



High-Level Forum on European Standardisation

Conclusions and recommendations from the Workstream 6 on Low-carbon cements

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I. Background

Standardisation of low-carbon cement is a key issue for the construction industry decarbonisation.

The cement industry represents around 7-8% of global GHG emissions (4% in Europe), because traditional Portland cement made of clinker is highly CO₂-intensive. To achieve the GHG emissions reduction targets of the European cement industry without relying only on CO₂ capture, it is necessary to develop new types of cement whose production processes emit less CO₂, to make sure that the existing low carbon cements can easily access the market and that the different cement and concrete standards contribute to facilitate the market launch of low carbon cements.

In addition, the construction sector is engaged in a decarbonisation pathway with new regulation concerning the carbon intensity of buildings, which will lead to an increased demand of low-carbon cement among other innovations (new components in cements and in concretes, increasing reuse of materials in concrete, evolution of conception of buildings, ...).

The development of low-carbon cements will lead to the use of various types of constituents and to the use of so-called “supplementary cementitious materials” (SCM), so **the primary objective is to ensure that (i) the European standardisation system is able to address a wider plurality of cements, regarding the cement standards, and that (ii) the concrete related standards and the construction related standards will appropriately account for the low-carbon cements and the related standards expected on the market in the coming years.** In parallel, it will be crucial to ensure a coherence between these multiple and simultaneous changes (design, materials and execution levels) to **maintain the same level of quality and safety** for construction.

The current standardisation process is a long process due to the technical complexity of issues, and the existing approach insufficiently accounts for new evolutions in the market, making it difficult for innovative companies to pass through the overall standardisation process to obtain an evolution of the standards to address each one of their new solutions. It is worth noting that the existing framework with European Technical Assessments for experimental use of innovative cements offers some useful possibilities, although feedback from manufacturers shows that the process is in general longer, involves additional costs and the final access to the market is limited in many cases.

Additionally, current standardisation stakeholders have to deal with the work related to the **revision of the Construction Products Regulation**, and with the **existence of non-harmonised standards** covering the different elements of the construction sector.

Considering this, the objective of this workstream is to examine, from the European Standardisation System point of view, actions that can be taken to enable the scaling up of innovative products that will contribute to the overall decarbonisation of the construction sector.

II. Description of the existing standardisation framework

Cement, concrete and buildings

The technical framework of the construction sector is complex, with standardisation work split between structures dedicated to different specific topics. In particular, there are technical committees on cements (and binders), technical committees on concrete and technical committees on buildings (design of buildings, construction rules and concrete processing, ...). While the main focus will be on the cement technical committee (CEN TC 51), it will also be necessary to take into account the way that some standards related to concrete or buildings may reference specific cement standards.

Cements standards used in EU are mainly European standards

Given that cement is a high density and a relatively low selling price product, the cement trade between different regions is not an issue at this stage. The global EU production of cement is about 180 Mt and the EU consumption of cement is about 170 Mt¹. The global EU import and export of cement are around 10 Mt and the EU is today a net-exporter of cement (~ below 5 Mt since 2021). It can be noticed that the clinker tends to be more and more imported in the EU, from the Mediterranean countries. The CBAM will aim at limiting carbon leaks. The EU exports of cement are mainly to the US and UK and the imports are mainly from within Europe (Ukraine, Turkey, Norway) or the MENA regions (e.g. Algeria, Tunisia)². The EU cement producers own almost 60% of the cement and lime production capacity in the US, and have significant production facilities in the rest of the world.

¹ <https://cembureau.eu/media/1fqjyve5/key-facts-figures-2021.pdf>

² <https://cembureau.eu/media/1ibpjhpn/eu-cement-industry-trade-statistics-full-year-2023.pdf>

Given the figures above, from the standardisation point of view, the primary focus of this workstream is the European standards framework, in particular the European cement standards used in Europe by the cement stakeholders and more generally by the stakeholders of the construction sector.

This workstream did not establish any particular recommendation related to international cements standards, which are established today for instance in the ISO TC 74 or in ASTM (an international standards organization with a strong focus on construction materials); neither did the workstream identify any particular issue related to the international concrete standards elaborated by the ISO TC 71 on concrete. Given the growing involvement of some regions in international standardisation, the international standardisation organisations or consortia could still be monitored to ensure that the European actors still maintain their influence in the relevant markets where they are active.

