CG Plus – A Hybrid Thermal Grout
Overview

• Introduce GeoPro’s new **hybrid salt water resistant** grouting formulation

• Who is GeoPro
  o Our background and goals

• The current products we offer
  o Advantages and uses of said products

• Where we are going with product development
  o CG Plus / PowerTECx the reason you are all here
COMPANY OVERVIEW

• GeoPro became the first ever GROUT company to exclusively focus on the GSHP industry.
  o That same focus remains today.
  o Aggressively promoting the growth of the industry.

• GeoPro understands the mechanical (heat transfer) benefits and limitations of GROUT far better than any of our competitors.
  o We are a mechanical engineering based company with an intimate understanding of the system and what effects heat transfer, not a geological based company focuses on “finding” bentonite reserves.

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To show how grout can impact the initial cost of the ground heat exchanger (GHE).

- Education
- Design Assistance

Lead the market in developing the next generation of grouting products.

- Thermally-enhanced Grouts

Offer technical support and support tools for these innovative grout products.
PRODUCTS

**BENTONITE-BASED GROUT**
- BH 20 – (Standard Grout)
- TG Lite – (0.79-1.20 Btu/hr ft °F )
- TG Select – (1.20-1.60 Btu/hr ft °F)

**THERMAL ENHANCEMENT**
- PowerTECx Additive

**CEMENT-BASED GROUT RECIPE**
- CG Plus - (TG + PowerTECx)

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• Not thermally-enhanced
• Requires only potable water
• Residential is a common application
• Will not Flash Hydrate
• Requires no chemical additives
• Workable for up to 20 minutes
• Not designed for:
  o Higher than 25% solids
  o Being used as a TG
  o Being used for CG Plus

<table>
<thead>
<tr>
<th>TARGET SOLIDS CONTENT (% MIXED WEIGHT)</th>
<th>FRESH WATER (GAL)</th>
<th>YIELD / 50LB BAG (GAL)</th>
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<td>25</td>
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</table>
• Thermally-enhanced
  o PTECx range 0.79-1.20 Btu/hr ft °F
• Used for commercial/residential
• Will not Flash Hydrate
• Requires no chemical additives
• Workable for up to 30 minutes
• Not designed for:
  o Reaching TC values higher than 1.2

<table>
<thead>
<tr>
<th>Target Thermal Conductivity (Btu/hr-ft-°F)</th>
<th>PowerTECx (lb)</th>
<th>Fresh Water (gal)</th>
<th>Yield (gal)</th>
<th>Density (lb/gal)</th>
<th>% Solids (gy weight)</th>
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<td>19.3</td>
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</table>
• Thermally-enhanced
  o PTECx range 1.40-1.60 Btu/hr ft °F
• Commonly used for commercial
• Will not flash hydrate
• Requires no chemical additives
• Workable for up to 30 minutes
• Not designed for:
  o Low solids applications

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<tr>
<th>Target Thermal Conductivity (Btu/hr-ft-°F)</th>
<th>PowerTECx (lb)</th>
<th>Fresh Water (gal)</th>
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</table>
• What is PowerTECx?
• What’s the thermal conductivity range for PowerTECx?
• What does a “typical” recipe using PowerTECx look like compared to the traditional Thermal Grout/Sand mix?
• Why would the contractor use PowerTECx?
• Is it safe to use?
• Designed EXCLUSIVELY for **TG Lite** or **TG Select**.
PowerTECx
Thermal Conductivity Range

TG Lite + PowerTECx

TG Select + PowerTECx

SCALE: (Btu/hr-ft-°F)

“NO SAND” recipes

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• Reduces total weight of dry material on the site by **62% - 72%**.

When considering a grout thermal conductivity of 1.00 Btu/hr-ft-°F

1 lb of *PowerTECx* = 18.3 lbs of Silica Sand
Recipe Comparison

Traditional Mix
- Silica Sand (55%)
- Thermal Grout (11%)
- Water (34%)

No Sand
- Water (70%)
- Thermal Grout (25%)
- PowerTECx (5%)

Grout with a Target TC of 1.00 Btu/hr-ft-°F

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**Safety**

- **Graphite-based Compound**
  - Graphite is chemically inert to virtually everything

- **PowerTECx** is certified to NSF/ANSI Standard 60
  - The listing is exclusive as an additive to Thermal Grout

- Not listed as a carcinogen.

- See MSDS on our web site for handling issues.

- **Graphite is a VERY good electrical conductor**
  - Caution should be taken when handling around electrical devices, switches or fuse boxes.

