Green World Crete, Inc.

Geo-Green Crete™

- “Zero-based” Portland Cement
- Low-Carbon Footprint Cement
- Competitive Alternative to Portland Cement

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Development of Sustainable and Multi-Functional Inorganic Polymer Coating Material for Restoration and Protection of Constructed Concrete infrastructure as well as New Structures

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F. Achille 4/15/10
Low-Carbon Footprint Sustainable Geo-Green Crete™ cement for Restoration and Protection of Constructed Concrete infrastructure

Exposed Concrete  
Geo-Green Crete™ coating

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Background: Green World Crete, Inc.

- Supply the global construction community with "Geo-Green Crete™" a clean zero-Portland cement product based on new patent pending, cutting-edge low emissions technologies.

- Provide a superior concrete product that truly is 100% green and friendly to our atmosphere.

- To establish "Geo-Green Crete™" as the global solution for emissions reduction* in the construction sector.

- Meet the standards of the United Nations and be eligible to receive Carbon Credits.

*(1.5% to 10% of all greenhouse gas effect is reported due to Portland Cement production).

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Technical Development

- Developed a novel method of producing a binding agent to create a one-part “low-carbon footprint” sustainable cementitious product
- Utilize a non-heating blending process to produce the binding agent and the Geo-Green Crete™ Cement
- 2 to 6 percent by weight of binding agent in blends with post-industrial waste materials (Fly Ash, GGBFS) is required to achieve desired compressive strength for use in structural and non-structural applications
- Working with a structural engineering firm to certify Geo-Green Crete™ cement & concrete in all 50 States
Commercial Development

- Developing market through licensing agreement
- Participating in all market segments:
  - Ready-Mix
  - Cement Product Manufacturers
  - Contractors
  - Building Material Dealers
- Geo-Green Crete™ been tested in ASTM and ACI certified laboratory in the USA, Jamaica, Ecuador, and UAE
- Negotiating licensing agreement in USA, Jamaica, Spain, and UAE,
Low-Carbon Footprint Sustainable Geo-Green Crete™ cement coating & patching material

- Concrete-based infrastructure is continuing to decay and in desperate need of repair and rehabilitation –
  - 2009 American Society of Civil Engineers (ASCE, 2009) estimated a $2.2 trillion 5-year investment
  - 1999-2001 study by CC Technologies Laboratories, Inc shows the total annual estimated direct cost of corrosion in the U.S. to be $276 billion
- Our aim to meet this challenge is to provide a material that embraces the goal of global economic development coupled with “green emphasis” to extend the designed life of these valuable assets greater than 50 to 100 years

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• Low-carbon footprint materials targeted are aluminosilicate-intense including:
  - Class F Fly Ash
  - Volcanic Ash
  - Kaolin clay
  - Other clays
  - Iron slag
  - Class C Fly Ash
  - Metakaolin
  - Microsilica
  - Steel slag
  - Ground Granulated Blast Furnace Slag (GGBFS)

• Why Fly Ash?
  - Low-Carbon Dioxide Footprint
    - Ordinary Portland Cement: 959 CO2e per ton
    - Ground Granulated Blast Furnace Slag: 155 CO2e per ton
    - Fly Ash Class F: 93 CO2e per ton
  - Cost

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<table>
<thead>
<tr>
<th>Sample thickness (inches)</th>
<th>Sample weight (grams)</th>
<th>Volume of test solution (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25</td>
<td>0.6</td>
<td>10</td>
</tr>
</tbody>
</table>

Control: Portland cement based concrete, and three specimens derived from fly ash. These samples are briefly described following:

A liquid paste is formed that can be sprayed, brushed and painted on a porous to semi-porous surface.

Sample 33 (Geo-Green Crete LC-33) is a Fly Ash Class F pozzolan material having a mean diameter of 3.0 micron that has been activated in an alkaline environment with a water/cementitious ratio of 0.06 to create.

Sample 34 (Geo-Green Crete LC-34) is a Fly Ash Class F pozzolan material having a mean diameter of 3.0 micron that has been activated in an alkaline environment with a water/cementitious ratio of 0.13.

