



EUROPEAN CEMENT STANDARDS

ALL YOU NEED TO KNOW

DECEMBER 2024

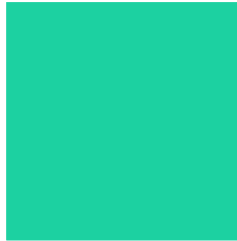


What are standards?

Standards establish a common way to make products, deliver services, or manage processes. When done right, standards can facilitate the creation of larger markets, all the while helping to protect consumers and the environment. On the other hand, however, standards can also restrict competition on the market, stifle innovation and prevent decarbonisation.

How are standards developed?

Most standards are developed in standardisation bodies (e.g., CEN and CENELEC in Europe, ISO and IEC internationally). These are private entities, made up of National Standardisation Bodies (NSBs). The drafting happens in Technical Committees (TCs), which are organised per topic (e.g. cement). Each NSB sends a delegation of experts to represent their national perspective. These are informed by meetings at the national level based on the input of industry representatives, as well as other stakeholders like civil society. Involvement of civil society, as opposed to industry participants, is often sporadic, uncoordinated and insufficient – in particular at national level. This is mostly due to limited funding, difficulty in accessing the technical groups where standards are developed, and lack of expertise.



Why do we need cement standards?

In the case of cement, standards put forward a framework that ensures the composition of cements used in construction and infrastructure works. This is particularly relevant in a risk-averse sector such as construction. Using cements that are compliant with the standard is the easiest way to show due diligence, as standards are deemed to reflect the state-of-the art in a given area. However, when this is not the case, standards can have a negative impact, effectively hindering innovative solutions.

Cement standards can be a great tool to reduce complexity but only on the condition that they are up to date with recent innovations and scientific evidence.

What is a harmonised standard?

A harmonised standard is a European standard developed by a recognised European Standards Organisation: CEN, CENELEC, or ETSI. It is created following a request from the European Commission to one of these organisations. Manufacturers, other economic operators, or conformity assessment bodies can use harmonised standards to demonstrate that products, services, or processes comply with relevant EU legislation in terms of safety, health and environmental requirements. When doing so, producers can affix a CE mark to their product. Harmonised standards are an integral part of EU legislation as they are cited in the Official Journal of the European Union¹. Applied to cement, the easiest, cheapest and fastest route for a cement to obtain a CE mark is to comply with the harmonised European cement standard (i.e. EN 197-1).

What is the importance of the EU Construction Products Regulation for cement?

The Construction Products Regulation (CPR) is the main legal framework for construction products in the EU. It lays down the harmonised rules for the placement of construction products on the internal market, by providing a common technical language to assess the performance of construction products. This is done through the development of harmonised standards. The overarching objective of the CPR is to ensure that construction products (like cement) are offered a level-playing field for market entrance across the Single Market, by providing a harmonised framework on how to assess the performance of a certain product. Importantly, standards developed under the CPR need to be performance-based and technology neutral in order to comply with EU law. This is spelled out explicitly in the standardisation requests which are the guiding document for CEN when drafting a harmonised standard².



Are harmonised standards the only route to CE marking?

The CPR foresees an alternative route for CE marking for construction products. The underlying logic is that harmonised standards cannot always anticipate technological innovations at the time of their development. This route is commonly referred to as the EOTA route – referring to the European Organisation for Technical Approval – a private entity in charge of assessing the compliance of novel products with the EU legal framework. However, the CPR does not allow this route for products covered by harmonised standards. Applied to cement, this means that a common cement – referring to a cement used in a wide range of applications – cannot follow the EOTA route due to the existence of a harmonised standard for common cements (EN 197-1).

How did European cement standards evolve over time?

All over the world, cement standards are among the oldest product standards. This is not different in Europe, as they go all the way back to the invention of modern cement making in the early 1800s. While, historically, different production methods (and products) existed, the access to cheap and abundant energy (i.e. fossil fuels) resulted in the mass production of Portland cement. As a result, cement standards developed at that time were tailored to Portland cement and its properties³. This has not changed since, and when the first harmonised standard for cement was developed in 1989, it was (and still is) a standard for Portland cements.



What is Ordinary Portland Cement and why should we try to consume as little of it as possible?

Ordinary Portland Cement (OPC) – also commonly referred to as traditional cement – is the dominant cement on the market. It was first patented 200 years ago. Its main ingredient is clinker - marble-sized grey balls, produced through a chemical process called calcination. This involves heating up crushed rocks and other raw materials – typically limestone – in kilns at a staggering temperature of up to 1450°C. This initiates a chemical reaction in which the material is split into CO₂ and calcium oxides. These oxides form clinkers, and once cooled, grinded, and mixed with other ingredients, they turn into ready-to-use cement.

