

Jan 14, 2025

Protocol of the article "Seashell powder as a sustainable alternative in cement-based materials: a systematic literature review"

DOI

<https://dx.doi.org/10.17504/protocols.io.n2bvj99d5lk5/v1>

Alison Lopes da Silva¹, Emilia Rahnemay Kohlman Rabbani¹, Mahmoud Shakouri²

¹University of Pernambuco; ²Colorado State University



Alison Lopes da Silva

University of Pernambuco

Create & collaborate more with a free account

Edit and publish protocols, collaborate in communities, share insights through comments, and track progress with run records.

Create free account

OPEN  ACCESS



DOI: <https://dx.doi.org/10.17504/protocols.io.n2bvj99d5lk5/v1>

Protocol Citation: Alison Lopes da Silva, Emilia Rahnemay Kohlman Rabbani, Mahmoud Shakouri 2025. Protocol of the article "Seashell powder as a sustainable alternative in cement-based materials: a systematic literature review". **protocols.io** <https://dx.doi.org/10.17504/protocols.io.n2bvj99d5lk5/v1>

License: This is an open access protocol distributed under the terms of the **Creative Commons Attribution License**, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited

Protocol status: Working

This protocol was used to conduct the search and selection of articles for the systematic review of the paper titled "Seashell Powder as a Sustainable Alternative in Cement-Based Materials: A Systematic Literature Review."

Created: December 13, 2024

Last Modified: January 14, 2025

Protocol Integer ID: 115439

Keywords: Systematic review, seashells, cementitious materials, cement replacement, reuse of seashell, production of cementitious composite, cementitious composite, potential of seashell, effects of shell incorporation, partial replacement for cement, cement, seashell, sustainable construction material, shell, shell incorporation, characteristics of the shell, based material

Funders Acknowledgements:

Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES)

Grant ID: 001

Polytechnic School of the University of Pernambuco (POLI/UPE)

Grant ID: Plan for the Application of State Government Resources for Postgraduate Studies 2024

Academic Enhancement Program (PFA) of the University of Pernambuco (UPE)

Grant ID: Extension Program PG24-DESS@POLI 2024, public notice 01/2024

Academic Enhancement Program (Programa de Fortalecimento Acadêmico - PFA) of University of Pernambuco (UPE) through PROPEGI

Grant ID: Group Safe and Sustainable Development - DESS, Project No. P00980, Faixa C, public notice "Apoio à Pesquisa (APQ) – 2024

Disclaimer

DISCLAIMER – FOR INFORMATIONAL PURPOSES ONLY; USE AT YOUR OWN RISK

The protocol content here is for informational purposes only and does not constitute legal, medical, clinical, or safety advice, or otherwise; content added to [protocols.io](https://dx.doi.org/10.17504/protocols.io.n2bvj99d5lk5/v1) is not peer reviewed and may not have undergone a formal approval of any kind. Information presented in this protocol should not substitute for independent professional judgment, advice, diagnosis, or treatment. Any action you take or refrain from taking using or relying upon the information presented here is strictly at your own risk. You agree that neither the Company nor any of the authors, contributors, administrators, or anyone else associated with [protocols.io](https://dx.doi.org/10.17504/protocols.io.n2bvj99d5lk5/v1), can be held responsible for your use of the information contained in or linked to this protocol or any of our Sites/Apps and Services.



Abstract

This protocol is part of a systematic literature review aimed at critically analyzing and synthesizing the current body of knowledge on the reuse of seashells as a partial replacement for cement in the production of cementitious composites. The review emphasizes the characteristics of the shells examined, the processing methods utilized, the dosage levels implemented, and the laboratory tests conducted.

Although previous literature reviews on this subject exist, we have identified a need for a systematic review that provides a structured and comprehensive synthesis of studies. This approach allowed the extraction and organization of reported data, clarifying the effects of shell incorporation on these materials and understanding the potential of seashells as sustainable construction materials.

Defining the terms of interest and guiding questions for the review

1 Defining the terms of interest using the acronym PICO (Population, Interest, Context)

A	B	C
Criteria	Description	Synonyms
Population	Seashells	Seashell waste; Mollusk seashell; Seashell powder
Interest	Application in cementitious composites	Cement paste; Mortar; Concrete
Context	Replacing cement	Cement replacement; As binder

2 Preparing the generic string with the relevant terms of interest

(seashell OR seashell waste OR mollusk shell OR seashell powder OR seashell ash) AND (cementitious composites OR cement paste OR mortar OR concrete) AND (cement replacement OR replacing cement OR binder replacement OR as binder)

3 Defining the guiding questions for the review

1. What processing procedures have been applied in studies utilizing seashells as partial replacements for cement in cementitious composites?
2. What are the physical and chemical properties of the seashell powder used in these replacements?
3. What are the most commonly used substitution levels and types of cement?
4. How does the addition of shell powder impact the properties of the produced composite?

