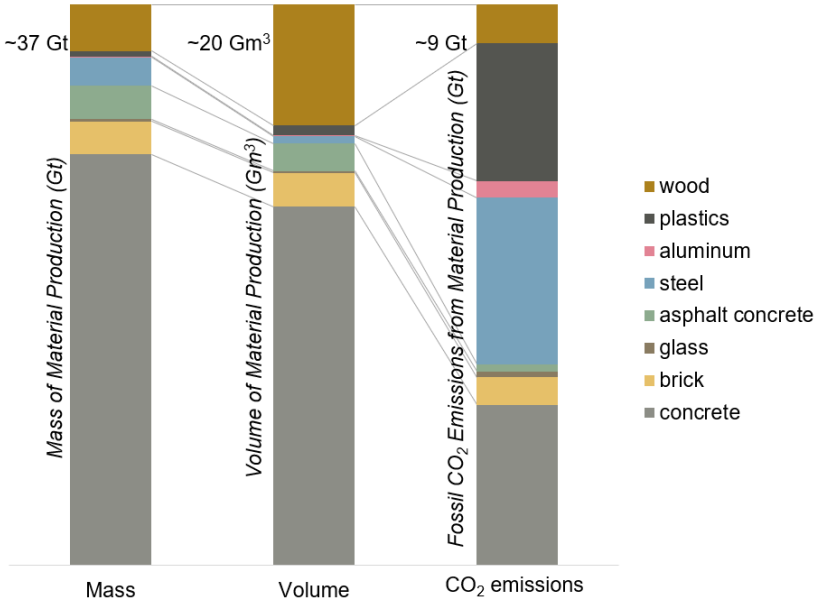
MSE-420 Cementitious materials (advanced)

Prof. Karen Scrivener

Lecture 1

11/09/2024


~37 Gt
~20 Gm3
~9 Gt
Mass of Material Production (Gt)
Volume of Material Production (Gm3)
Fossil CO2 Emissions from Material Production (Gt)
wood
plastics
aluminum
steel
asphalt concrete
glass
brick
concrete
Mass
Volume
CO2 emissions

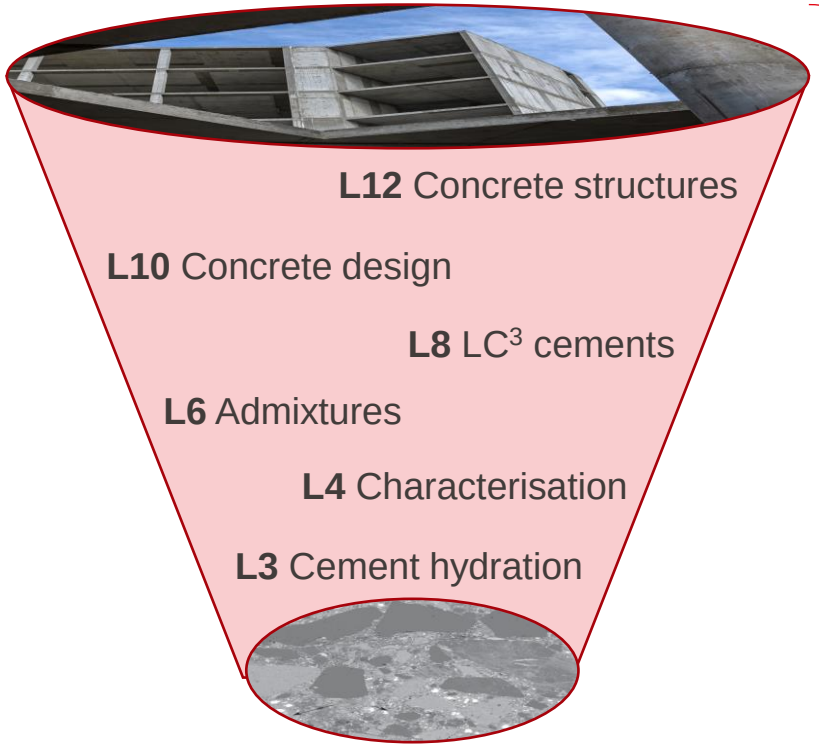
By the end of this course you will be able to…

- **Explain** chemical and physical processes underlying the behaviour of cementitious materials
- **Interpret** scientific papers related to cementitious materials
- **Analyze** appropriateness of different characterisation techniques
- **Analyze** economic and ecological appropriateness of different materials solutions

Course contents

Prof. Karen Scrivener / Dr. Alastair Marsh

Macro-structures



Micro-structures

L12 Concrete structures

L10 Concrete design

L8 LC^3 cements

L6 Admixtures

L4 Characterisation

L3 Cement hydration

L2 Durability

Durability & Sustainability

L9 Life cycle analysis

L11 Sustainability approaches for construction

Course schedule

Week #	Class date	Title	Lecturer
1	11/09/2024	Introduction and Literature Review	Prof. Karen Scrivener / Dr. Alastair Marsh
2	18/09/2024	Durability	Dr. Beatrice Malchiodi
3	25/09/2024	Cement hydration	Prof. Karen Scrivener
4	02/10/2024	Characterisation	Dr. Federica Boscaro
5	**09/10/2024**	**Presentation 1**	
6	16/10/2024	Admixtures	Dr. Federica Boscaro
7	**30/10/2024**	**Presentation 2**	
8	06/11/2024	Life cycle analysis for cementitious materials	Dr. Alastair Marsh
9	13/11/2024	Limestone calcined clay cements (LC^3)	Dr. Franco Zunino
10	20/11/2024	Concrete design	Dr. Beatrice Malchiodi
11	27/11/2024	Sustainability appraoches for construction	Dr. Alastair Marsh
12	04/12/2024	Concrete structures / Q&A on Presentation 3	Prof. David Ruggiero
13	**11/12/2024**	**Presentation 3**	
14	18/12/2024	Re-use & standardization	Prof. David Fernandez / Prof. Corentin Fivet

Course deliverables

- **Presentation 1: Week 5 (Wednesday 09th October)**
  - What are the **principles** of the key degradation mechanisms in your team's scenario?
  - Which **characterization techniques** would you use to investigate the reactions, and reaction products, relevant to your degradation mechanism?

- **Presentation 2: Week 7 (Wednesday 30th October)**
  - Select **3 research articles** that use **different characterization techniques** to investigate your scenario's degradation mechanism: at least one "good" and one "bad"
  - Summarise the findings in these articles - why are they either "good" or "bad"?

- **Presentation 3: Week 13 (Wednesday 11th December)**
  - Assess how your degradation mechanism could **affect your structure** – and, will it affect the whole structure, or just part of it?
  - Explain the **principles** of the **three suggested strategies** – how could they be used to prevent or mitigate the degradation mechanism for your structure?
  - Through a semi-quantitative analysis, **evaluate advantages and disadvantages** of the three strategies – how do they compare, in terms of effectiveness, their embodied carbon, and their cost?

Scenario #1

Google Maps

- DDA (Delhi Development Authority) Sector G7, Bhorgarh, Narela, Delhi, India
- Primary degradation mechanism = **carbonation**

Google Maps

Google Maps

Prof. Karen Scrivener / Dr. Alastair Marsh

Carbonation

- Degradation process due to CO_2 ingress into concrete
- CO_2 from the environment
- Induced corrosion of steel rebars
- Disruption of passivating film due to lowering of pH

- For more information, see previous lectures in MSE 322 Building materials + Laboratory work - EPFL

Prof. Karen Scrivener / Dr. Alastair Marsh

Scenario #2

Google Maps

- Tinsulanonda Bridge, Ko Yo, Thailand
- Primary degradation mechanism = **chloride ingress (marine exposure)**

