,000 ppm  
Cardiac Sensitization threshold (dog) 75,000 ppm.  
HFC-134a: LC<sub>50</sub>: 4 hr. (rat) - > 500,000 ppm  
Cardiac Sensitization threshold (dog) > 80,000 ppm.

##### **DELAYED (SUBCHRONIC AND CHRONIC) EFFECTS:**

HFC-32: Teratogenic NOEL (rat and rabbit) - 50,000 ppm  
Subchronic inhalation (rat) NOEL - 50,000 ppm  
HFC-125: Teratogenic NOEL (rat and rabbit) - 50,000 ppm  
Subchronic inhalation (rat) NOEL - ≥50,000 ppm  
Chronic NOEL - 10,000 ppm  
HFC-134a: Teratogenic NOEL (rat and rabbit) - 40,000 ppm  
Subchronic inhalation (rat) NOEL - 50,000 ppm  
Chronic NOEL - 10,000 ppm

##### **OTHER DATA:**

HFC-32, HFC-125, HFC-134a: Not active in four genetic studies

## MATERIAL SAFETY DATA SHEET

### Genetron<sup>®</sup> 407C

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#### 12. ECOLOGICAL INFORMATION

**Degradability (BOD):** Genetron 407C is a gas at room temperature; therefore, it is unlikely to remain in water.  
**Octanol Water Partition Coefficient:** Unknown for mixture

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#### 13. DISPOSAL CONSIDERATIONS

##### RCRA

Is the unused product a RCRA hazardous waste if discarded?      Not a hazardous waste  
If yes, the RCRA ID number is:      Not applicable

##### **OTHER DISPOSAL CONSIDERATIONS:**

Disposal must comply with federal, state, and local disposal or discharge laws. Genetron 407C is subject to U.S. Environmental Protection Agency Clean Air Act Regulations Section 608 in 40 CFR Part 82 regarding refrigerant recycling.

The information offered here is for the product as shipped. Use and/or alterations to the product such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

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#### 14. TRANSPORT INFORMATION

**US DOT PROPER SHIPPING NAME:** Refrigerant gas R 407C  
**US DOT HAZARD CLASS:** 2.2  
**US DOT PACKING GROUP:** Not applicable  
**US DOT ID NUMBER:** UN3340

For additional information on shipping regulations affecting this material, contact the information number found in Section 1.

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#### 15. REGULATORY INFORMATION

##### TOXIC SUBSTANCES CONTROL ACT (TSCA)

**TSCA INVENTORY STATUS:** Components listed on the TSCA inventory

**OTHER TSCA ISSUES:** None

##### SARA TITLE III/CERCLA

"Reportable Quantities" (RQs) and/or "Threshold Planning Quantities" (TPQs) exist for the following ingredients.

<u>INGREDIENT NAME</u>	<u>SARA/CERCLA RQ (lb.)</u>	<u>SARA EHS TPO (lb.)</u>
No ingredients listed in this section		

Spills or releases resulting in the loss of any ingredient at or above its RQ requires immediate notification to the National Response Center [(800) 424-8802] and to your Local Emergency Planning Committee.

## MATERIAL SAFETY DATA SHEET Genetron<sup>®</sup> 407C

**SECTION 311 HAZARD CLASS:** IMMEDIATE  
PRESSURE

**SARA 313 TOXIC CHEMICALS:**

The following ingredients are SARA 313 "Toxic Chemicals". CAS numbers and weight percents are found in Section 2.

<u>INGREDIENT NAME</u>	<u>COMMENT</u>
No ingredients listed in this section	

**STATE RIGHT-TO-KNOW**

In addition to the ingredients found in Section 2, the following are listed for state right-to-know purposes.

<u>INGREDIENT NAME</u>	<u>WEIGHT %</u>	<u>COMMENT</u>
No ingredients listed in this section		

**ADDITIONAL REGULATORY INFORMATION:**

Genetron 407C is subject to U.S. Environmental Protection Agency Clean Air Act Regulations at 40 CFR Part 82.

