ThermaLock Cement:
A Solid Investment

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The year 2007 marks the sixtieth anniversary of Brookhaven National Laboratory (BNL). Over the years, BNL has helped improve society through its scientific advances; one such breakthrough technology is the creation of ThermaLock Cement by BNL chemist Toshifumi Sugama. Sugama, a three time winner of the R&D 100 Award, a prestigious award granted annually by R&D Magazine to the top hundred technological achievements, was granted the award in 2000 for his high-performance ThermaLock Cement. His new material had immediate revolutionary implications globally and poses potential large-scale innovations. (Greenberg, 2000)

Portland cement, the industry standard cement, is based on calcium hydroxide, $Ca(OH)_2$, and calcium silicon hydrates (U.S. Department of Energy, 2005). This poses a problem, especially in geothermal wells, where the highly acidic environment promotes the chemical deterioration of the cement. The oil industry finds Portland cement highly inefficient as well because oil wells use steam in injection wells, placing the cement under high thermal stress, accelerating its deterioration. In other cases, carbon dioxide may be used, however, the carbon dioxide readily reacts with any available water to form carbonic acid, which reacts with the cement, converting it into calcium hydrogen carbonate, a process known as carbonation (Carbonation, 2006). The low tensile strength and resiliency of Portland cement cause it to crack and buckle under high stress, instead of deforming.

ThermaLock, on the other hand, is formed from recycled fly ash, calcium phosphate hydrates, calcium aluminate hydrates, sodium polyphosphates, and mica-like calcium aluminosillicates – all substances which are abundant and inexpensive (U.S. Department of Energy, 2005). These substances are immune to the deteriorating effects of carbonation. Also, ThermaLock is functional in temperatures ranging from 140 ^{o}F to 700 ^{o}F. Research has not only shown that ThermaLock is resistant to carbon dioxide and thermal stress, but in fact, conditions cause Portland cement to lose up to half their weight leave ThermaLock properties virtually unchanged or even improved (ThermaLock Cement, n.d.).

ThermaLock cement is clearly beneficial for geothermic wells, which pump hot water or steam from the Earth's interior to run electricity-generating turbines. Such wells are significant because geothermal energy provides about two percent of the world's electricity (Greenberg, 2000). ThermaLock cement is also useful for the oil industry, which uses oil wells that utilize steam and/or carbon dioxide injection wells to obtain oil from deep within the Earth's crust (U.S. Department of Energy, 2005). These harsh conditions cause ordinary cement to deteriorate within a year, requiring it to be replaced frequently. However, ThermaLock lasts for approximately twenty years without significant decline in cement properties. This means savings of $150,000 per well per year; over twenty years, that adds up to significant financial savings that allow for money to be utilized in a more efficient manner (R&D Successes, n.d.).

However, ThermaLock's usefulness is not restricted to simply these specialized situations; rather, its effectiveness extends well outside the welling industries. ThermaLock cement can be used any place where normal cement is used. It is economical and environmentally-friendly, making it an appealing alternative to ordinary cement. Its resistance to acidity may prove to be an even greater incentive in the not-too-distant future. Global warming and industrial pollution are all factors that promote the precipitation of acid rain. Acid rain may wear down ordinary cement, but ThermaLock will endure the hardships of a possible acidic future.

This cement may also hold many other potential capabilities that may help shape the way our world works. ThermaLock may be a relatively inexpensive substance used to contain extremely hot materials, or to contain concentrated acids. By converting ThermaLock into either a liquid or spray form, it can be possible to have instant cement for creating thin layers of cement that still retain the same properties of thick slabs of cement. Thin layers of ThermaLock may be used to provide protection even more easily and readily. This could possibly develop into a promising product of ThermaLock that will serve a tremendous purpose for humankind.

Many possibilities lie in the advancement of ThermaLock cement or in its alternate uses. It may used simply as cement in welling industries, or its high-performance cement properties may prove to be useful in other surprising fields. Regardless of its potential use, it is surely a breakthrough that has, and will continue to have, a strong impact on human society.

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