Google Maps

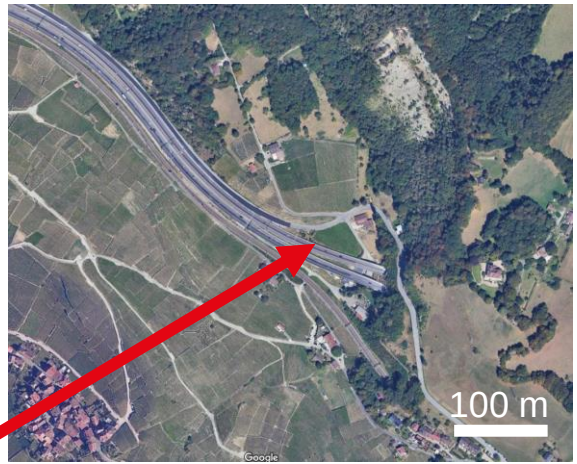
https://structurae.net/en/structures/tinsulanonda-bridge

https://thailandtourismdirectory.go.th/en/attraction/2056

Prof. Karen Scrivener / Dr. Alastair Marsh

Scenario #3

Google Maps



Google Maps

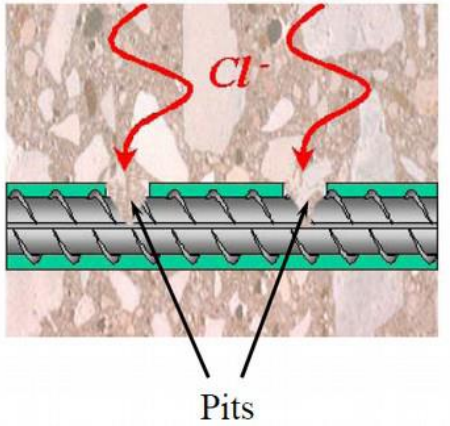
- Concrete retaining walls, E62 road, Bourg-en-Lavaux, Switzerland
- Primary degradation mechanism = **chloride ingress (deicing salts exposure)**

Google Maps

Prof. Karen Scrivener / Dr. Alastair Marsh

Chloride ingress

- Degradation process due to Cl^- ingress into concrete
- Cl^- from de-icing salts, seawater, etc.
- Induced corrosion of steel rebars
- Disruption of passivating film at high pH



- For more information, see previous lectures in MSE 322 Building materials + Laboratory work - EPFL

Prof. Karen Scrivener / Dr. Alastair Marsh

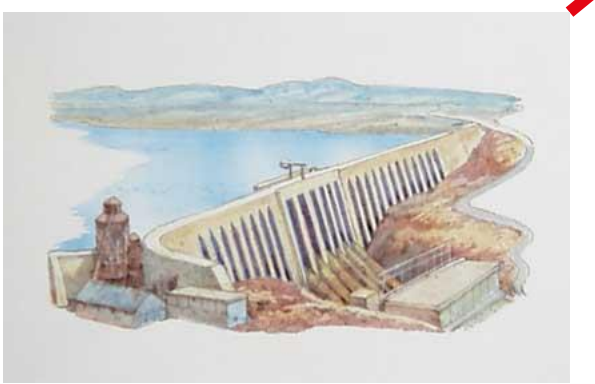
Scenario #4

Google Maps

- High Grand Falls Hydroelectric Dam, Kenya
- Primary degradation mechanism = **alkali-silica reaction**

Google Maps

- Construction not yet started
- Planned location for dam and reservoir: Kibuka falls, Tana river

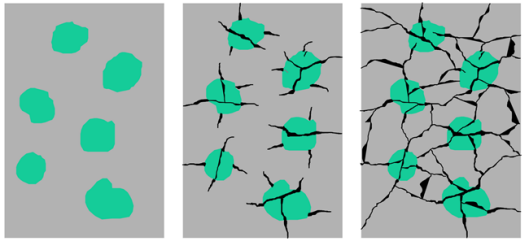


Tana and Athi Rivers Development Authority.

Prof. Karen Scrivener / Dr. Alastair Marsh

Alkali-silica reaction

- Degradation process due to the presence of alkali reactive aggregates
- Expansive gel formation - cracking
- Slow process
- 20-30% of Swiss dams are affected



- For more information, see previous lectures in MSE 322 Building materials + Laboratory work - EPFL

Groups and Teaching Assistants

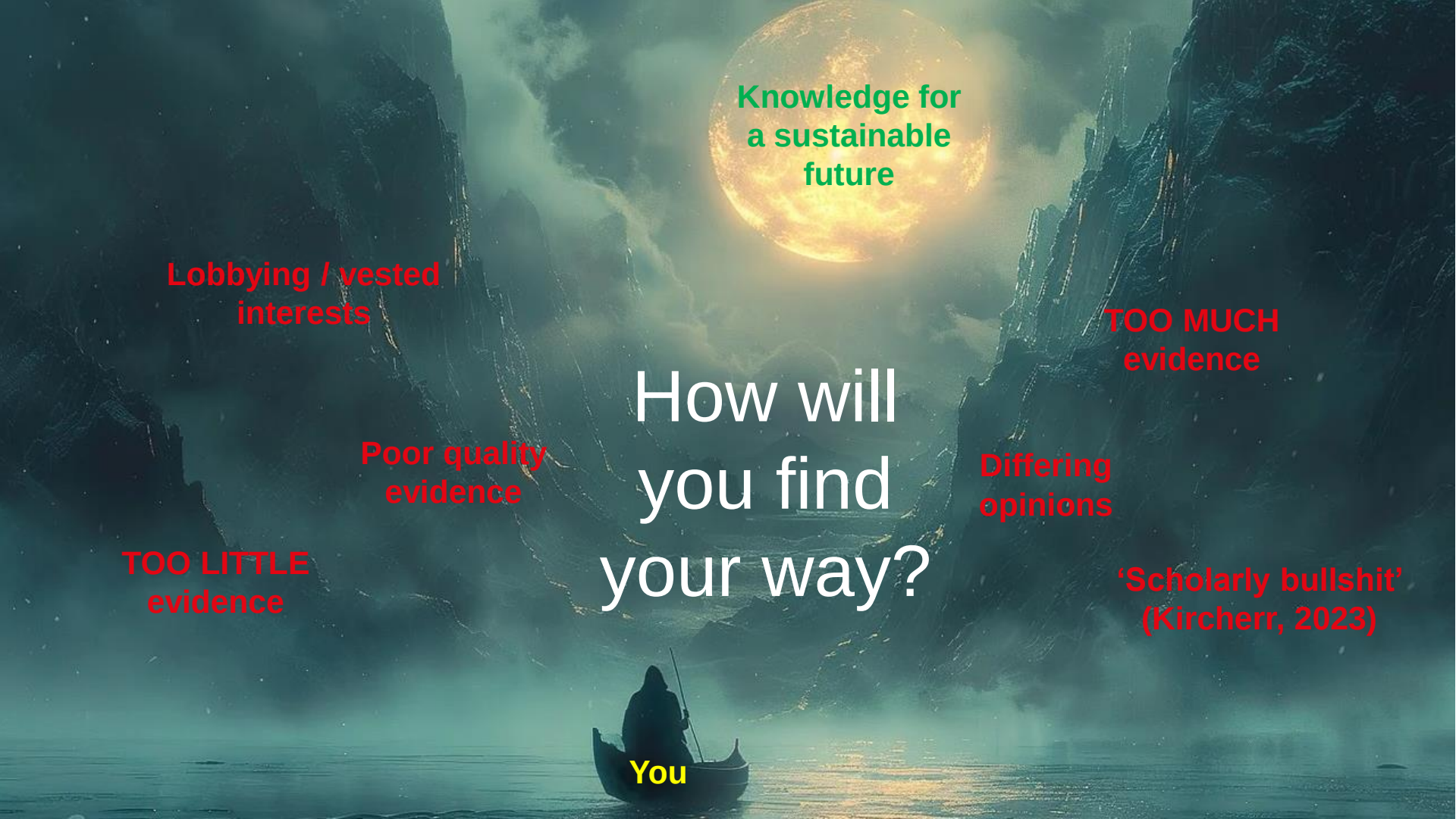
- Group 1 – Carbonation – Alice Titus Bakera
- Group 2 – Chloride ingress (bridge) – Beatrice Malchiodi
- Group 3 – Chloride ingress (road) – Alastair Marsh
- Group 4 – Alkali silica reaction – Federica Boscaro

Instructions for assessments #1 and #2 will be uploaded to Moodle shortly.

Prof. Karen Scrivener / Dr. Alastair Marsh

Lecture 1 Ctd.
How to search the literature and read critically

11/09/2024


Knowledge for a sustainable future
Lobbying / vested interests
TOO MUCH evidence
How will you find your way?
Poor quality evidence
Differing opinions
TOO LITTLE evidence
‘Scholarly bullshit’ (Kircherr, 2023)
You

Why do I need a lecture to tell me how to search for information?