Defining the databases for the search and the adapted strings

4 Selection based on data collection

Databases with collections focused on building and construction:

- **Engineering Village** - <https://www.engineeringvillage.com/home.url?redir=t>
- **American Society of Civil Engineers** - <https://www.asce.org/>

Databases with comprehensive collections:

- **Science Direct** - <http://www.sciencedirect.com>
- **Web of Science** - <https://www.webofscience.com/wos/woscc/basic-search>

- **Scopus** - <https://www.scopus.com/home.uri>
- **Google Scholar** - <https://scholar.google.com.br/>

5 Modifying the generic string to fit the structure of each database search engine

A	B
Database	Adapted string
Science Direct	(Seashell waste OR seashell powder OR mollusk shell) AND (Cementitious composites OR cement paste OR mortar OR concrete) AND (Replacing cement OR cement replacement)
Web of Science	ALL=((seashell) OR (shell waste) OR (mollusk shell) OR (seashell powder) OR (seashell ash)) AND ((cementitious composites) OR (cement paste) OR (mortar) OR (concrete)) AND ((cement replacement) OR (replacing cement) OR (binder replacement) OR (as binder)))
Scopus	(seashell OR "seashell waste" OR "mollusk shell" OR "seashell powder") AND ("cementitious composites" OR "cement paste" OR mortar OR concrete) AND ("cement replacement" OR "replacing cement" OR "binder replacement" OR "as binder")
Engineering Village	((Seashell OR shell waste OR seashell powder) AND (Cementitious composites OR cement paste OR mortar OR concrete) AND (Replacing cement OR cement replacement))
American Society of Civil Engineers	(Seashell OR shell waste OR seashell powder OR mollusk shell) AND (Cementitious composites OR cement paste OR mortar OR concrete) AND (Replacing cement OR cement replacement OR binder replacement OR as binder)
Google Scholar	(seashell OR seashell waste OR mollusk shell OR seashell powder OR seashell ash) AND (cementitious composites OR cement paste OR mortar OR concrete) AND (cement replacement OR replacing cement OR binder replacement OR as binder)

Defining the selection criteria for research papers

6 Criteria for including files for evaluation:

IC1: The study presents the search terms in the title, abstract, and keywords.

IC2: The study was published between 2013 and 2023.

IC3: The study is classified as a primary study (not purely a review).

IC4: The study was published as a scientific article in a journal.

Criteria for excluding files during selection:

EC1: Duplicate study between databases.

EC2: The study was published before 2013.

EC3: The study is not classified as primary research but as a literature review.

EC4: The study was published in conference proceedings, books, or other non-journal publications.

EC5: Access to the full study is unavailable or only accessible for a fee.

EC6: The study does not address the use of seashells in any cementitious composite as a total or partial substitute for cement*.

**This review did not include studies investigating geopolymers, alkali-activated mixtures, and replacing limestone in cement production.*

Quality requirements:

1. The methodology described in the study is inconsistent or incomplete.
2. The characterization of the seashell is inconsistent (basic characterization data is missing).

7 Quality assessment checklist

The following checklist was used to evaluate the quality criteria of the articles, where mandatory items must be present, considering the nature of the studies. The additional items, marked as "extra" will serve as parameters to assess the level of detail, robustness, and overall study quality.

QA1: Does the study's methodology provide at least basic information regarding the following dosage details?

- Proportion of the mix (mandatory)
- Materials used in the mix (mandatory)
- Type of cement (mandatory)
- Quantities of each material per mix (extra)
- Detailed specifications of the materials (extra)

QA2: Is the seashell characterized at least in basic terms in the study, including the following items?

- Chemical composition with key elements (mandatory)
- Physical properties such as shape, specific gravity, surface area, etc. (mandatory)
- Description of the origin location (extra)
- Microstructural analysis (extra)

Article acquisition and selection

- 8 Conducting searches in databases by utilizing modified search strings and implementing inclusion criteria as limiting factors.
- 9 Downloading the data acquired from the search in both .bib and .ris formats, complete with associated metadata.
- 10 Uploading .bib and .ris files to the Rayyan platform (<https://www.rayyan.ai/>) for selection based on exclusion criteria.
- 11 Identifying duplicate files and performing an initial screening by reviewing the title, abstract, and keywords to apply the exclusion criteria.
- 12 Verification of full-text availability for the files selected during the initial screening, followed by an in-depth selection based on the content analysis of the articles to determine eligibility according to the exclusion criteria.
- 13 Conducting the quality assessment of the articles approved during the in-depth content analysis to ensure compliance with quality criteria.
- 14 Searching for articles within the references of the selected articles to broaden the results, with the identified articles undergoing the same selection process as outlined in steps 9 to 13.
- 15 Definition of the selected articles for data synthesis and addressing the proposed questions.

Data extraction and literature synthesis

- 16 Extraction of qualitative and quantitative data for grouping and reporting through descriptive statistics.
- 17 Extracted data storage in Excel tables and analyzed using R Studio software.
- 18 Addressing the proposed questions based on the analyses.
- 19 Reporting the results following the PRISMA statement recommendations (<https://www.prisma-statement.org/prisma-2020-checklist>).

Protocol references

Page M J, McKenzie J E, Bossuyt P M, Boutron I, Hoffmann T C, Mulrow C D et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews BMJ 2021; 372 :n71 doi:10.1136/bmj.n71