**WARNING:** Contains pentafluoroethane (HFC-125), 1,1,1-trifluoroethane, tetrafluoroethane, greenhouse gases which may contribute to global warming

**Do Not vent** to the atmosphere. To comply with provisions of the U.S. Clean Air Act, any residual must be recovered.

**WHMIS CLASSIFICATION (CANADA):**

This product has been evaluated in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

**FOREIGN INVENTORY STATUS:**

EU – EINECS # 2065578 – HFC-125  
# 2008394 – HFC-32  
# 223770 – HFC134a

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**16. OTHER INFORMATION**

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**CURRENT ISSUE DATE:** January, 2000

**PREVIOUS ISSUE DATE:** August, 1999

**CHANGES TO MSDS FROM PREVIOUS ISSUE DATE ARE DUE TO THE FOLLOWING:**

Section 1: New company name  
Section 14: New hazardous material shipping description  
Section 16: Modified NFPA and HMIS codes

MATERIAL SAFETY DATA SHEET  
Genetron<sup>®</sup> 407C

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**OTHER INFORMATION:**   HMIS Classification: Health – 1, Flammability – 1, Reactivity – 0  
                                  NFPA Classification: Health – 2, Flammability – 1, Reactivity – 0  
                                  ANSI/ASHRAE 34 Safety Group – A1

Regulatory Standards:

1. OSHA regulations for compressed gases: 29 CFR 1910.101
2. DOT classification per 49 CFR 172.101

Toxicity information per PAFT Testing

## COPPER TUBING IN SOILS

Copper tubing buried in the earth is used for the refrigerant-to-earth heat exchanger in the EarthLinked® (direct geexchange geothermal) heat pump system of ECR Technologies, Inc. Copper was chosen for the buried earth loop heat exchangers for several reasons.

Copper tubing is strong, ductile, resistant to corrosion, has a very high thermal conductivity, and is available in many different diameters and in long coil lengths. Copper connections can be brazed, the tubing may be bent, and copper tubing is economically available. In addition, copper has a long history of use in air conditioning and refrigeration, and is the material of choice for potable water for water lines buried underground and in buildings.

In 2001, ECR retained the services of Dr. T. D. Burleigh (a university professor with a Ph.D. in Metallurgy from the Massachusetts Institute of Technology, who is a NACE certified Corrosion Specialist and a registered Professional Engineer) to analyze the system and recommend the best methods to assure that the copper loops would never corrode. A comprehensive study was conducted in cooperation with Robert W. Cochran, a Professional Engineer with ECR. Following is a summary of the results of that proprietary study and the description of the protective system developed by ECR.

Copper metal has a very long and indefinite lifetime in most soils. Copper buried in the earth is naturally corrosion resistant because it generally requires an oxidizing environment to corrode, and most soils are reducing, thus they contribute electrons to the copper and protect it against corrosion. In those areas where corrosive conditions may exist, corrosion can be prevented with a small amount of "impressed electrical current" applied to the copper loop via an insulated cable.

For long life and reliability, ECR chose the Impressed Current method of Cathodic Protection. ECR developed an electronic control system, known as the Cathodic Protection System (CPS) to deliver a steady flow of electric current to the earth loops, manifolds, and line sets, without regard to weather, changing soil conditions, and other subsurface conditions. The copper loop is connected to the negative terminal of a rectifier, and a buried inert metal or graphite anode is connected to the positive terminal. The earth completes the electric loop. The amount of current is pre-set at the factory to match the amount of copper in the system to be protected.

Corrosion of metals is an electrochemical process of deterioration that results from a loss of electrons as they react with water and oxygen. As the current flows from the CPS, the metal surface to be protected is given a uniform negative electrical potential that precludes corrosion.

The CPS was designed by ECR in consultation with Dr. Burleigh in 2001 to preclude corrosion of Earth loops in hostile environments.



Live safer.\*

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## NSF Product and Service Listings

These Listings were Last Updated on Friday, June 05, 2009 at 4:15 AM Eastern Time.  
Please contact NSF International to confirm the status of any Listing, report errors, or make suggestions.

**Warning:** NSF is concerned about fraudulent downloading and manipulation of website text. If you have received this listing in hard copy, always confirm this certification/listing information by going directly to <http://www.nsf.org/Certified/PwsChemicals/Listings.asp?Company=C0031963&Standard=060> for the latest most accurate information.