- There are two extremes:

1. ‘Just Google it’ (can take <30 seconds)

2. A PRISMA-compliant systematic review (Moher et al., 2009) (can take >1 year!)

- We want to search for information in a rigorous way that’s **suitable for our needs** (i.e. finding information for the assessment presentations)

- Searching for information is **not trivial!** We can only read what we have found.

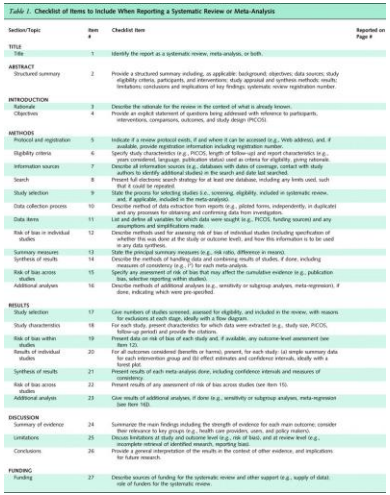


Table 1. **Checklist of Items to Include When Reporting a Systematic Review or Meta-Analysis**

Section/Topic	Item #	Checklist Item	Reported on Page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome-level assessment (see Item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., health care providers, users, and policy makers).	
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified research, reporting bias).	
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	

Moher et al., 2009

By the end of this lecture you will be able to…

1. **Design and implement** a **search strategy** to review the literature on a given topic in cementitious materials

2. **Understand** the key characteristics one can use to appraise the **quality and relevance of a scientific article.**

How should I search for information?

What are the steps for searching for information?

- Many guidance articles on doing a **literature review** are very complex, and/or subject-specific (frequently for medicine)
- Here is a simple list of key steps for **searching** the literature (adapted from Watson, 2020):

1. Think about your search question(s)
2. Identify your key concepts
3. Think about alternative search terms or synonyms
4. Choose the most appropriate databases to search
5. Combine your search terms
6. Consider any limits that you want to apply
7. Run your search and review your results
8. Adapt your search strategy, if necessary

After explaining the steps… let's do an example!

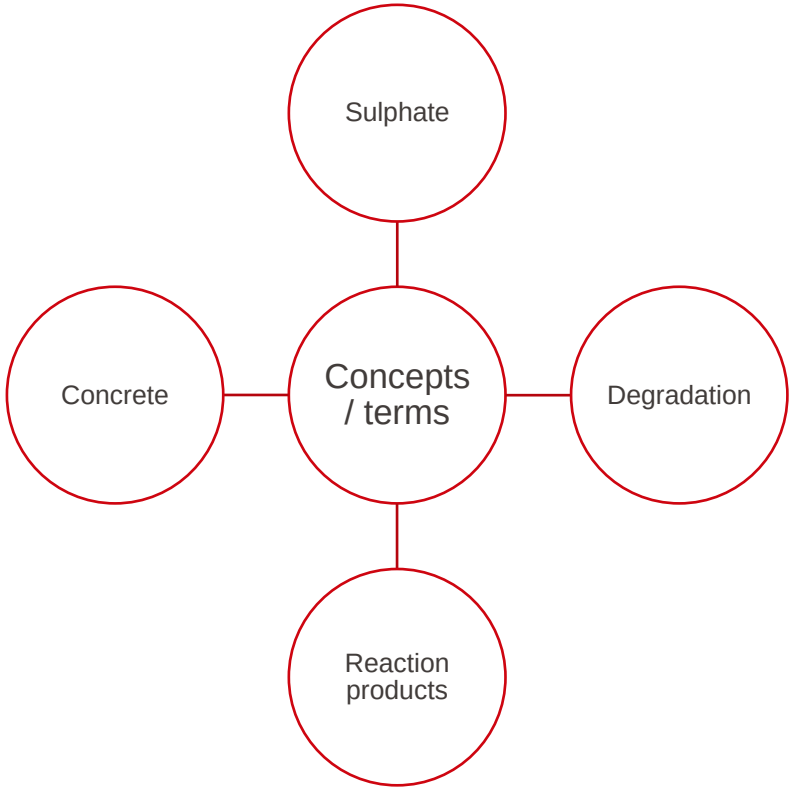
1. Think about your search question(s)

E.g. "*What are the reaction products in sulphate degradation of concrete?*"

2. Identify your key concepts

- Map out the **key concepts and terms** that we might want to search for.

Q: "*What are the reaction products in sulphate degradation of concrete?*"



3. Think about alternative search terms/synonyms

Some synonyms are common. E.g.:

- “Degradation” ≈ “Attack”

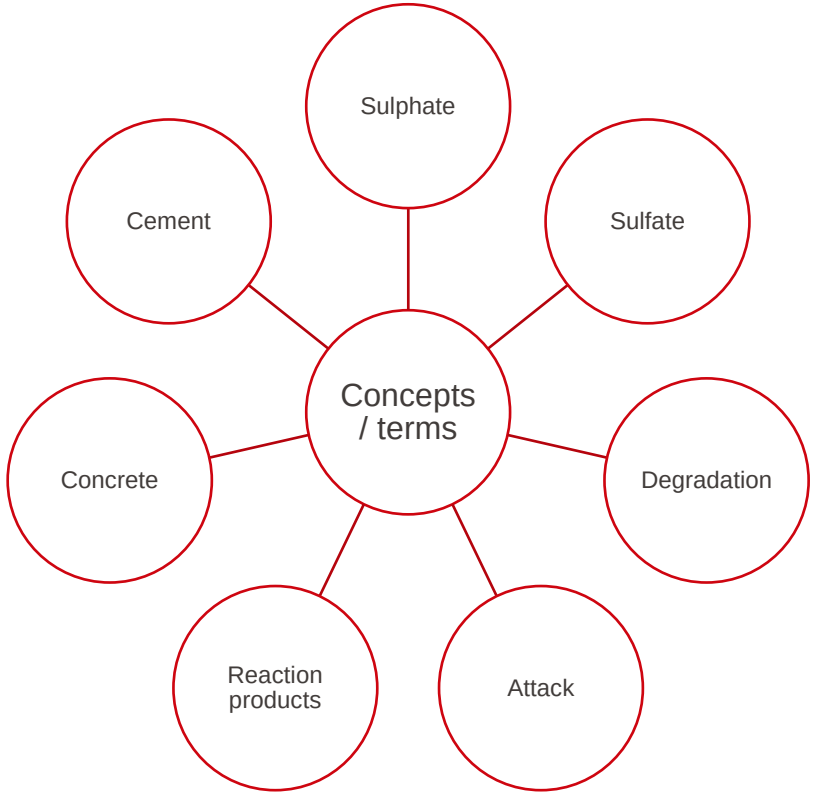
We may be mainly interested in concrete, but also want to learn from studies on **cement paste**:

- + “Cement”

Beware regional **spelling differences**:

- “Sulphate” = sulfate”

- We do not always know what the alternative terms / synonyms are at the beginning of our search…
- This is something that can be revised in the search plan later.



4. Choose the most appropriate databases to search

What is the difference? Why does it matter?

- Choice of **database / search engine** determines (Gusenbauer & Haddaway, 2020)…
  - TYPE of **literature** included in the search (i.e. peer-reviewed academic literature only, or 'grey literature' too)
  - TYPE of **search** (i.e. 'tuned' search vs. replicable search)
  - OPTIONS to **filter/refine** the searches

- Most appropriate choice depends on what is most **suitable for our needs**.
- Google Scholar is more appropriate IF we expect the **grey literature** to be important.
- If we want **repeatable** search results within **academic literature**, Google Scholar is less appropriate.