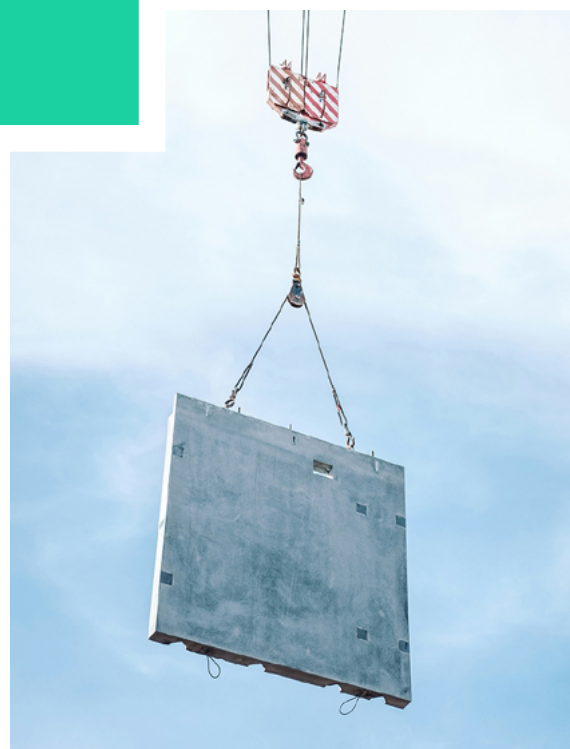
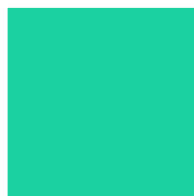
This, however, comes at a great environmental cost. Cement production processes generate almost a tonne of CO₂ for every tonne of cement produced, amounting to 8% of global CO₂ emissions - more than the combined emissions of aviation, trucking, and shipping! Decarbonising the sector is ever so urgent – and within reach.

This can be done in several ways. At the risk of oversimplification, we can distinguish between (i) maximising the use of Supplementary Cementitious Materials (SCMs) in Portland cements (i.e. reducing the share of clinker as much as possible); and (ii) alternative cement types which replace the need for traditional Portland cement altogether because they rely on different feedstocks, production methods and binding chemistries.

What is the problem with European cement standards?

European cement standards have always followed a recipe-based approach. In such logic, products are specified based on their composition, restricted to a set of predefined chemical and/or physical requirements. This means that a cement standard will contain lengthy and detailed tables outlining different cement types based on mixing proportions of Portland clinker and a predefined set of so-called secondary cementitious materials (SCMs).

However, both from an environmental and innovation point of view, such approach is hugely problematic as the bulk of low-carbon cement types (Portland cements with low-clinker levels, as well as alternative binder mechanisms) are insufficiently covered by European cement standards, if at all. For example, while the use of certain SCMs is allowed in the standard, a fast-growing number of them are not covered at all. Furthermore, the existing predefined mixing combinations and the degree to which clinker can be substituted are not in line with technological innovations. In a similar fashion, the main European cement standards are not open to alternative cement types - they are in essence designed for Portland cement mixes only.



Worse still, as the European experience shows, and academic literature confirms, recipe-based standards are by nature inflexible and hard to change. Each new material (and potential set of mixes) needs to go through an entire standardisation process separately, requiring huge time investments (the development of a new standard takes several years). Not only is this very unrealistic, but such 'solution' is also needlessly complicated and by default bound to fail as innovations in cement are at an all-time high^{4,5} And even if one were successful, the final standard would be incredibly complex, and impractical for any end-user, as such defeating its very purpose^{6,7}.

Finally, also from a competitiveness point of view, it is well established that recipe-based cement standards favour actors seeking to protect the status-quo⁸. In fact, incumbents with no interest in novel SCMs or cements can act as gatekeepers to standards, often even to the extent that they *take active measures to block the inclusion of a given SCM [or alternative binder] on cement specification to prevent a competitor from gaining a competitive advantage*⁹ – something the European market experiences on a regular basis.



Are SCMs and alternative cements scalable?

It is often claimed that SCMs and alternative cements are not scalable, an argument meant to downplay the relevance and importance of the standards issue. In fact, the opposite is true. Various studies show that Europe has significant potential for reducing its reliance on traditional Portland clinker^{10,11}. For example, the DETCOS project shows that Europe has the potential to reduce its clinker-to-cement ratio to 40% by 2030 and 25% by 2035 (down from the clinker-to-cement ratio of 80%). In other words, clinker production in Europe can be halved, and replaced with low-carbon cement production in the next decade¹². However, to make this happen, cement standards need to change.