Sample 35 (Geo-Green Crete LC-35) is a Fly Ash Class F pozzolan material having a mean diameter of 3.0 micron combined with a high SiO₂ containing material that has been activated in an alkaline environment with a water/cementitious ratio of 0.13.

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- Durability testing:
  - Includes all major environmental and chemical degradation modes for concrete
  
<table>
<thead>
<tr>
<th>Carbonation</th>
<th>Salt injury</th>
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</thead>
<tbody>
<tr>
<td>Sulphate</td>
<td>Oxidation – Nitric acid and basic degradation</td>
</tr>
<tr>
<td>degradation</td>
<td></td>
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</tbody>
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- Study base line (room conditions 20°C)
  - sulfuric acid $5 \times 10^{-5}$ M;
  - nitric acid $10^{-4}$ M;
  - sodium chloride 0.5 M;
  - sodium hydroxide $4 \times 10^{-6}$ M and
  - $6 \times 10^{-3}$ M sodium carbonate (a water soluble source of the carbonate ion).

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Samples beginning (left set) and after 10 months (right set) in sulfuric acid (10 Molar) right from left to right in each set:
- concrete, LC-33, LC-34, LC-35.

LC 33 and LC 34 crumbled within 30 minutes after addition to the acid. The PC bubbled on addition of the acid and after 2 weeks finally completed crumbling. LC 35 remained over the test period.

Samples beginning (left set) and after 10 months (right set) in sodium hydroxide (5 Molar) right from left to right in each set:
- concrete, LC-33, LC-34, LC-35.

the PC samples, were stable in the sodium hydroxide solution throughout the entire 10 month study except LC33 showed some, a minor amount, formation of feathery-like material at about 10 months time.

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Samples beginning (left set) and after 10 months (right set) in sodium chloride (0.5 Molar) right from left to right in each set: concrete, LC-33, LC-34, LC-35.

beginning (left set) and after 10 months (right set) in sodium carbonate (0.3 Molar) right from left to right in each set: concrete, LC-33, LC-34, LC-35.

the PC samples, were stable in the sodium chloride and sodium carbonate solutions throughout the entire 10 month study.

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Samples beginning (left set) and after 10 months (right set) in nitric acid (10 Molar) right from left to right in each set- concrete, LC-33, LC-34, LC-35.

LC 33 and LC 34 crumbled within 30 minutes after addition to the acid. The PC bubbled on addition of the acid and after 2 weeks finally completed crumbling. LC 35 remained over the test period.

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- Along with the positive environmental aspects, improved physical characteristics are envisioned in comparison to no coating/filler and organic coatings. These improved characteristics are:

<table>
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<th>Improved adhesion</th>
<th>Improved workability</th>
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<tr>
<td>Decreased permeability</td>
<td>Improved sulfate protection</td>
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<tr>
<td>Reduced shrinkage</td>
<td>Improved expansion compatibility</td>
</tr>
<tr>
<td>Reduced creep</td>
<td>Decreased bleeding/segregation</td>
</tr>
<tr>
<td>Increased strength</td>
<td>Reduced heat of hydration</td>
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<tr>
<td>(compressive and flexural)</td>
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reasons for using an aluminosilicate shield or coating in comparison to typical organic coatings (paints).

- Thermal coefficient of aluminosilicate is closer to that of concrete compared to most organic coatings (coefficient of linear thermal expansion for concrete is about $12 \times 10^{-6}$/K; volumetric thermal expansion is about $36 \times 10^{-6}$/K; for polymer coatings it is about $50-90 \times 10^{-6}$ K and $100$ to $300 \times 10^{-6}$/K; and for aluminosilicate about $10 \times 10^{-6}$/K and $30 \times 10^{-6}$/K). Thus, there is less cause for cleavage of the adhesion between the concrete and aluminosilicate.

- Organic coatings are derived from petrochemicals while aluminosilicates are derived from essentially waste material.

- Aluminosilicate coatings are less expensive with a cost approaching less than ten dollars a gallon whereas specialized organic coatings cost are greater than ten dollars a gallon in bulk.

- Organic coatings have much lower ability to resist scratching and etching in comparison to aluminosilicate coatings.

- Aluminosilicate coatings adhere though formation of chemical bonds with the concrete whereas organic coatings adhere through mechanical means.
Thank You....

Any Questions