## Plan Overview

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*A Data Management Plan created using HKUL DMPTool*

**Title:** Biomimetic wet carbonation recycling of recycled concrete powder

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**Principal Investigator:** Zhiguang Wang

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**Template:** HKU Template

**Project abstract:**

Biomimetic wet carbonation recycling of recycled concrete powder (RCP) integrates bio-inspired principles with organic polymers to upgrade construction waste. In this process, organic polymers act as biomimetic templates that regulate $CaCO_3$ crystallization and pore structure, promoting a denser, more uniform microstructure. Their functional groups enhance $CO_2$ capture and carbonation efficiency under mild conditions, while the polymer matrix bridges microcracks and strengthens interfacial bonding. The optimized RCP demonstrates improved density and mechanical strength, enabling its high-value utilization as a supplementary cementitious material or high-performance artificial aggregate. This approach not only improves the physicochemical properties of RCP but also achieves efficient $CO_2$ sequestration and sustainable valorization of construction waste.

**Start date:** 02-01-2025

**End date:** 12-31-2028

**Last modified:** 04-20-2026

**Copyright information:**



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# Biomimetic wet carbonation recycling of recycled concrete powder

## Data Collection

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### What data will you collect or create?

For this biomimetic wet carbonation study, we will collect experimental data on recycled concrete powder (RCP) treated with organic polymer templates, including XRF and XRD for chemical and phase composition, TGA for $CO_2$ uptake quantification, FTIR spectra of polymer–mineral bonding, SEM/TEM images of templated $CaCO_3$ morphology, MIP and BET pore structure metrics, and compressive strength results of cementitious composites incorporating the upgraded RCP as a high-value supplementary material.

### How will the data be collected or created?

Data will be collected through controlled wet carbonation experiments on recycled concrete powder with organic polymer additives, followed by standardized material characterization. Phase composition will be measured via X-ray diffraction, $CO_2$ uptake via thermogravimetric analysis, and polymer–mineral bonding via FTIR spectroscopy. Microstructural images will be captured using scanning electron microscopy, while pore structure metrics will be obtained from mercury intrusion porosimetry and nitrogen adsorption. Mechanical performance data will be generated through compressive strength testing of mortar specimens incorporating the upgraded RCP. All instrumental data will be recorded digitally in raw instrument formats and subsequently processed into open-access tabular and graphical files.

## Documentation and Metadata

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### What documentation and metadata will accompany the data?

Raw data files will be accompanied by a README text file documenting experimental conditions (RCP source, polymer type, carbonation duration, and environmental parameters), instrument settings, and sample nomenclature. Metadata will include standardized descriptors for each dataset: date of acquisition, operator, calibration standards, and file format details. For spectral and imaging data, processing parameters such as baseline correction methods and magnification scales will be embedded within file headers or provided in separate log files to ensure reproducibility and interoperability.

## Ethics and Legal Compliance

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### How will you manage any ethical issues?

This study involves only laboratory experiments on inorganic construction materials and does not involve human participants, animal subjects, or personally identifiable data; therefore, no formal ethics committee approval is required. We will uphold research integrity by ensuring accurate data recording, transparent reporting of all experimental conditions, and proper attribution of methodologies. Any potential conflict of interest related to the organic polymers used will be disclosed in publications. Additionally, we will adhere to standard laboratory safety protocols and responsible waste disposal practices for chemical reagents to minimize environmental impact.

### How will you manage copyright and Intellectual Property Rights (IP/IPR) issues?

The data generated in this project are owned by the research institution and principal investigators. Datasets will be made available under a Creative Commons Attribution (CC BY) license where possible, requiring appropriate citation of the source publication. Any patentable findings related to the organic polymer templating process will be disclosed to the institutional technology transfer office prior to public data release to preserve intellectual property protection. Use of third-party software for data analysis will comply with respective license agreements, and all reused data from external sources will be properly cited.

## Storage and Backup

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### How will the data be stored and backed up during the research? i. e. until stored in the final location (e.g. on your password protected laptop)?

During the active research phase, raw and processed data will be stored on a password-protected institutional network drive with daily automated backups to a secure off-site server. Instrument computers will transfer data to this central repository immediately after acquisition. Temporary working files on password-protected laptops will be synchronized regularly, and critical datasets will also be manually archived on encrypted external hard drives to ensure redundancy before final archival in the university's long-term data repository.

### How will you manage access and security?

Access to all research data will be restricted to the principal investigator and authorized project members through password-protected institutional accounts and network drives with role-based permissions. Data transfers between collaborators will occur exclusively via encrypted institutional cloud services or secure file transfer protocols. Physical records, if any, will be stored in locked office cabinets. Raw instrument files will be set to read-only mode to prevent accidental alteration,

while processing scripts and analysis logs will be version-controlled. Any sensitive preliminary findings will be embargoed internally until publication clearance is obtained.

## Selection and Preservation

### Which data are of long-term value and should be retained, shared, and/or preserved?

The long-term value resides in datasets that underpin the reproducibility of the biomimetic carbonation process and its upgrading efficacy. Raw and processed data essential for retention include X-ray diffraction patterns, thermogravimetric $CO_2$ uptake curves, scanning electron microscopy images of polymer-templated $CaCO_3$, pore size distributions from mercury intrusion porosimetry, and compressive strength results of the final composite materials. These core datasets will be preserved in open formats to enable future benchmarking, meta-analysis, and life-cycle assessment modeling in sustainable construction research.

### What is the long-term preservation plan for the dataset?

The final preserved dataset will be deposited in the institutional research data repository with a persistent digital object identifier (DOI) assigned for stable citation. Data will be curated in open, non-proprietary formats and accompanied by comprehensive metadata to ensure long-term discoverability and reuse. Retention will follow the funder and university policy, with a minimum preservation period of ten years. Access to processed datasets will be open where possible, while raw instrument files may be embargoed or shared upon reasonable request to comply with institutional guidelines and potential intellectual property considerations.

## Data Sharing

### How will you share the data?

Processed datasets underpinning key findings will be shared via the institutional data repository under a Creative Commons Attribution license, with a persistent DOI for citation. Data will be provided in open, machine-readable formats, accompanied by a README file detailing experimental parameters and file structure. Access to the repository is unrestricted for download. In accordance with funder requirements and institutional policy, data supporting publications will be made available at the time of article publication. Raw instrument files exceeding reasonable repository size limits may be shared upon direct request to the corresponding author.

### Are any restrictions on data sharing? If yes, Why?

Yes, a temporary embargo period may apply to certain datasets pending patent review or journal publication to safeguard intellectual property rights related to the organic polymer templating method. Following this period, data will be released without restriction under an open license. No long-term restrictions related to privacy, national security, or commercial confidentiality are anticipated, as the study involves only non-hazardous construction materials and no human subject data.

## Responsibilities and Resources

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### Who will be responsible for data management?

The principal investigator will hold overall responsibility for data management throughout the project lifecycle, including oversight of collection, secure storage, and final archival in the institutional repository. Day-to-day data handling and quality control will be executed by designated research team members under the principal investigator's supervision. The university library or research data management office will provide technical support for metadata creation, repository deposition, and long-term preservation compliance.

### What resources will you require to deliver your plan?

Implementation of this data management plan will require institutional network storage capacity of approximately 50 GB for raw instrument files and processed datasets, access to licensed laboratory software for data acquisition and analysis, and basic training in repository deposition workflows provided by university library staff. Personnel time for data curation and metadata preparation will be supported by existing project funding. No specialized hardware or commercial data services beyond standard institutional provisions are anticipated.

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