## NSF/ANSI STANDARD 60 Drinking Water Treatment Chemicals - Health Effects

### SUPERGROUT PRODUCTS LLC



314 CHISHOLM STREET  
P.O. BOX 396  
ALPENA, MI 49707  
989-419-5890

**Facility :** WAUKEGAN, IL

#### Miscellaneous Water Supply Products[1]

*Trade Designation*  
GEO SUPERGROUT

*Product Function*  
Well Sealant

*Max Use*  
N/A

[1] Prior to using the system for drinking water, the well is to be properly flushed until the turbidity of the water is <1 NTU.

Number of matching Manufacturers is 1

Number of matching Products is 1

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## Material Safety Data Sheet

### Section 1: PRODUCT AND COMPANY INFORMATION

Product Name(s): GEO SuperGrout

Manufacturers Name: SuperGrout Products, LLC  
PO Box 3484  
Saginaw, MI 48605

Telephone Numbers: (888) 299-3860

Product Use: Thermal Conductive Grout used in geothermal or other bore holes. GEO SuperGrout is a "single" bagged material when water is added, can be directly poured, placed or pumped into geothermal or other bore holes.

### Section 2: COMPOSITION/INFORMATION ON INGREDIENTS

Component	Percent (By Weight)	CAS Number	OSHA PEL-TWA (mg/m <sup>3</sup> )	ACGIH TLV TWA (mg/m <sup>3</sup> )	LD <sub>50</sub> (Mouse, Intraperitoneal)
Portland Cement	Proprietary	65997-15-1	15 (T): 5 (R)	10 (R)	NA
Calcium Carbonate	5-50	1317-65-3	15 (T): 5 (R)	10 (T)	NA
Calcium Oxide	0-30	1305-78-8	5 (T)	2 (T)	3059 mg/kg
Calcium Sulfate	1-10	13397-24-5	15 (T): 5 (R)	10 (T)	NA
Silica Fume (Amorphous Silica)	0-10	69012-64-2	NA	2 (R)	NA
Magnesium Oxide	0-10	1309-48-4	15 (T)	10 (T)	NA
Crystalline Silica	0-10	14808-60-7	[(10)/(%SiO <sub>2</sub> +2)] (R) [(30)/(%SiO <sub>2</sub> +2)] (T)	0.05 (R)	NA

### Section 3: PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Solid (Powder). Evaporation Rate: NA.

Appearance: Grayish to Tan Powder pH (in water): 12-13

Odor: None Boiling Point: >1000°C

Vapor Pressure: NA. Freezing Point: None, Solid.

Vapor Density: NA. Viscosity: None, Solid.

Specific Gravity: 2.2 – 2.5 Solubility in Water: Slightly (0.1-1.0%)

### Section 4: HAZARD IDENTIFICATION

Geo SuperGrout contains a small fraction of Portland cement and/or Portland cement derivatives which are fully disclosed in the following Hazard Identification. These factors are clearly defined beginning with the word "Cement" in the following disclosures. These disclosures are common in ordinary Portland cement and Portland cement mixtures. The remaining balance of ingredients are inert and pose no hazard requirements other than silica exposures, which are fully disclosed under the cement disclosures.



MSDS: GEO SuperGrout

Emergency Overview: Cement is a solid, grey, odorless powder. It is not combustible or explosive. A single, short term exposure to the dry powder presents little or no hazard. Exposure of sufficient duration to wet cement, or to dry cement on moist areas of the body, can cause serious, potentially irreversible tissue (skin, eye, respiratory tract) damage due to chemical (caustic) burns, including third degree burns.

Potential Health Effects:

Eye Contact: Airborne dust may cause immediate or delayed irritation or inflammation. Eye contact with large amounts of dry powder or wet cement can cause moderate eye irritation, chemical burns and blindness. Eye exposures require immediate first aid and medical attention to prevent significant damage to the eye.

Skin Contact: Cement may cause dry skin, discomfort, irritation, severe burns, and dermatitis.

SECTION 5: FIRST AID

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Inhalation: Remove to fresh air immediately. If breathing difficulty occurs, seek medical attention and administer oxygen if coughing and other medical symptoms persist.

Skin: Wash skin with soapy water and rinse with clean cool water immediately. Apply moisturizing lotion to dry and irritated skin areas. Seek medical attention in cases of severe irritation and burns.

Eyes: Immediately flush eyes with large quantities of water, flushing for 15 minutes include under the lids to remove grainy particles. Call a physician immediately.

Ingestion: Do NOT induce vomiting. If conscious, have victim drink plenty of water and call a physician immediately.

