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Carbonating a Fine Metallic Powder and Tailoring the Micro-Structure to Develop Dense Binder Systems

AzTE Case # M14-242P

Inventors

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Background

Anthropogenic carbon dioxide (CO_2) emissions are harmful to the environment. Attempts at physical sequestration, or capturing CO_2 in stationary receptacles, have proven to be only short-term solutions, with substantial amounts of CO_2 leaking back into the atmosphere. Researchers are attempting to identify methods of chemical sequestration, where CO_2 is consumed in a chemical reaction to produce harmless, or even useful, products. Standard manufacturing processes produce tens of millions of tons of metallic iron waste. Due to the economic infeasibility of recycling methods, that waste is discarded in landfills. A recent trend in industrial manufacturing has been to seek out methods of recycling waste products to create a more sustainable industrial ecology, where waste products from one process are recycled as input materials for other processes. Profitable combination the waste metallic iron and CO_2 would subdue two major sources of environmental degradation and economic waste.

Invention Description

Researchers at ASU have discovered a method of combining iron and CO_2 byproducts to produce a new binding matrix for concrete. Production of conventional binding materials also produces large amounts of greenhouse gas (GHG) emissions. This new process, using a chemical reaction between metallic iron and aqueous CO_2, produces no GHGs. Sequestering CO_2 by chemically binding it to iron ensures it cannot escape back into the environment. Since the input materials are waste products from other industrial processes, this method is more cost effective than standard techniques. The binding material has properties comparable to traditional concrete without the harmful byproducts. Altering the exact ratio of the chemical reactants also allows exact physical properties, such as density, to be fine-tuned for manufacturing specifications. As the United States, and the world, works toward implementation of sustainable industrial ecosystem practices, processes such as this will put companies ahead of the curve.

Potential Applications

- Ecofriendly alternative to cement
- Building and Infrastructure
- Construction Industry
- Chemical CO_2 sequestration
- Landfill size reduction through elimination of a major source of manufacturing process waste

Benefits and Advantages

- **Public Image** – Use of ecofriendly techniques improves public perception.
- **Low Cost** – Easily integrated into existing processes.
- **Sustainability** – Uses ecofriendly industrial processes to sequester CO_2.
- **Energy Conservation** – Reaction occurs at ambient temperatures, minimizing necessary additional energy input.
- **Industrial Ecology** – Waste iron and CO_2 from other processes is recycled directly into the process stream.
- **Fiscally Responsible** – All input materials are waste products from other processes, making them low cost and environmentally friendly.
- **Flexibility** – Physical properties such as density of the final binding material can be tailored to specification.

Intellectual Property Status:

Pending

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