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**CAUTION**
• **Bottom line:**
  – Proven to be more economical.
  – Reduces material handling needs
  – Prevents expensive equipment maintenance
  – Achieves thermal performance not seen before
  – Creates a flexibility aiding in new product development
    • i.e. CG Plus
What is **CG Plus**?

CG Plus is a set of cement-based field mix recipes that GeoPro has developed for installations requiring the use of a cement-based grout. CG Plus is not rigid like traditional cement-based grouts which means it forms a better seal around the u-bend. Available in a range of thermal conductivities, CG Plus handles extreme salt water environments with higher yield per bag than traditional cement-based grouts.

As a mix, CG Plus is not listed or certified to NSF/ANSI Standard 60. However, the components of the mix supplied by GeoPro are listed and certified to Standard 60.

CG Plus is not meant for use when high compressive strength characteristics are required, but it does deliver a much firmer set than traditional bentonite-based grout mixes.

### HOW TO MIX

1. Fill conventional paddle mixer with dry mix. Dry mix required when mixing new batches of mix. 

2. Add 40 lbs of water to the recommended amount of Type II Portland Cement.

3. Immediately add up to the recommended amount of Thermal Grout. Stop when mix is the consistency of pancake batter.

### PUMPING

Pump with a positive displacement pump designed for cement. A standard pump recommended through a conventional line using a conventional line at a rate of 1.5-2.5 gal/min.

WARNING:

Use caution when handling this and all products containing Portland cement. Direct body contact with freshly mixed Portland cement can cause severe burns.

The product contains cement and will set solidly. Ensure that grouting equipment is properly flushed with water after mixing.

### Mix Table

<table>
<thead>
<tr>
<th>Target TC (Btu/hr-ft·°F)</th>
<th>Thermal Grout (lb)</th>
<th>PowerTECx (lb)</th>
<th>Type II Portland Cement (lb)</th>
<th>Fresh Water (gal)</th>
<th>Yield (gal)</th>
<th>Density (lb/gal)</th>
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</thead>
<tbody>
<tr>
<td>0.40</td>
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<td>9</td>
<td>23.5</td>
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<td>0.70</td>
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<td>9</td>
<td>23.5</td>
<td>26.0</td>
<td>29.4</td>
<td>10.1</td>
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</tbody>
</table>
• **Goals for Design**
  o Salt water resistant up to 35 g/L
  o Provide a substitute for consolidated formations
  o Provide a higher yield replacement
  o Provide the same range of TC values
  o Low heat of hydration
  o Eliminate a need for polymers or additives
  o Still provide a semi-flexible material

• **Advantages over mix 111**
  o Eliminates Sand
  o More yield reducing cost
  o Lower heat of hydration
  o Eliminates the need for polymers
  o Provides a range of TC values
  o Adheres to pipe wall

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PROJECT NAME: GEOPRO, INC.
Sample ID: GeoPro's Thermal Grout with Type II Portland Cement 40 Thermal Grout w/ Type II Portland (CG Plus) - 25.00%
DEIONIZED WATER - 75.00%

Sample tested after a 28 day curing period within a salt water bath.

AVERAGE 9.1E-08 cm/sec
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**HOW TO MIX**

1. Fill conventional paddle mixer with required volume of fresh water.

<table>
<thead>
<tr>
<th>Mix Table</th>
<th>Thermal Grout (lb)</th>
<th>PowerTEC (lb)</th>
<th>Type II Portland Cement (lb)</th>
<th>Fresh Water (gal)</th>
<th>Yield (gal)</th>
<th>Density (lb/gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.40</td>
<td>50</td>
<td>0</td>
<td>23.5</td>
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<tr>
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<td>50</td>
<td>7.5</td>
<td>23.5</td>
<td>26.0</td>
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<td>15</td>
<td>23.5</td>
<td>26.0</td>
<td>30.0</td>
<td>10.2</td>
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</table>
Heat of Hydration

Peak Temperature 135 F

Peak Temperature 95 F

CG Plus 1
CG Plus 2
CG Plus 3
Neat Cement 1
Neat Cement 2
Neat Cement 3
Ambient
CG Plus
Conditionally Approved For Use in Minnesota Bedrock

In Minnesota, it is required that vertical loops installed in bedrock formations use cement based grout. To satisfy this requirement you may now use GeoPro’s CG Plus. A set of high yield cement based field mix recipes that combine TG Lite, Portland Cement (Type II) and PowerTECx.