SECTION 6: HMIS HAZARD RATINGS

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Product Rating		Scale	
HEALTH:	=1	Insignificant	= 0
FLAMMABILITY:	=0	Slight	= 1
PHYSICAL HAZARD:	=0	Moderate	= 2
REACTIVITY:	=0	High	= 3
		Extreme	= 4
PERSONAL PROTECTIVE EQUIPMENT = E		Chronic Health Hazard = *	

(E = SAFETY EYEWEAR, GLOVES, DUST RESPIRATOR)



**SECTION 7: FIRE FIGHTING MEASURES**

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FLASH POINT: N/A

AUTO IGNITION TEMPERATURE: N/A

FLAMMABLE LIMITS: LEL: N/A  
UEL: N/A

EXTINGUISHING MEDIA: Product is non-combustible. Carbon dioxide, water, dry-chemical, or chemical foam may be used should smoldering occur.

FIRE FIGHTING PROCEDURES: No special procedures required.

UNUSUAL FIRE AND EXPLOSION HAZARDS: No unusual hazards.

HAZARDOUS COMBUSTION PRODUCTS: None.

**SECTION 8: ACCIDENTAL RELEASE PROCEDURES**

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IN CASE OF ACCIDENTAL RELEASE OR SPILL: This material is not considered hazardous under RCRA (40 CFR Part 261), do not discharge spills or waste into lakes, ponds streams or waterways. Avoid creating dust and use adequate dust collection and ventilation.

**SECTION 9: HANDLING AND STORAGE**

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SPECIAL HANDLING AND STORAGE PROCEDURES: Repair or properly dispose of broken bags. Store bags in a dry place. Moisture will cause the cementitious fraction to react. Avoid creating dust by sweeping release area and disposing of the residue properly.

**SECTION 10: EXPOSURE CONTROLS AND PERSONAL PROTECTION**

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PERSONAL PROTECTION

RESPIRATORY PROTECTION: Use dust masks that are certified to comply with standard 42 CFR Part 84, series N95. Use of dust masks during blending is recommended.

PROTECTIVE GLOVES: Wear impervious, alkali resistant gloves, boots and protective clothing to prevent contact with skin. If contact occurs, wash with soapy water, and rinse with clean clear water. Moisturizing lotion can be added to dry affected areas as necessary.

EYE PROTECTION: Wear tight fitting goggles to prevent contact with eyes. Contact lenses should not be worn when handling any products that contain cementitious materials.



OTHER REQUIRED EQUIPMENT: None.

ENGINEERING CONTROLS: Use local exhaust to reduce dust concentrations to levels below the OSHA PEL or the ACGIH TLV. Refer to ACGIH publication "Industrial Ventilation" for design of ventilation systems. It is acceptable to utilize similar publications for design according to the above parameters.

**SECTION 11: DISPOSAL PROCEDURES**

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WASTE DISPOSAL: Product is NOT considered a hazardous waste under RCRA 40 CFR Part 261. Dispose of any wastes according to local, state and federal agency regulations.

**SECTION 12: TRANSPORTATION INFORMATION**

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Product is not considered to be hazardous under the US Department of Transportation (USDOT) Regulations.

**SECTION 13: REGULATORY STANDARDS AND INFORMATION**

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SARA Title III Sections 311 and 312

Portland cement, certain Portland cement derivatives and crystalline silica qualify as hazardous substances with delayed health effects.

CERCLA/Superfund 40 CFR 117 and 302

Not listed.

SARA Title III Section 303

Not subject to reporting requirements under Section 313.

TSCA Inventory

Most components of this product are listed in the TSCA Inventory.

OSHA Hazard Communication Standard

Most of the components of this product are considered hazardous chemicals under this regulation and should be included in an employer's Hazard Communication Program.

Federal Hazardous Substances Act

Portland cement is a hazardous substance subject to statutes promulgated under the subject act.

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The information provided herein by SuperGrout Products is believed to be accurate at the time of preparation or prepared from sources believed to be reliable. Users have the responsibility to comply with all health and safety laws, as well as environmental regulations when using this product, and should determine the suitability of the product for its intended use. Seller makes no warranty, express or implied, concerning the product or the merchantability or fitness thereof for any purpose or concerning the accuracy of information provided by SuperGrout Products.