Common databases/search engines (relevant to all subjects):

- Web of Science
- Scopus
- Google Scholar
- Semantic Scholar

Prof. Karen Scrivener / Dr. Alastair Marsh

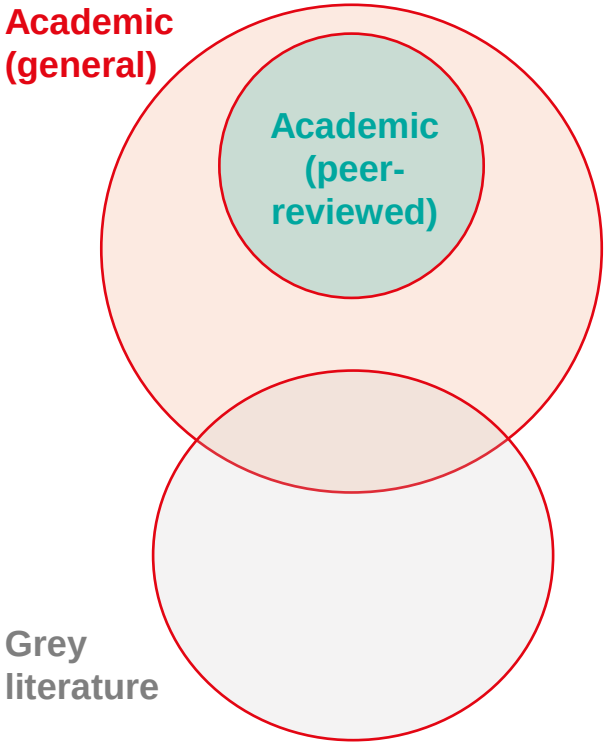
What is the difference between peer-reviewed / academic / grey literature?

Academic journal literature (peer-reviewed)

- *Generally* the most reliable category of literature
- **Peer review** is either single or double anonymized (2 – 3 external experts).
- However, just because an article has been peer-reviewed, this is NOT an automatic guarantee of quality.

Academic literature (in general)

- Produced by an academic person, organization, or publishing entity.
- Variable, and not always reliable (see slides on Journals)



What is the difference between peer-reviewed / academic / grey literature?

Grey literature

= "…*document types produced on **all levels of government, academics, business and industry** in print and electronic formats that are protected by intellectual property rights, of sufficient quality to be collected and preserved by library holdings or institutional repositories, but **not controlled by commercial publishers***..." (Schopfel, 2011)

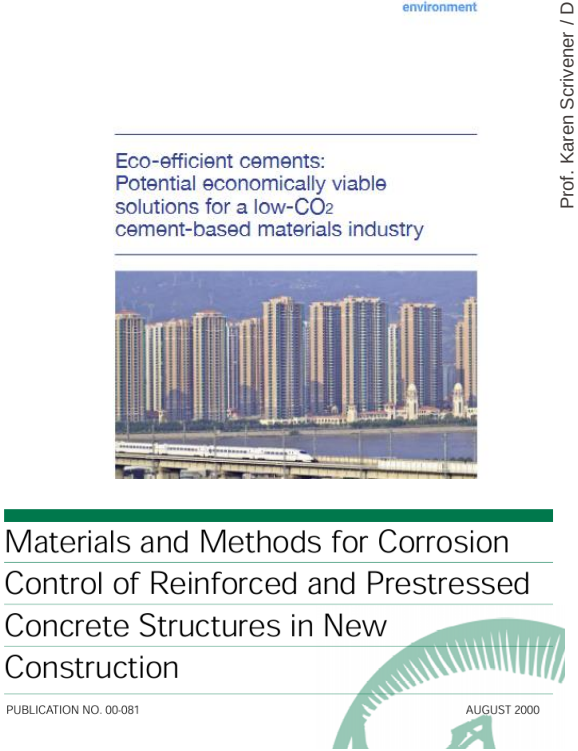
- Varies VERY widely. Includes…

+ **Reports** from highly-respected organisations (e.g. US Department of Transportation, United Nations)

+ **PhD theses** (sometimes highly valuable)

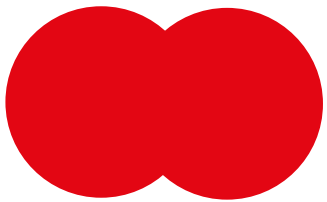
- **Masters theses** (sometimes valuable, often questionable)

- Grey literature CAN sometimes be reviewed (e.g. UN reports), but not necessarily in the same anonymous manner as academic peer review.

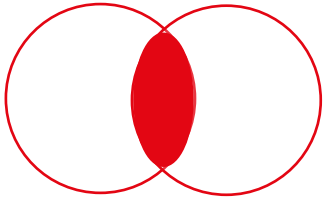


5. Combine your search terms

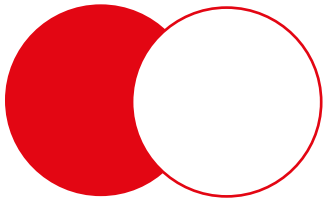
- Boolean operators = AND, OR and NOT
- Use these to combine search terms in order to widen or limit the search result



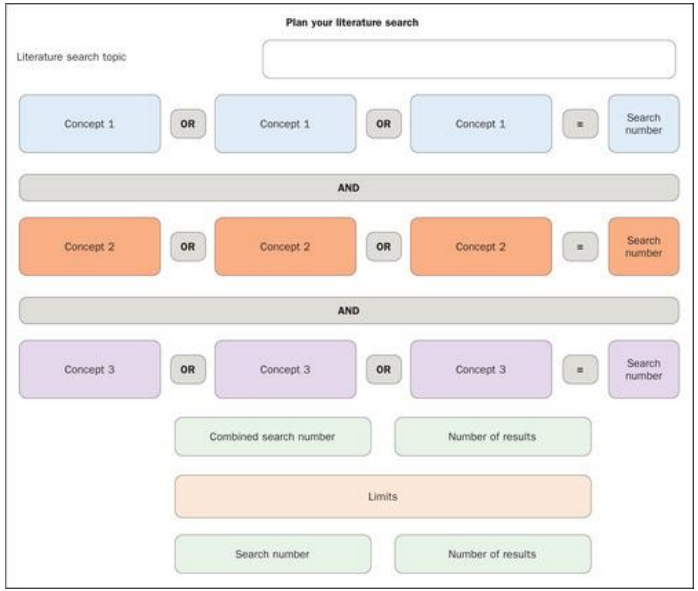
sulphate OR concrete



sulphate AND concrete



sulphate NOT concrete

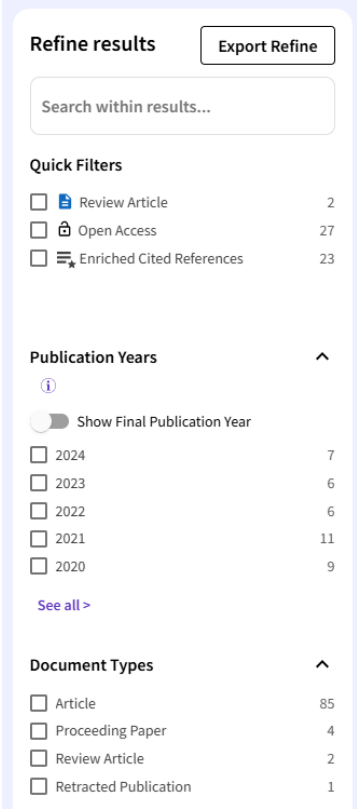


Watson, 2020

6. Consider any limits that you want to apply

- Different databases/search engines will have **different filter options**
- **Common filters** include:
  - Year of publication
  - Article type
- **Other filters** are available on some databases/search engines:
  - Journal
  - Author
  - Language
  - Region/country

Web of Science



7. Run your search and review your results

- Questions to ask yourself about the initial search results, to check whether the search conditions are suitable:
  - **How many** results am I getting? Too many? (e.g. 100s or 1000s) Too few? (e.g. <5)
  - Are the article **titles/abstracts relevant** to my question?

- Beware studies in **different subjects** that also use cements (e.g. dentistry).

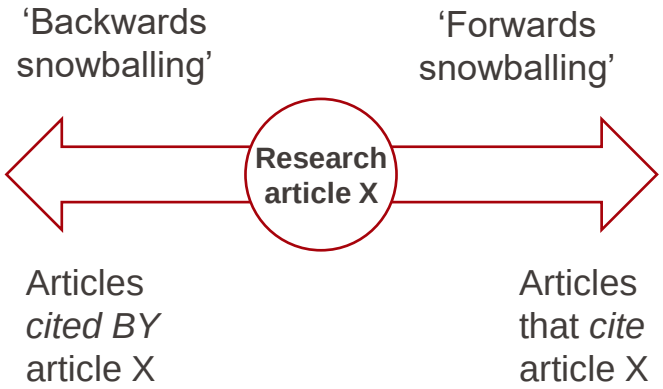
8. Adapt your search strategy, if necessary

- Depending on the results of the initial search, you may want to **adapt** the search conditions. E.g…

- **Too many** results? Use more (or more restrictive) search conditions.
- **Too few** results? Use less (or less restrictive) search conditions.
- Too many **irrelevant** results? Add in NOT restrictions.