What is the way forward for EU cement standards?

The literature is clear: performance-based standards successfully address all shortcomings of the recipe-based approach. Rather than specifying the composition of a product, performance-based standards predefine its goals or functions – in other words, performance requirements. It is up to the market to meet these, creating a level-playing field for different technologies and innovations¹³.

A textbook example of a performance-based cement standard is the American standard ASTM C1157. First developed in 1992, it covers all hydraulic cements, both for general and specific applications, without any restrictions on composition. The standard classifies six types of cements based on their final function (e.g. general use, high-early strength, high-sulphate resistance) and subsequently specifies rigorous quality criteria on relevant properties, including strength development, durability or shrinkage and cracking.

The great advantage of a performance-based approach is that it addresses most – if not all – shortcomings of prescriptive standards. The lack of chemical and compositional requirements offers flexibility to use new materials and technologies. For this reason, the role of performance-based standards in facilitating innovation and decarbonisation has been widely recognised and praised in literature^{14 15 16 17} as well as by international organisations such as the OECD¹⁸.

Importantly, looking at the European legal context, the newly revised Construction Products Regulation leaves no room for interpretation: harmonised standards need to be performance-based. This provision in the CPR is not new. Already the 'old' CPR from 2011 – and its predecessor, the Construction Products Directive (CPD) – clearly stipulated that products need to be CE marked through a performance-based approach. However, in the past, different actors (including the European Commission) have always tolerated the prescriptive approach of the EN 197-1 standard, well-aware of the legal risks that came with it. For decades now, prescriptive cement and concrete standards have been a highly controversial issue in Europe. At a time when a great number of low-carbon cement solutions seek market entrance, the need to give them a chance – also from a legal perspective – is more pressing than ever.



What do we gain if we succeed?

At a time when research and development in low-carbon cement technologies is at an all-time high, Europe has much to gain from performance-based cement standards. Shifting to a performance-based approach will serve as a key driver of decarbonisation and global competitiveness of the cement industry. Studies show that Europe has the potential to half the emissions from cement production by shifting to performance-based standards¹⁹. This change is also needed from a competitiveness perspective, following the example set by other countries and regions in the world – most notably the United States. Given that cement technologies are increasingly traded on a global level, it is key for the EU to follow this international trend. A strong internal market based on innovation and fair competition is key for European cement innovators to scale their technologies and compete on a global level with other players who have benefited from performance-based cement standards for quite some time already.

Finally, it is also key to highlight that performance-based standards are crucial to minimising costs and energy consumption of construction. As highlighted before, cement standards have a direct impact on the market uptake of low-carbon cements. Importantly, the majority of these solutions is cost-effective (e.g. because they reduce the need for traditional clinker). As such they drastically reduce the need for unproven and much more expensive and energy-consuming decarbonisation levers such as carbon capture and storage (CCS), which will drive up the need for (clean) energy and come with a substantial price tag. This will, in turn, undermine the affordability of construction as these costs will be passed on to the downstream value chain (and end consumer).

Will the EU finally deliver?

For obvious reasons, the topic of cement standards has attracted growing political attention in recent years within Europe. Amongst others, the European High-level Forum on Standardisation recommends shifting to performance-based cement standards, highlighting both the legal context of the CPR (requiring such shift) and the many restrictions for low-carbon cements presented by today's standards²⁰.

