Argonne NATIONAL LABORATORY

Energy Systems

CERAMICRETE Provides Concrete Evidence of Superior Performance

1996 R&D 100 Award Winner

2000 Federal Laboratory Consortium Award

BENEFITS

√ Specialty applications are favored to take advantage of excellent physical properties, including porosity, nonflammability, and strength.

√ Process uses conventional concrete mixing and handling equipment.

√ Use of common waste materials extends value (e.g., sh, styrofoam, sawdust).

√ No formation energy is required, in contrast to fired Ceramics or vitrification.

Links to Online Information:

Further details about Ceramicrete:
http://www.anl.gov/techtransfer/Available_Technologies/Material_Science/Ceramicrete/index.html:

Ceramicrete properties (Table 2):
http://www.anl.gov/techtransfer/Available_Technologies/Material_Science/Ceramicrete/properties-table2.pdf

Patents issued and licenses:
http://www.anl.gov/techtransfer/Available_Technologies/Material_Science/Ceramicrete/Ceramicrete_Patents.html

Argonne National Laboratory has developed an innovative, chemically bonded phosphate ceramic (CBPC), called Ceramicrete, strong enough to both construct buildings and fill teeth. The material was developed initially to serve as a binder in solving waste management problems. However, Ceramicrete's strength and versatility have made it ideal for a variety of applications.

How Ceramicrete Works

CBPCs are formed by acid-base reactions between an acid phosphate (e.g., potassium, ammonium, or aluminum) and a metal oxide (e.g., magnesium, calcium, or zinc). A powder blend of the two is mixed with water to make a slurry. The slurry sets at room temperature within minutes or hours, depending on the additives. It forms a dense ceramic that can be tailored to possess desirable properties. For example, adding fly ash enhances this mixture's strength to between two and three times that of conventional cement.

Building, Construction, and Architectural Products

Ceramicrete can recycle high-volume wastes such as fly ash, mineral waste, and natural fibers by binding them into value-added products. Combined with natural fibers, Ceramicrete forms a compound that could replace particle board for home construction. Fireproof insulation, bricks, and tiles can all be made from Ceramicrete. It also offers an alternative material for decorative terra cotta. In developing countries in Central and South America and the Caribbean, homes that use Ceramicrete have the potential to be cost-competitive with cement structures. Ceramicrete holds promise for homes located in cold climates as well. Because it sets hard even in freezing temperatures, it is an ideal cement for frigid regions.

Oil and Gas Well Cement and Sealant

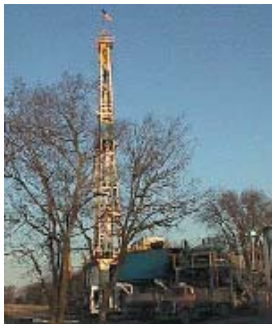

Photo courtesy of GTI and the GTI Catoosa™ Test Facility.

Unlike conventional drilling cement, Ceramicrete bonds tightly to earth materials and casings in the presence of drilling fluids or hydrocarbons. It slightly expands during setting and is drillable and machinable. The hardened Ceramicrete is not affected by severe downhole conditions and is stable in a wide range of chemical environments. It is especially useful as a drilling cement in permafrost regions because it has low thermal conductivity and can be pumped at very low viscosity. Moreover, it is an excellent insulating cement that protects permafrost surroundings.

KEY CERAMICRETE MARKETS

Application	Properties	Benefits	Status
Building, Construction, and Architectural Products	Modern, high-tech binder that strengthens end-product (e.g., wallboard) or serves as a property-enhancing coating.	• Versatile • Flame-Resistant • Strong • Environmentally friendly	Licensed and used commercially; new product applications being developed for alternative construction techniques and products.
Oil and Gas Well Cement and Sealant	By changing additives, user can engineer its properties and character-istics to meet varying downhole conditions.	Offers the mechanical strength and bonding required in deep, high-pressure wells and wells drilled in permafrost regions.	Proven in the lab. Yard and field tests in progress. License available.
Dental and Bone Cements	Biocompatible; sets quickly; bonds with most other materials; more durable; performs better than existing materials.	Holds promise for filling teeth and repairing bone. Proven to be compatible in dental and orthodontic applications.	Lab testing has yielded positive results. Ready to proceed to next phase of testing and development.

GENERAL PROPERTIES

- √ Offers 2-3 times the strength of cement
- √ Mixes at ambient temperatures
- √ Hardens quickly
- √ Bonds with most materials
- √ Resists corrosion
- √ Does not absorb water
- √ Stable in acidic and high-temperature environments

"Ceramicrete's properties make it ideal for building and construction. It lends itself well to virtually any application where a cement binder is required. It's easy to use, cures quickly, has a high compressive strength, and bonds well to metal. To date, 15 Departments of Transportation have approved it for use in repairing tollways. Our customers have also purchased it for architectural molding and casting, as well as refractory applications."

Tom Lally
President, Bindan Corp,
Phosphate Binder Products Developer
Oak Brook, Illinois

Dental and Bone Cements

Ceramicrete holds good promise as a dental cement for tooth fillings and for repairing bone damage. Ceramicrete offers density and rigidity that are comparable to bone, and calcium-based CBPCs are biocompatible with bone and dentine. They can be formed at room temperature as a paste and implanted in the body, where they harden and form a suitable microstructure, simulating biological materials.

THE UNIVERSITY OF CHICAGO

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