Expanding your search

- A complementary strategy to a database search is **snowballing**
- Database searching and snowballing strategies can be **used together** effectively – it is not a choice of one or the other (Wohlin et al., 2022).

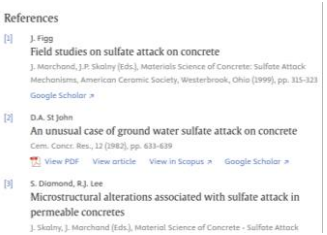


- '*Backwards* snowballing'

→ Read references list

- '*Forwards* snowballing'

→ Use 'cited by' function on database / search engine.

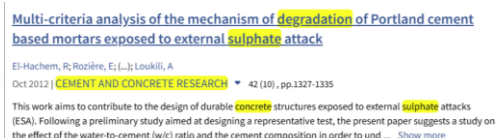


References

[1] J. Figg
Field studies on sulfate attack on concrete
J. Marchand, J.P. Skalny (Eds.), Materials Science of Concrete: Sulfate Attack Mechanisms, American Ceramic Society, Westerbrook, Ohio (1999), pp. 315-323
Google Scholar

[2] D.A. St John
An unusual case of ground water sulfate attack on concrete
Cem. Concr. Res., 12 (1982), pp. 633-639
View PDF View article View in Scopus Google Scholar

[3] S. Diamond, R.J. Lee
Microstructural alterations associated with sulfate attack in permeable concretes
J. Skalny, J. Marchand (Eds.), Material Science of Concrete - Sulfate Attack



Multi-criteria analysis of the mechanism of degradation of Portland cement based mortars exposed to external sulphate attack

El-Hachem, R; Rozière, E; (...); Loukili, A

Oct 2012 | CEMENT AND CONCRETE RESEARCH 42 (10) , pp.1327-1335

This work aims to contribute to the design of durable concrete structures exposed to external sulphate attacks (ESA). Following a preliminary study aimed at designing a representative test, the present paper suggests a study on the effect of the water-to-cement (w/c) ratio and the cement composition in order to und ... Show more

84 Citations
40 References

What about AI tools?

- AI tools already have **widespread use** in literature reviews: searching for literature, analysing literature, and generative writing (Ngwenyama and Rowe, 2024)
- **Academic journals** have different approaches – some ask authors to declare use of AI tools, others do not.

- Our approach (on this course) is to reflect/anticipate the working environments you will join…

You are permitted to use AI tools if you choose

AND

You are responsible for the content you present

- Your key competencies will be assessed during the **group presentation assessments**.

How can I *critically* read a research article?

What is critical reading?

Critical reading forms part of **critical thinking** in general (adapted from synthesis of Lai, 2011):

- Analyzing arguments, claims, or evidence
- Identifying assumptions
- Making inferences from data using inductive or deductive reasoning
- Judging or evaluating evidence (and interpretations of evidence)
- Making decisions or solving problems

What does it mean to be critical in your **reading**?

- **Evaluate the credibility** of what you read (assume authors are knowledgeable, while remaining alert for possible flaws in the reasoning)
- **Infer and analyse patterns** (or lack of) across data from different sources
- **Interpret** data and findings to **answer your question**

i.e. Not just critic-ISM! Not just passive! Critical reading is an active, and creative, process.

Discussion exercise

Gather into 4x groups of ~6 people, around a sheet of paper

- **Q1:** What are the characteristics of a '***good***' research article?

2 minutes – without talking, write down your ideas on post-it notes and stick onto the paper

3 minutes – talk through your ideas in your group (ensure that everyone explains at least one of their ideas)

At the end of the two minutes I will ask someone from each group to **share one of their ideas, and explain why.**

Discussion exercise

Gather into 4x groups of ~6 people, around a sheet of paper

- **Q2:** What are the characteristics of a '***bad***' research article?

2 minutes – without talking, write down your ideas on post-it notes and stick onto the paper

3 minutes – talk through your ideas in your group (ensure that everyone explains at least one of their ideas)

At the end of the two minutes I will ask someone from each group to **share one of their ideas, and explain why**.

Prof. Karen Scrivener / Dr. Alastair Marsh

Aspects to consider with critical reading

General aspects

- Article type
- Year of publication
- Journal

Section-specific aspects within a research article

- Introduction
- Method
- Results
- Conclusions

Article type

Common article types are:

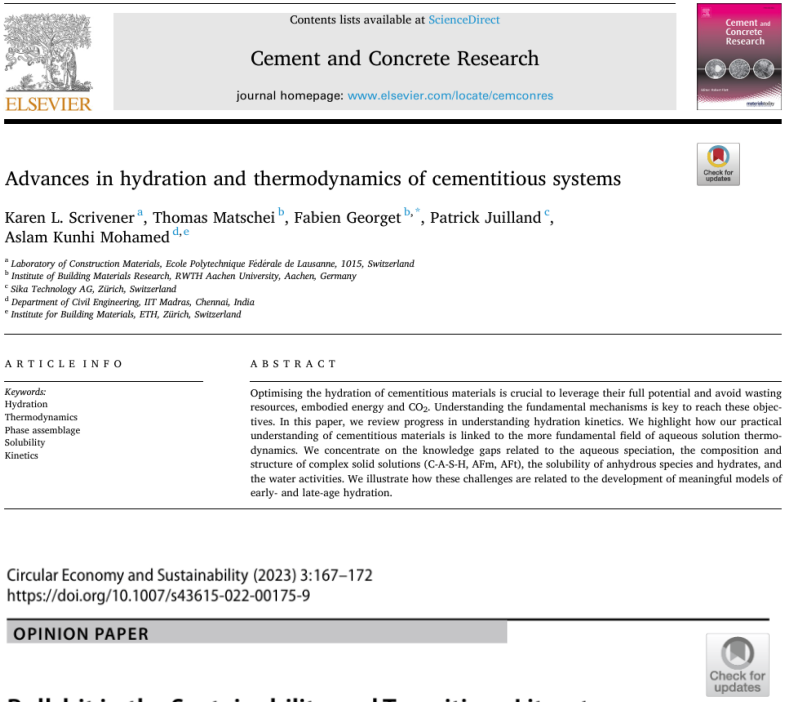
- Research article
- Communication (i.e. a short research article)
- Review article
- Perspective/commentary

Review articles are an excellent way to start learning about a new topic…

… but research articles should be the focus of your reading

"*Wherever appropriate, cite primary literature in which observations are first reported rather than reviews in order to give credit where credit is due*." (DORA, 2012)

'**Perspective/commentary**' type articles can vary widely – some are simply opinions.



Contents lists available at ScienceDirect

Cement and Concrete Research

journal homepage: www.elsevier.com/locate/cemconres

Advances in hydration and thermodynamics of cementitious systems

Karen L. Scrivener [a], Thomas Matschei [b], Fabien Georget [b,*], Patrick Juilland [c], Aslam Kunhi Mohamed [d,e]

[a] Laboratory of Construction Materials, Ecole Polytechnique Fédérale de Lausanne, 1015, Switzerland
[b] Institute of Building Materials Research, RWTH Aachen University, Aachen, Germany
[c] Sika Technology AG, Zürich, Switzerland
[d] Department of Civil Engineering, IIT Madras, Chennai, India
[e] Institute for Building Materials, ETH, Zürich, Switzerland

ARTICLE INFO

Keywords:
Hydration
Thermodynamics
Phase assemblage
Solubility
Kinetics

ABSTRACT

Optimising the hydration of cementitious materials is crucial to leverage their full potential and avoid wasting resources, embodied energy and CO_2. Understanding the fundamental mechanisms is key to reach these objectives. In this paper, we review progress in understanding hydration kinetics. We highlight how our practical understanding of cementitious materials is linked to the more fundamental field of aqueous solution thermodynamics. We concentrate on the knowledge gaps related to the aqueous speciation, the composition and structure of complex solid solutions (C-A-S-H, AFm, AFt), the solubility of anhydrous species and hydrates, and the water activities. We illustrate how these challenges are related to the development of meaningful models of early- and late-age hydration.