At the EU level, the main TC to consider is the **CEN TC 51 about cement, hydraulic binders and building limes**. As mentioned above, given the link between cement and concrete, the low-carbon cement standards issue will need to take into account the work of **CEN TC 104 on concrete** (and possibly other CEN TC dealing with buildings, or standards like Eurocodes, CEN/TC250 for instance).

Links with the regulation and ongoing regulation-linked standardisation works

As mentioned, the Construction Products Regulation (CPR) is in its final stage of revision. The new CPR will enter into force gradually, and there will be a progressive shift from the current regulation to the revised CPR. Additionally, there are currently Standardisation Requests that have been sent to the CEN based on current directives and regulations. To give the construction stakeholders a smooth transition from the current standardisation framework to the future standardisation framework adapted to the revised CPR, a specific group (the “Acquis group”) was established to guarantee overall coherence of standardisation works dedicated to the implementation of the construction sector regulation (current and future).

In particular, concerning cement, the **Acquis group has established a sub-group focusing on “cement, building limes and other hydraulic binders”, in charge of establishing a unique Standardisation request on cement** (objective: Q4 2024), that will allow the construction stakeholders to initiate standardisation work to have cements standards adapted to the future CPR.

Given the aforementioned elements, it is recommended that the High-Level Forum rely on this Acquis sub-group on cement as the central actor to assist and tackle the issues identified in this workstream, and the HLF should transmit the recommendations and suggested avenues for actions to this sub-group for inclusion in their ongoing work.

III. Avenues for action and recommendations

The meetings of this workstream have enabled the members to agree on different recommendations and avenues for actions, listed below; in addition, there are still open questions, listed in the part IV.

All members agreed on the **urgency to identify faster ways to decarbonise the construction sector**, specifically the cement industry. Four avenues for action have been identified so far.

1. Using the future Standardisation Request on cements and the Acquis group to address the low-carbon cements issues raised in this workstream

As mentioned above, a specific subgroup on cement, building limes and other hydraulic binders has been established in the Acquis group. This subgroup will produce a technical report by the end of 2024, to be sent to CEN. This technical report will constitute the core of a future Standardisation request (SReq) on cements, which will subsequently enable the development of European harmonised standards on cements. This or these future standard(s) will also constitute the core of CE marking for the future cements and the demonstration of their compliance with the new Construction Product Regulation.

As this cement subgroup is working on a global framework for the future cement standards and their use or referencing in “application standards” (for instance concrete standards, building standards, ...), it is important that the conclusions and recommendations of this workstream are addressed and analysed by this subgroup. In addition, **this cement subgroup has already gathered important technical expertise**, so it is the best positioned to develop the prerequisite for the future Standardisation request to ensure that this SReq covers the majority, and possibly all, the future low-carbon cements.

The members of the workstream did not identify another technical group necessary to involve; to maintain the coherence of the technical workshops led by the European Commission, they concluded **that the present low-carbon issue has to be addressed by the Acquis cement subgroup**.

2. Questionnaire / survey about innovative cements’ components

There are a very large variety of alternative constituents that can be used in cements to either lower the rate of clinker and therefore the carbon footprint of cements, or even reduce all together the need for Portland clinker (e.g. alternative binder systems and cements using different feedstock).

There are many academia works to characterise the possibility of using such constituents (the so-called SCM or “supplementary cementitious materials”), which can be for instance biomass ash, coal fly ash, calcined clay, recycled concrete fines or steel slag; in addition, use of materials like limestone, pozzolanic materials can also be optimised. The ability of these different constituents to be used depends of **their predictable availability, their “acceptability” by the concrete stakeholders and their compatibility with the intended use of concrete and cement and their compatibility with the needed guarantee of the long-term durability and mechanical performance of cements, and therefore the long-term durability and mechanical performance of concretes and different applications** (buildings, civil works, ...).

Given the variety of innovative constituents and the need to have a better understanding of their intended use by the construction sector stakeholders, members of the workstream believe it would be useful to conduct a questionnaire/survey among stakeholders from the construction sector and/or standardisation (cement manufacturers, concrete manufacturers, building or civil works actors, research scientists, for example).