REFERENCES

- 1 <https://ecostandard.org/wp-content/uploads/2018-06-11-The-use-of-standards-in-legislation-and-policies-ECOS-discussion-paper.pdf>
- 2 https://single-market-economy.ec.europa.eu/single-market/european-standards/notification-system_en#possible-future-standardisation-requests-to-european-standardisation-organisations
- 3 John, V. M., Quattrone, M., Abrão, P. C. R. A., & Cardoso, F. A. (2019). Rethinking cement standards: Opportunities for a better future. *Cement and Concrete Research*, 124, 105832. <https://doi.org/10.1016/j.cemconres.2019.105832>
- 4 Snellings, R., Suraneni, P., & Skibsted, J. (2023). Future and emerging supplementary cementitious materials. *Cement and Concrete Research*, 171, 107199. <https://doi.org/10.1016/j.cemconres.2023.107199>
- 5 Tautorat, P., Lalin, B., Schmidt, T. S., & Steffen, B. (2023). Directions of innovation for the decarbonization of cement and steel production – A topic modeling-based analysis. *Journal of Cleaner Production*, 407, 137055. <https://doi.org/10.1016/j.jclepro.2023.137055>
- 6 Beushausen, H., Torrent, R., & Alexander, M. G. (2019). Performance-based approaches for concrete durability: State of the art and future research needs. *Cement and Concrete Research*, 119, 11–20. <https://doi.org/10.1016/j.cemconres.2019.01.003>
- 7 <https://doi.org/10.1016/j.cemconres.2019.105832>
- 8 Dewald, U., & Achternbosch, M. (2016). Why more sustainable cements failed so far? Disruptive innovations and their barriers in a basic industry. *Environmental Innovation and Societal Transitions*, 19, 15–30. <https://doi.org/10.1016/j.eist.2015.10.001>
- 9 John, V. M., Quattrone, M., Abrão, P. C. R. A., & Cardoso, F. A. (2019). Rethinking cement standards: Opportunities for a better future. *Cement and Concrete Research*, 124, 105832, page 4
- 10 Shah, I.H., Miller, S.A., Jiang, D. et al. Cement substitution with secondary materials can reduce annual global CO₂ emissions by up to 1.3 gigatons. *Nat Commun* 13, 5758 (2022). <https://doi.org/10.1038/s41467-022-33289-7>
- 11 Dunant, C.F., Joseph, S., Prajapati, R. et al. Electric recycling of Portland cement at scale. *Nature* 629, 1055–1061 (2024). <https://doi.org/10.1038/s41586-024-07338-8>
- 12 <https://cordis.europa.eu/project/id/101119929>
- 13 Sutter, L. L., & Hooton, R. D. (2023). Progress towards sustainability through performance-based standards and specifications. *Cement and Concrete Research*, 174, 107303. <https://doi.org/10.1016/j.cemconres.2023.107303>
- 14 Beushausen, H., Torrent, R., & Alexander, M. G. (2019). Performance-based approaches for concrete durability: State of the art and future research needs. *Cement and Concrete Research*, 119, 11–20. <https://doi.org/10.1016/j.cemconres.2019.01.003>
- 15 John, V. M., Quattrone, M., Abrão, P. C. R. A., & Cardoso, F. A. (2019). Rethinking cement standards: Opportunities for a better future. *Cement and Concrete Research*, 124, 105832
- 16 Lowitt, S. (2020a). TOWARDS THE DECARBONISATION OF THE SOUTH AFRICAN CEMENT INDUSTRY: OPPORTUNITIES AND CHALLENGES. www.tips.org.za
- 17 Sutter, L. L., & Hooton, R. D. (2023). Progress towards sustainability through performance-based standards and specifications. *Cement and Concrete Research*, 174, 107303. <https://doi.org/10.1016/j.cemconres.2023.107303>
- 18 OECD. (2005). Performance-based Standards for the Road Sector. OECD. <https://doi.org/10.1787/9789282123386-en>
- 19 <https://alliancelccc.com/wp-content/uploads/2023/05/Methodology-report-Clinker-Substitution-in-the-EU-Cement-Sector.pdf>
- 20 <https://ec.europa.eu/docsroom/documents/62574>

ABOUT ECOS

ECOS - Environmental Coalition on Standards is an international NGO with a network of members and experts advocating for environmentally friendly technical standards, policies, and laws. We ensure the environmental voice is heard when they are developed and drive change by providing expertise to policymakers and industry players, leading to the implementation of strong environmental principles.



In this context, the European Commission initiated the CPR acquis process in 2023 to revise the European cement standards. Despite a clear commitment to shift to a performance-based approach, current drafts continue to display a recipe-based logic, restricting the scope of the future standard to cement types which are today already covered by existing standards. Obviously, this approach is far from technology-neutral, nor does it respect the logic of performance-based standards. Furthermore, no scientific evidence has been provided as to why such restrictive approach is justified. This has sparked much criticism among industry frontrunners, civil society organisations and think tanks (see e.g. here). The European Commission has an opportunity to deliver on the much-needed change, as it is now finalising the standardisation request to CEN TC 51 (the EU standardisation body in charge) on EN 197.

Author

Joren Verschaeve,
Senior Programme Manager
ECOS

ECOS - Environmental Coalition on Standards

c/o WeWork

Rue du Commerce 31

1000 Brussels, Belgium

T +32 2 899 76 80

info@ecostandard.org

www.ecostandard.org

Follow us



@ECOS_Standard



ECOS-NGO



@ecosngo.bsky.social

Designed by Tokay Digital: www.tokaydigital.com