Circular Economy and Sustainability (2023) 3:167–172
https://doi.org/10.1007/s43615-022-00175-9

OPINION PAPER

Bullshit in the Sustainability and Transitions Literature: a Provocation

Julian Kirchherr[1]

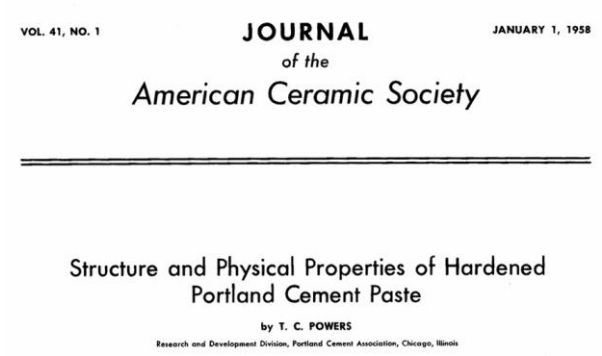
Received: 15 November 2021 / Accepted: 1 May 2022 / Published online: 20 May 2022

Year of publication

- There are **no clear rules** about how useful/valid a research article may be, based on its year of publication. For example…

- **Powers' (1958)** insights into how available space limits the extent of hydration are still valid (and still cited) today.

- The existence of a "third aluminate hydrate" phase in C-A-S-H was **only disproven very recently** (Kunhi Mohamed et al., 2020)… many recent articles have (and still do!) incorrectly assume that this phase exists.



VOL. 41, NO. 1 JOURNAL JANUARY 1, 1958

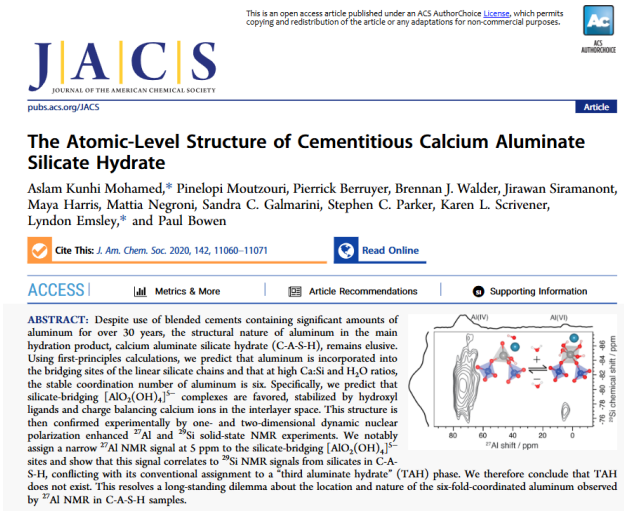
of the

American Ceramic Society

Structure and Physical Properties of Hardened Portland Cement Paste

by T. C. POWERS

Research and Development Division, Portland Cement Association, Chicago, Illinois



JACS

JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

pubs.acs.org/JACS Article

The Atomic-Level Structure of Cementitious Calcium Aluminate Silicate Hydrate

Aslam Kunhi Mohamed,* Pinelopi Moutzouri, Pierrick Berruyer, Brennan J. Walder, Jirawan Siramanont, Maya Harris, Mattia Negroni, Sandra C. Galmarini, Stephen C. Parker, Karen L. Scrivener, Lyndon Emsley,* and Paul Bowen

Cite This: J. Am. Chem. Soc. 2020, 142, 11060−11071 Read Online

ACCESS | Metrics & More | Article Recommendations | Supporting Information

ABSTRACT: Despite use of blended cements containing significant amounts of aluminum for over 30 years, the structural nature of aluminum in the main hydration product, calcium aluminate silicate hydrate (C-A-S-H), remains elusive. Using first-principles calculations, we predict that aluminum is incorporated into the bridging sites of the linear silicate chains and that at high Ca:Si and H_2O ratios, the stable coordination number of aluminum is six. Specifically, we predict that silicate-bridging $[AlO_3(OH)_4]^{5-}$ complexes are favored, stabilized by hydroxyl ligands and charge balancing calcium ions in the interlayer space. This structure is then confirmed experimentally by one- and two-dimensional dynamic nuclear polarization enhanced ^{27}Al and ^{29}Si solid-state NMR experiments. We notably assign a narrow ^{27}Al NMR signal at 5 ppm to the silicate-bridging $[AlO_3(OH)_4]^{5-}$ sites and show that this signal correlates to ^{29}Si NMR signals from silicates in C-A-S-H, conflicting with its conventional assignment to a "third aluminate hydrate" (TAH) phase. We therefore conclude that TAH does not exist. This resolves a long-standing dilemma about the location and nature of the six-fold-coordinated aluminum observed by ^{27}Al NMR in C-A-S-H samples.

Journal

- Assessing the **quality of a journal** is complicated – it partly depends on…
  - Subject area
  - Point in time

- Ultimately, you can only judge the quality of a research article on its **contents**.
- BUT, considering journals can help our search, and how to **prioritise** our reading.

- We can assess the ‘quality’ of a journal by the **average quality of its articles**.

Journal

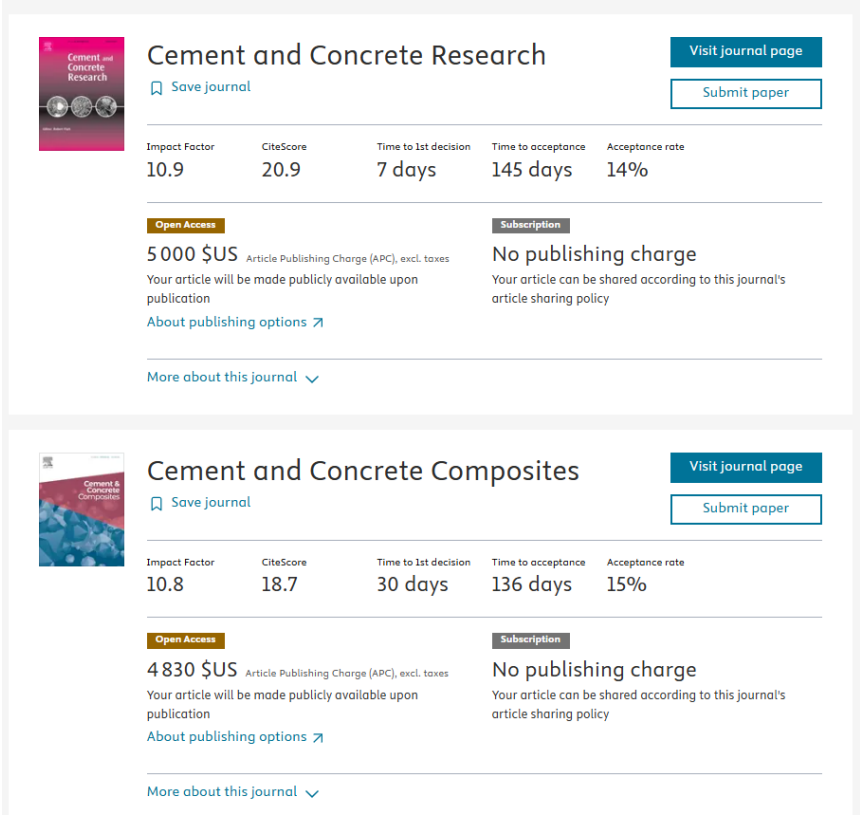
How can we assess the average quality of the articles in a journal?

Journal impact factor = a measure of how many times articles in a journal have been cited in the next 2 years.

"*the most widely used, misused and abused bibliometric index in academic science*" (!) (Ioannidis & Thombs, 2019)

- E.g. **review articles** get a lot of citations. More review articles in a journal → higher impact factor.

- CAN be a general measure of quality… the **top journals** generally do have the highest impact factors
- But remember, it's also **easily skewed/biased** in the lower ranges.