Firstly, such a survey could provide a clearer view of the intended use of these new constituents, and thereby, give factual elements on the prioritisation of standardisation works related to the different categories of alternative constituents.

Secondly, the survey could allow the stakeholders to report points of concern regarding the possible challenges on durability or mechanical performance on cements that some families of constituents could raise, and, possibly, any specific additional characterisation or test needed to ensure that a specific family of constituents can be used in cement, in the framework of a performance-based approach concerning the cements’ standards.

As the Acquis’ cement subgroup has a task or milestone planned to identify the different components to be dealt with in the elaboration of the future SReq, members of the workstream believe that the **cement subgroup should issue the questionnaire or incorporate the specific points above if a questionnaire or a survey is already planned.**

It is worth noting that a project entitled SuStaCEM (proposal for topic 26 – SMP – STAND-2023-ESOS-02-IBA Standards for low-carbon cement) will probably cover in one of its Work Packages the identification of promising new constituents. The activity is expected to start as soon as the Grant Agreement will be finalised, maybe Q2 2024. Also relevant is the work currently being conducted by ASTM where a performance-based standard for SCMs is in its final stage before adoption (timeline foreseen June 2024), building upon a similar effort carried out by academia and industry actors.

3. Introduce more flexibility in the processes and in the perimeter of the future Standardisation Request, in order to facilitate the elaboration of European harmonised standards covering existing or future low-carbon cements

The development of a European standard intended to become a harmonised standard cited in the OJEU requires that this standard is “requested” by the European Commission to one or several ESOs, through a “Standardisation request”.

As low-carbon cements are a very innovation intensive domain, many compositions are developed by the manufacturers and therefore a very diversified list of constituents can exist with varying rates of use of these constituents in the cements to be launched in the market.

As the innovative use of alternative constituents grows, in a continuous innovation context, some of the innovative cements can be “out” of the framework planned in a standardisation request. In that case, unless a new standardisation request is developed, a long process, these new cements cannot be addressed by a harmonised standard: even if the CEN develops a standard dealing with these cements, they will not be cited in the OJEU.

For example, the standard EN 197-6 is “out” of the scope of the existing SReq, so it is currently a classical EN standard, not a harmonised standard, although the stakeholders would benefit from its citation as a harmonised standard, to have the benefits of a harmonised standardisation, the CE marking, ...

The questions raised above apply to cements as well as hydraulic binders, which we will refer to collectively as binders in what follows.

Members agreed (i) that it would be beneficial to introduce more flexibility to cover as wide a range of binders (cements and hydraulic binders) as possible (ii) to introduce flexibility in the access-to-market process for binders (CE marking through standards or ETA); (iii) that the new Construction Product Regulation (CPR) relies on a performance-based approach ; (iv) that a product not covered by the upcoming standardization request can be placed on the market through an ETA process.

In view of the possibly wide range of binders involved, the standardization request will likely have to restrict to a limited scope of products. Members agree that this scope should be as large and capable to evolve as possible.

ECOS points out that a too narrow scope of the SReq will have the effect to treat the various binders applying for market access differently. ECOS suggests no limitation should appear in the scope of the SReq itself in order to encourage innovation.

The details of this new flexibility in the SReq process could be discussed with the experts of the Acquis group.

Moreover, it is important to ensure that the concrete related standards and the construction related standards will appropriately account for the low carbon cements and the related standards. There is a lack of harmonised approach which should be dealt with. Final acceptance by users is a fundamental issue.

4. Introduction of a performance-based approach for durability matters and performance-based standards, that could help to have more flexibility in the use of innovative components in the future cements

Given the great variety of alternative constituents – including non-Portland based systems – as well as SCMs that the cement manufacturers could use in the future, in order to have standards covering as many cements as possible, the members of the workstream consider that the development of “performance-based” standards could be beneficial.

Concerning the development of standards on cements (and possibly on concretes), two approaches exist, and two different kinds of standards can be developed:

- “Composition-based standards”: the cement standard indicates, for a specific list of possible constituents, the upper and lower limits of the rate of these constituents in the cement; for example, this is the case for the current standardised common cements for which the properties into concrete are perfectly known after decades of experience.
- “Performance-based standards”: the cement standard indicates which performance has to be reached for different concrete application to guarantee its durability for instance. For example, any standardised constituents could be used without any specific limits of rate, provided that the cement meets the performance level set in the performance-based standard.

