Title

Sustainable Bioinspired Polymer–Mineral Composites for Adaptable Repair in Conservation Applications

Abstract

Every year, tens of thousands of tons of plaster-based materials are used in restoration and conservation applications, many of which are derived from non-renewable sources and discarded at the end of their service life. Here, we introduce a biodegradable, bio-derived composite based on chitosan and calcium carbonate that is composed of simple, widely available constituents and designed for adaptable repair applications. By varying polymer molecular weight, concentration, and mineral content, the composite can be formulated to span injectable, paste-like, and putty-like behaviors, enabling accommodation of diverse structural filling and stabilization needs. We examine relationships between composition, flow behavior, and mechanical performance through rheological characterization of the wet composite and measurements of bulk density, porosity, and compressive strength in the hardened state. Rather than targeting a single optimized formulation, this work demonstrates a tunable material platform in which relationships between composition, flow behavior and mechanical performance guide selection of material behavior based on application requirements. Future applications of this approach include sustainable repair and conservation materials for exhibits, architectural restoration, and other contexts where adaptable handling, mechanical integrity, and biodegradability are desired.

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