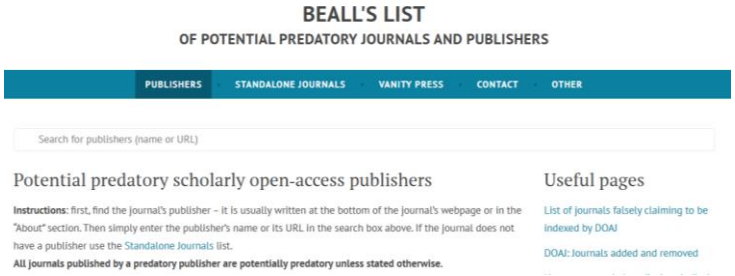
Journal

‘Predatory’ journals and publishers

= “*…entities that prioritize self-interest at the expense of scholarship and are characterized by* ***false or misleading*** *information,* ***deviation from best editorial and publication practices****, a* ***lack of transparency****, and/or the use of* ***aggressive and indiscriminate*** *solicitation practices*.” (Grudniewicz et al., 2019)

How to check?

- Beall’s List https://beallslist.net/
- Retraction Watch https://retractionwatch.com/



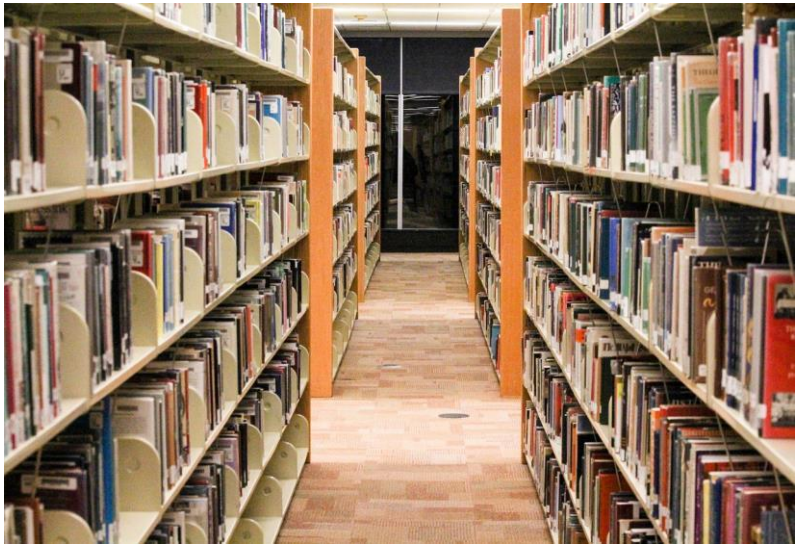
‘Semi-predatory’ publishers

- MDPI publications?
- Excessive self-citations, very short peer review time, income model (Oviedo-Garcia, 2021)

Journal

‘Core’ journals (non-exclusive) in the field of cementitious materials:

- Cement and Concrete Research
- Cement and Concrete Composites
- Journal of the American Ceramic Society
- Materials and Structures
- Construction and Building Materials
- Advances in Cement Research
- Structural Concrete



Acceptance by one of these journals is not a guarantee of quality – but are the **most widely used journals in our field**.

Section-specific aspects of a research article

These considerations are partly based on the **peer review questions** of Cement and Concrete Research (the top journal in cement science):

Introduction

- Are the aim, objectives and research questions clearly stated?

Method

- Is the description sufficiently detailed to make the study repeatable?

Results

- Are the results readable/intelligible?
- Is there consideration of uncertainties?

Conclusions

- Are the interpretations and conclusions supported by the data?

Prof. Karen Scrivener / Dr. Alastair Marsh

An example…

- An article I peer-reviewed for a (well-regarded) journal in recent years.
- Selective extracts; anonymity is retained.

Mechanical and microstructural properties of Na_2CO_3-NaOH activated calcinated phosphate mine tailing

An example… Abstract/Introduction

Q: *Are the aim, objectives and research questions clearly stated?*

- No – the aim is essentially '*what happens if I combine these two potential cementitious ingredients*?'
- No clear rationale, research questions or hypothesis being tested.

Abstract

This study aims to investigate the properties of sodium carbonate and sodium hydroxide activated phosphate washing waste *PWW*. The flexure and compressive strength were used to

The present paper investigates the elaboration of the AAM based on the Tunisian phosphate sludge activated by the sodium hydroxide and sodium carbonate as the use of sodium carbonate as activator of phosphate tailing has not been investigated. The mortars are assessed through different analysis. The flexure and compressive strength were used as mechanical

Prof. Karen Scrivener / Dr. Alastair Marsh

An example… Method

Q: *Is the description sufficiently detailed to make the study repeatable?*

- Not completely – no details are given about the “preliminary essays”.
- The sieve size isn’t stated – this is very important to evaluate how effectively the aggregate will be separated from the hydrated paste.

The mortar compositions were prepared with the method of unitary volume [29, 57] and the densities of the components are presented in the Table 3. First the liquid/solid mass ratio was fixed after preliminary essays, next the needed quantities of the extra water and the sand were determined to obtain the adequate workability for the alkali activated materials.

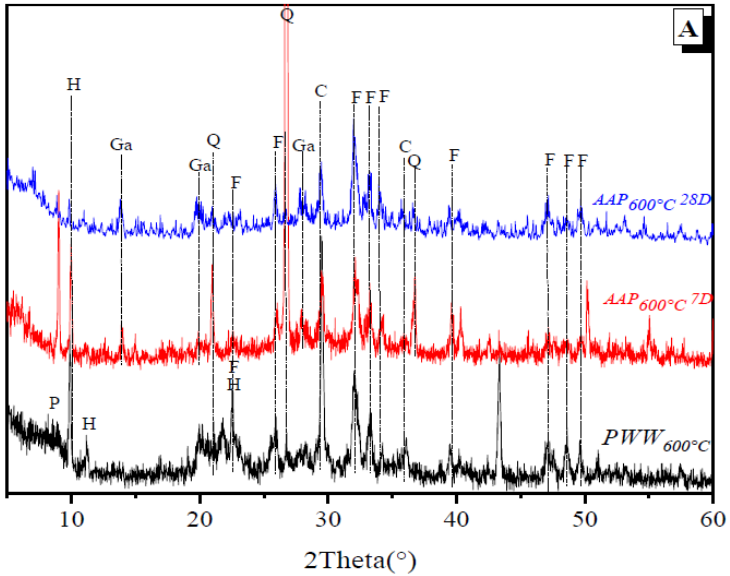
The XRD, FTIR(ATR), DSC-TG and SEM were conducted for the cured samples at 7 and 28 days. After the mechanical analysis, the mortars were then crushed and sieved to eliminate the aggregate and then used for the analysis listed above.

Prof. Karen Scrivener / Dr. Alastair Marsh

An example… Results

Q: Are the results readable/intelligible?

- XRD figure – not good. Several significant peaks **not indexed**.
- Figure 1 – **no labelling** of which mortar prism is which mix!



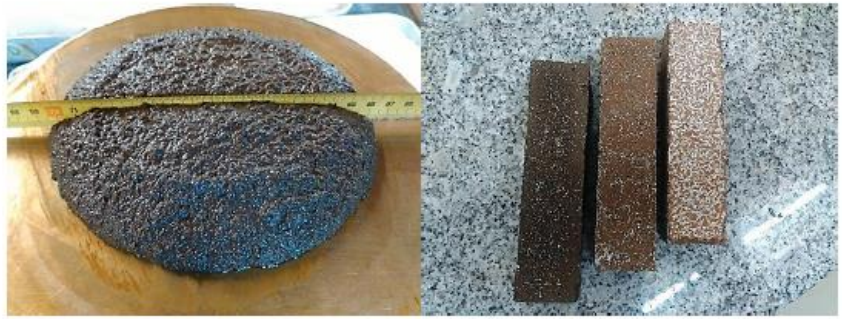


Figure 1: The flow table test and the 3 specimens of the mortars

mixture based on the $PWW_{700°C}$. The $AAP_{800°C}$ in the case of activation with Na_2CO_3-NaOH was not hardened and it was feasible for mechanical and structural studies as the Figure 1 shows. This behaviour is due to the long setting characteristic presented by the sodium

Prof. Karen Scrivener / Dr. Alastair Marsh

An example… Results

Q: Is there consideration of uncertainties?