Even if it is possible today for manufacturers to introduce some innovative or alternative constituents in the existing European standardisation framework, using for instance the guidelines provided by the technical report TR 16912 published by the CEN TC 51, members of the workstream agreed that the development of a performance-based standard could facilitate and accelerate the use of a wider

diversity of products and constituents, and, therefore, facilitate the market launch of cements with lower carbon footprint.

In other words, the development of performance-based cement standards could accelerate the European standardisation system ability to cover a wider variety of lower carbon footprint cements. Consequently, provided that these future standards are referenced appropriately by the concrete standards and other construction sector standards, it could also facilitate the use of these new cements by all the stakeholders and the overall decarbonization of the construction sector.

Beyond the above distinction between composition-based and performance-based approaches, two other important elements are worth highlighting:

- The CPR (old and new) prescribes a performance-based approach. Therefore, any future standardisation request should be assessed against this wider legal context.
- A shift in standards approach might potentially impact the European standards framework and the activity of construction sector’s stakeholders. Such dynamic, however, has not been seen in markets outside Europe (countries with different technical and legal concerns) that successfully shifted to an entirely performance-based approach³.

The performance-based approach could be implemented following some prerequisites such as:

- Being accompanied with a mechanism related the verification of performance and durability of concrete that will use these cements. CEN is drawing attention to practical implementation.
- Need to make sure that transparency on cement composition is mandatory

To date, the members of the workstream did not reach a consensus on the implementation of this fourth avenue for action, so the different questions are listed in the 4th part of this document.

IV. Open questions

This part lists some open questions, for which the members of the group have yet to reach a complete consensus.

The elements and consequences (advantages / drawbacks) of the different alternatives could provide food for thought to the Acquis’ experts and the reflections initiated in this workstream could be pursued in the cement sub-group, with all the relevant stakeholders.

Q1: is a global / unrestricted shift towards performance-based standards feasible / desirable or will it have to be progressive or focused on some new kind of constituents, through a well-established methodology for their characterization?

³ <https://ecostandard.org/publications/international-performance-based-cement-concrete-standards/>

Provided a European performance-based standard is available in the future, the members of the workstream have yet to reach a consensus on the concept of “eligibility” of a constituent in the future. In other words, the question is: Is the notion of eligibility of constituents compatible with the performance-based approach (for instance, through mechanisms like ‘allow list’ and/or ‘exclude list’)? or does a performance-based approach implies the absence of any kind of restrictions concerning the constituents a manufacturer use in the cement he’s putting on the market?

<p><i>Global shift towards a performance-based approach. In particular, no restrictions about the constituents used by the manufacturers, provided they allow the cement to meet the performance and durability requirements mentioned in the standard and legal frameworks in place</i></p>	<p><i>Progressive elaboration of a list of constituents / families of constituents eligible for performance-based approach, after characterization of their chemistry with cements</i></p>
<p><i>Advantages</i></p>	<p>Facilitate and accelerate the test and use of any kind of constituent; therefore, facilitate and accelerate the market launch of various types of cements</p> <p>Allow the absence of any kind of limitations concerning the innovation in terms of SCMs and low-carbon cements</p> <p>Given that a performance-based approach will allow the manufacturers to use any constituents (given they respect the overall performance and durability target for cement), it will allow the European standardization framework to address a greater number of cements and compositions of cements</p> <p>It should be pointed out that we are not starting from scratch in terms of performance-based-approach tests for concrete durability. Tests are available at European level and RILEM (International Union of Laboratories and Experts in Construction Materials, Systems and Structures) has advanced work streams to develop tests for verification of performance and durability of concrete.</p> <p>Could facilitate the long-term evolution towards performance-based approach, for the existing and new actors</p> <p>Will facilitate a step-by-step approach, firstly with the best known and most common constituents, and secondly with SCMs being identified as promising / hopeful</p> <p>Could allow quickly the availability of a performance-based standard, covering the SCMs that don’t represent a specific “challenge” in terms of chemistry with cements, and therefore, could help to develop the confidence in performance-based approach</p>

