

Controlled And Efficient Synthesis Of Inorganic-Organic Composite Cementation Agents With Enhanced Strain Capacity

Tech ID: 31881 / UC Case 2019-648-0

SUMMARY

Researchers in the UCLA Department of Civil and Environmental Engineering, Department of Chemical Engineering and Department of Chemistry and Biochemistry have developed an energy-saving approach to controllably fabricate cemented solids with hybrid microstructures and enhanced properties.

BACKGROUND

Concrete and ordinary portland cement (OPC) are fundamental building materials, produced at 30 billion tons and 4.1 billion tons per year, respectively. Conventional manufacturing methods used to make these materials, however, have significant deficiencies. The chemical reactions currently used to produce those materials are highly-energy intensive (>5kJ/g), and account for 9% of anthropogenic CO₂ emissions every year. Furthermore, once the concrete and OPC are put into use, the produced material can react with water at standard temperature and pressure resulting in an uncontrollable microstructure and the requirement of skilled laborers to ensure durable construction and length of structural service-life.

INNOVATION

The proposed synthesis method to fabrication of cemented solids can produce cemented solids with enhanced properties that have low-temperature activation, active control of reactions by hydrothermal synthesis, and design of hybrid microstructures. The method is energy efficient, enhancing dissolution rates of the cement and OPC precursors and industrial wastes at sub-boiling temperatures and ambient pressure. Activation of these abundant precursor materials reduces the overall energy required to process the raw materials (relative to conventional cements), and removes the need for CO₂. Additionally, this process allows for an elevated degree of control of the temperature, pressure and flow-rate, allowing for a more predictable microstructure and higher level of certainty for the service life of the materials produced, even by unspecialized laborers.

APPLICATIONS

- Universal architecture materials • Land reclamation materials • Other commercial construction materials

ADVANTAGES

- 50% energy saving • Low CO₂ emission • Enhanced mechanical properties • Super durability and fracture-resistance

STATE OF DEVELOPMENT

A comprehensive and integrated manufacturing method is proposed.

RELATED MATERIALS

- ▶ Erika Callagon La Plante, Tandr  Oey, Yi-Hsuan Hsiao, LaKeshia Pery, Jeffrey W. Bullard and Gaurav Sant. Enhancing Silicate Dissolution Kinetics in Hyperalkaline Environments. J. Phys. Chem. C 2019, 123, 6, 3687-3695. DOI: 10.1021/acs.jpcc.8b12076. - 01/15/2019
- ▶ Zongsu Wei, Yi-Hsuan Hsiao, Xin Chen, Erika Callagon La Plante, Iman Mehdipour, Dante Simonetti, Narayanan Neithalath, Laurent Pilon, Mathieu Bauchy, Jacob Israelachvili and Gaurav Sant. Isothermal Stimulation of Mineral Dissolution Processes by Acoustic Perturbation. J. Phys. Chem. C 2018, 122, 50, 28665-28673. DOI: 10.1021/acs.jpcc.8b08343 - 11/26/2018

PATENT STATUS

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INVENTORS

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OTHER INFORMATION

CATEGORIZED AS

- ▶ **Materials & Chemicals**
- ▶ Composites
- ▶ Other

RELATED CASES

2019-648-0

Country	Type	Number	Dated	Case
United States Of America	Published Application	20220169569	06/02/2022	2019-648
European Patent Office	Published Application	EP 3935024	01/12/2022	2019-648

Additional Patent Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ [Method For Mitigation Of Alkali-Silica Reaction In Concrete Using Chemical Additives](#)
- ▶ [Inorganic Admixtures for Preventing Conversion Phenomena in High-Alumina Cements](#)
- ▶ [Buffer-Free Process Cycle For Co2 Sequestration And Carbonate Production From Brine Waste Streams With High Salinity](#)
- ▶ [Facile, Low-Energy Routes for the Production of Hydrated Calcium and Magnesium Salts from Alkaline Industrial Wastes](#)

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