- Yes – **error bars** for compressive strength measurements of mortar prisms (from 3x specimens)

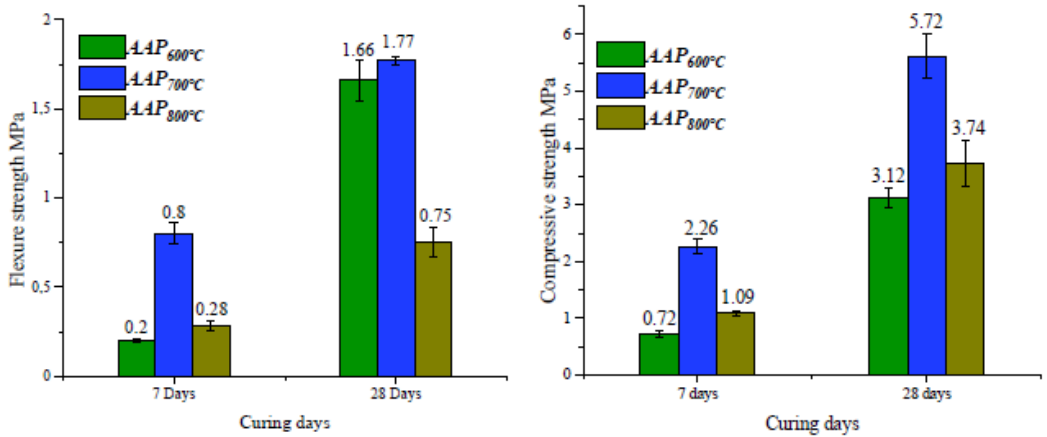


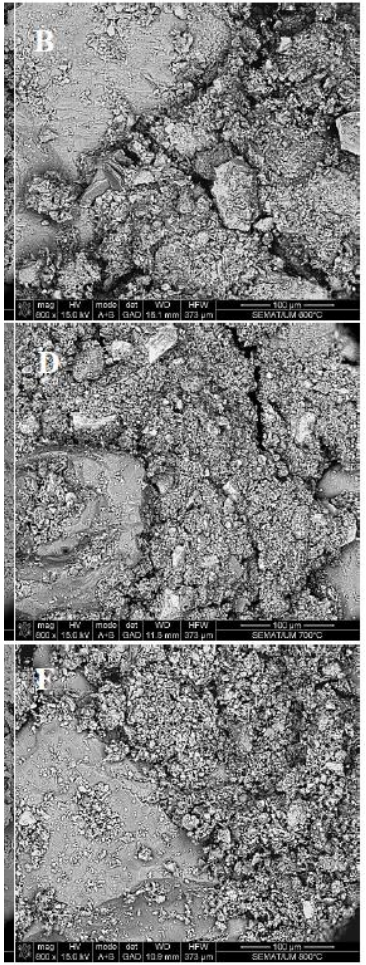
Figure 2: Mechanical strengths of the $AAP_{600°C}$ and $AAP_{700°C}$ and $AAP_{800°C}$ at 7 and 28 days

The mechanical properties measured in the study refers to compressive and flexure strength at 7 and 28 days of curing. The mechanical properties were performed in accordance to the European Standard EN 1015-11 and the results were the average of three tests specimens.

An example… Conclusions

Q: *Are the interpretations and conclusions supported by the data?*

- Not all of them – is it **clear** that the microstructure of the AAP700C (i.e. the middle image) is "*denser and less porous*"? No.
- A fracture surface is **not a good sample preparation** method to use for this kind of analysis – it would have been better to use:
  - a polished specimen for SEM analysis
  - a specific technique to measure porosity (e.g. mercury intrusion porosimetry)



the $AAP_{600°C}$, $AAP_{700°C}$ and $AAP_{800°C}$ microstructure. It is clear from the images that the $AAP_{700°C}$ present the denser and less porous structure compared to the other specimens. The

An example… Conclusions

Q: *Are the interpretations and conclusions supported by the data?*

- No – for the first conclusion, **no measurements** were made to assess the "*reactivity of the powder*". So therefore, a **causal link** cannot be drawn.
- The second conclusion is simply **too vague** – "*affect the mechanical properties*" doesn't refer to any physical/chemical mechanism. It doesn't improve our understanding.

- The mechanical properties show that the $AAP_{700°C}$ present the good mechanical strength after curing compared to the other mixtures, this is due to the reactivity of the powder $PWW_{700°C}$ compared to those of the $PWW_{600°C}$ and the $PWW_{800°C}$.
- The combination of (Na_2CO_3 and NaOH) compared to (Na_2SiO_3 and NaOH) affect the mechanical and structural properties. The *PWW* activated by the ($Na_2CO_3$and NaOH) need to be more investigated to improve the properties and the final products.

Prof. Karen Scrivener / Dr. Alastair Marsh

An example…

- **A well-equipped** laboratory (XRD, FTIR, DSC-TG, SEM, Solid state NMR)
- **Experienced** researchers (all had PhDs)

- Nonetheless, the study was **poor quality** in terms of…
  - Experimental design
  - Sample preparation
  - Presentation of data
  - Interpretation of data
  - Inference of conclusions

- My recommendation was therefore to **reject** the article

- In contrast, an excellent research article would do all these functions very well.

By the end of this lecture you will be able to…

1. **Design and implement** a **search strategy** to review the literature on a given topic in cementitious materials

2. **Understand** the key characteristics one can use to appraise the **quality and relevance of a scientific article** based on its general characteristics.

Course schedule

Week #	Class date	Title	Lecturer
1	11/09/2024	Introduction and Literature Review	Prof. Karen Scrivener / Dr. Alastair Marsh
2	18/09/2024	Durability	Dr. Beatrice Malchiodi
3	25/09/2024	Cement hydration	Prof. Karen Scrivener
4	02/10/2024	Characterisation	Dr. Federica Boscaro
5	**09/10/2024**	**Presentation 1**	
6	16/10/2024	Admixtures	Dr. Federica Boscaro
7	**30/10/2024**	**Presentation 2**	
8	06/11/2024	Life cycle analysis for cementitious materials	Dr. Alastair Marsh
9	13/11/2024	Limestone calcined clay cements (LC^3)	Dr. Franco Zunino
10	20/11/2024	Concrete design	Dr. Beatrice Malchiodi
11	27/11/2024	Sustainability appraoches for construction	Dr. Alastair Marsh
12	04/12/2024	Concrete structures / Q&A on Presentation 3	Prof. David Ruggiero
13	**11/12/2024**	**Presentation 3**	
14	18/12/2024	Re-use & standardization	Prof. David Fernandez / Prof. Corentin Fivet

Instructions for assessments #1 and #2 will be uploaded to Moodle shortly.

References

- DORA (2012). San Francisco Declaration on Research Assessment https://sfdora.org/read/
- Grudniewicz, A., Moher, D., Cobey, K. D., Bryson, G. L., Cukier, S., Allen, K., ... & Lalu, M. M. (2019). Predatory journals: no definition, no defence.
- Gusenbauer, M., & Haddaway, N. R. (2020). Which academic search systems are suitable for systematic reviews or meta-analyses? Evaluating retrieval qualities of Google Scholar, PubMed, and 26 other resources. *Research synthesis methods*, *11*(2), 181-217.
- Ioannidis, J. P., & Thombs, B. D. (2019). A user's guide to inflated and manipulated impact factors. *European journal of clinical investigation*, *49*(9), e13151.
- Kirchherr, J. (2023). Bullshit in the sustainability and transitions literature: a provocation. *Circular Economy and Sustainability*, *3*(1), 167-172.
- Lai, E. R. (2011). Critical thinking: A literature review. *Pearson's Research Reports*, *6*(1), 40-41.
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group*, T. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of internal medicine*, *151*(4), 264-269.
- Ngwenyama, O., & Rowe, F. (2024). Should we collaborate with AI to conduct literature reviews? changing epistemic values in a flattening world. *Journal of the Association for Information Systems*, *25*(1), 122-136.
- Schöpfel, J. "Towards a Prague definition of grey literature." *Twelfth International Conference on Grey Literature: Transparency in Grey Literature. Grey Tech Approaches to High Tech Issues. Prague, 6-7 December 2010*.
- Watson, M. (2020). How to undertake a literature search: a step-by-step guide. *British Journal of Nursing*, *29*(7), 431-435.
- Wohlin, C., Kalinowski, M., Felizardo, K. R., & Mendes, E. (2022). Successful combination of database search and snowballing for identification of primary studies in systematic literature studies. *Information and Software Technology*, *147*, 106908.