	<p><i>Global shift towards a performance-based approach. In particular, no restrictions about the constituents used by the manufacturers, provided they allow the cement to meet the performance and durability requirements mentioned in the standard and legal frameworks in place</i></p>	<p><i>Progressive elaboration of a list of constituents / families of constituents eligible for performance-based approach, after characterization of their chemistry with cements</i></p>
<p><i>Drawbacks</i></p>	<p>A perfect knowledge of the mechanisms at the origin of long term (10 y – 100 y) performance is necessary to mitigate the risk of emergence of new pathologies in case of use of new constituents. .</p> <p>Identification of responsibilities in case of disputes is another reason to require information on binder composition A declaration of composition will be necessary to ensure transparency as regards chemical hazards.</p> <p>Long tests could have an impact on the conformity assessment framework. Today : 28 days is the longest duration in practice</p> <p>Complexity to set up a new framework that is easily embraced and implemented by stakeholders</p>	<p>Could appear like a “false” performance-based approach</p> <p>Needs to elaborate a process related to the “eligibility” of constituents, allowing a quick and efficient widening list of allowed constituents, without undue delay concerning the use of alternative innovative constituents.</p> <p>Significant risk that legal risks as well as speed of standardisation will come at the expense of clean tech innovations, especially in comparison to non-EU markets</p> <p>Long performance tests to create a list of eligible constituents, and then long performance tests for each new cement type. They could be beneficial but could have an impact on the conformity assessment framework.</p> <p>Risks creating a lock-in of only Portland-cement based cements.</p> <p>Complexity to set up a new framework</p>

Q2: can the introduction of performance-based standards be focused on new products only or will it have to replace any standards already covering cements?

	<p><i>Elaboration of performance-based standard only for the new cements (existing EN 197-x cement standards could stay unchanged for a while, unless the stakeholders identify a need for revision)</i></p>	<p><i>Elaboration of performance-based standards intended to address all the existing and future cements (existing cement standard EN 197-x to be withdrawn when the future performance-based standard is available)</i></p>
<p><i>Advantages</i></p>	<p>Unchanged standardisation framework and unchanged referencing for existing cements and the different application standards (concrete, buildings, ...). Stability of the system. The performance of existing products in the current framework is already well-known, works well and do not need additional requirements and extra tests.</p> <p>The elaboration of a performance based standard for new cement could be beneficial to get more confidence in the real performance of the product. It could be also a way to reduce the risk of emergence of new pathologies due to insufficient experiences.</p> <p>Relying on the current framework with necessary moderated adaptations to fulfill the new CPR is possible while preparing a new performance based approach.</p> <p>Final users can take benefit of wider possibilities, relying on the most appropriate depending on local constraints, material availabilities and construction regulations. In all cases, it will be mandatory for all products to provide environmental requirements which will be beneficial in particular for Green Public Procurement.</p>	<p>Unique framework for all existing and future cements</p> <p>Incentive to all stakeholders to build a robust performance-based standards framework, allowing a similar referencing of existing and future cements in the different application standards (concrete firstly).</p>
<p><i>Drawbacks</i></p>	<p>Coexistence of performance-based standards and composition-based standards, possibly leading to different or unequal or inconsistent requirements as seen in other markets</p> <p>Additional complexity for wider value chain, due to the coexistence of i) the</p>	<p>Need to rewrite existing EN 197-x series of cement standards, which will be a long process</p> <p>Unuseful addition of requirements and tests for existing products.</p>

<p><i>Elaboration of performance-based standard only for the new cements (existing EN 197-x cement standards could stay unchanged for a while, unless the stakeholders identify a need for revision)</i></p>	<p><i>Elaboration of performance-based standards intended to address all the existing and future cements (existing cement standard EN 197-x to be withdrawn when the future performance-based standard is available)</i></p>	
	<p>performance-based standards, ii) the composition-based standards and iii) the European Technical Assessments framework. This negatively affects the potential of other instruments such as Green Public Procurement and brings complexity</p> <p>Risk of buying habits remaining unchanged, the new standards being unused</p>	

Q3: identify the most efficient way to associate concrete (and possibly other application) stakeholders to the ongoing reflections

The most efficient and operational way to involve concrete stakeholders in the ongoing reflections is yet to be identified. It could potentially include for example an ad-hoc meeting with CEN TC 104 on concrete, a questionnaire / survey sent to TC 104 members to identify their prerequisites concerning the use of performance-based standards.