CG Plus mixes can substantially reduce material cost and show improved handling over traditional cement-based options. Click on a link below to view available mix recipes:

- CG Plus 120 (Submittal, PDF 133kB)
- CG Plus 70 (Submittal, PDF 133kB)
- CG Plus 40 (Submittal, PDF 133kB)

The ability to use these mixes is dependent on the approval of a site-specific variance. Contact the Minnesota Department of Health (MDH) for filing instructions.

Continue to use TG Lite without a variance in unconsolidated (non-bedrock) formations as you have in the past. With the ability to use our CG Plus recipes in bedrock, TG Lite is more versatile than ever. Contact us any time at (877) 580-8949 for free engineering consultation and technical support.
## Price Comparison

<table>
<thead>
<tr>
<th></th>
<th>Mix 111</th>
<th>CG Plus 100</th>
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<tbody>
<tr>
<td>Portland Type II (Unit Price $)</td>
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<tr>
<td>Superplasticiser (Unit Price $)</td>
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</tr>
<tr>
<td>Power TECx (Unit Price $)</td>
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<td>18.00</td>
</tr>
<tr>
<td>Silica Sand (Unit Price $)</td>
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</tr>
<tr>
<td>Bentonite (Unit Price $)</td>
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<td>18.00</td>
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<tr>
<td><strong>Total (Unit Price $)</strong></td>
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<tr>
<td><strong>Yield (gallons)</strong></td>
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<tr>
<td><strong>$/gallon</strong></td>
<td>2.13</td>
<td>1.30</td>
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</table>
CGPlus 100 (1.00 Btu/hr ft °F)
PRODUCT SUBMITTAL INFORMATION

When materials are mixed according to the following specifications, CG Plus will yield a cement-based grouting material with a minimum thermal conductivity of 1.00 Btu/hr ft °F.†

<table>
<thead>
<tr>
<th>Target TC  (Btu/hr-ft°F)</th>
<th>TG Lite (lb)</th>
<th>PowerTECx (lb)</th>
<th>** Type II Portland Cement (lb)</th>
<th>Mix Water (gal)</th>
<th>Yield (gal)</th>
<th>Density (lb/gal)</th>
<th>% Total Solids (by weight)</th>
<th>% Active Solids* (by weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>50</td>
<td>15.0</td>
<td>23.5</td>
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<td>30.0</td>
<td>10.2</td>
<td>29.0</td>
<td>25.3</td>
</tr>
</tbody>
</table>

**MIXING INSTRUCTIONS**

1. Fill conventional paddle mixer with required volume of fresh water (according to mix table).
2. Start mixer and add the required amount of PowerTECx according to the table.
3. Immediately add the required amount of Type-II Portland Cement.
4. Immediately add UP TO the recommended amount of Thermal Grout Lite. Stop when mix is the consistency of pancake batter.

† The combined weights of TG Lite, Portland Cement and Mix Water. Components supplied by GeoPro, Inc. PowerTECx is shipped on heat shrunk 75 bag pallets.

**PUMPING**

Pump with a positive displacement pump (piston pump recommended) through a 1¼” inside diameter tremie pipe at a rate of 5 to 15 gallons per minute.

**WARNING:**
Adding more than the specified amount of water may make this product more difficult to pump.
Mix water should be between 50°F and 80°F.
Will States allow its use in this application?
• Many States do not formally “approve”, but require NSF Standard 60 certification.
Project Scope (Lisa Meline and Randy Dockery)

- 76 of 280 Boreholes have been completed
- Diameter of borehole is 10 inches for the first 30-40 feet (depends on location) and 7 inches in diameter to 400 feet.
- U-bend is 1 inch.
- Tremie line is a 2” galvanized pipe
- CG Plus was spec’d for cement/salt water resistance properties
- Average measured grout TC 1.23 (1.20 Target btu/hr-ft-F)
- Formation losses are a major issue (major fault line)
  - # 8 Well Gravel added to help prevent loss
• Thermally enhanced bentonite/cement grouting formulation (0.79-1.20 Btu/hr ft °F )

• Salt water resistant to 35 g/L

• Can be used in consolidated formations with a variance

• More economical than past cement grouting products

• Designed to be used with either Type II or Type V cement

• Requires no additional polymers or additives

• PH range (11) allows it to be used with DX systems (Bonus)

Mix Table

<table>
<thead>
<tr>
<th>Target TC (Btu/ft²°F)</th>
<th>Thermal Grout (lb)</th>
<th>PowerTECx (lb)</th>
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QUESTIONS?