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USE OF SECONDARY RAW MATERIALS IN THE EU CEMENT INDUSTRY

QUESTIONS & ANSWERS

The use of secondary raw materials provides significant opportunity to decarbonise the EU cement industry whilst applying a circular approach and minimising waste. With this in mind, CEMBUREAU and its members proactively communicate on the key role such secondary materials can play in cement production, to communities and policy makers at both local, national and European level.

This Q&A document aims at providing an overview of the industry's understanding of the role of the secondary materials and the state-of-play of their deployment in the sector.

1. Which type of secondary materials are used in the clinker / cement / concrete manufacturing?

The secondary materials used in the cement industry are:

Alternative raw materials (ARM), which are defined as waste materials or by-products from other (mainly industrial) processes or societal sectors and used in clinker production to substitute natural raw materials. Typical wastes used as ARM in the clinker burning process include fly ash, as well as used foundry sand and residues from the iron and steel manufacturing industry.

Supplementary cementitious materials (SCMs) are natural materials (limestone, pozzolans, calcined clay, etc.) or by-products from other industrial processes (blast-furnace slag, fly ash[1], silica fume, etc.) and recycled concrete fines that can replace clinker in the cement production or can contribute to the properties of hardened concrete through hydraulic or pozzolanic activity in the concrete production.

Secondary materials are also used to substitute virgin aggregate in concrete production resulting in significant circular economy benefits, however the focus of this paper is on clinker and cement production.

The use of secondary materials (ARMs & SCMs) is crucial to the cement and concrete industry in Europe and plays a key role in achieving carbon neutrality by 2050, as set out in the CEMBUREAU 2050 Carbon Neutrality Roadmap

[1] Fly ash and blast furnace slag can be used as both ARMs and SCMs depending on their properties and origin.

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2. What are the benefits of using ARMs and SCMs? What are the cement industry's objectives when it comes to ARMs and SCMs?

The use of secondary materials is crucial to the cement industry in Europe and plays a key role in achieving carbon neutrality by 2050. They allow to significantly decarbonise cement production, notably by reducing the clinker-to-cement ratio – a key element as clinker is the most CO2-intensive part of cement production. Furthermore, the use of ARMs and SCMs is fully circular, as some of these products are wastes or by-products from other industries.

In terms of objectives, when it comes to the use of ARMs, CEMBUREAU envisages up to a 3.5% reduction of process CO2 using decarbonated materials by 2030 and up to 8% reduction by 2050. Concerning the use of SCMs and with regard to the clinker-to-cement ratio, CEMBUREAU targets to move from an average of 77% to 74% clinker in cement by 2030 (which corresponds to a reduction of 5 million tonnes of natural raw materials used for the EU cement production per year) and to 65% by 2050 (reduction of 20 million tonnes of natural raw materials per year).

3. If using ARMs has a positive environmental impact, what steps are you taking to use more ARMs?

The EU cement industry is constantly looking at using more ARMs.

In 2020, the average EU ratio of ARMs to natural raw materials for clinker production was 4.2% which corresponds to about 7.6 million tonnes of waste and by-products being used in the cement industry. Part of this volume was made of **decarbonated materials**, i.e., materials that contain in their composition calcium oxide (CaO). These decarbonated materials contribute significantly to the reduction of CO2 emissions. In 2020, at EU level, the use of decarbonated materials avoided more than 350 kilo tonnes of CO2 emissions.

The use of ARMs requires access to significant volumes of materials of suitable quality. In addition, the compatibility of the chemical composition of these materials with the clinker and cement chemical composition needs to be closely monitored as all the inorganic part of the ARM is incorporated to the clinker structure and finally in the cement product. The quality control department of the cement plant is responsible for the assessment of the ARM and for performing the laboratory tests to ensure the required criteria.

An additional important factor is the strong variation amongst the plants in terms of geographical availability of ARMs. As part of its 2022 study on alternative raw materials, CEMBUREAU assigned the European Cement Research Academy (ECRA) to carry out an inventory of the use of all secondary materials in clinker, cement and concrete production in 7 European countries. The picture is quite diverse, with many parameters having an influence[2].

The country which is most advanced in this field is Austria, where the ratio of Alternative Raw Materials to Natural Raw Materials for the clinker production was 15%, several times higher compared to the EU average. Austria has been strictly following the EC Landfilling Directive for many years already and has established an advanced waste management system which assures the collection, sorting and fractioning of waste. In the Austrian cement sector, a wide range of alternative raw materials are

[2] https://www.cembureau.eu/media/ez5mwmpq/220502-ecra-alternative-raw-materials-study.pdf

used, the majority of which are waste ceramics, tiles and bricks. These are not used to the same extent in any other European country.

As explained above, CEMBUREAU has set very ambitious targets in its Carbon Neutrality Roadmap and envisages up to a 3.5% reduction of process CO2 emissions by 2030 and up to 8% reduction by 2050 by using decarbonated materials. Thus, CEMBUREAU believes that there is currently a really excellent opportunity for a cross-sectoral approach for finding new waste materials and by-products which could replace some of the limestone and contribute to the CO2 emissions avoidance.

4. What about the use of SCMs? What steps are you taking to reduce the clinker-to-cement ratio?

According to the European Cement Research Academy (ECRA) study, prepared on behalf of CEMBUREAU, a reduction of the clinker to cement ratio requires[3]:

- in the short-term, access to SCMs, which varies considerably across the EU. For instance, some countries and cement plants benefit from a higher SCM access due to their proximity from other industries such as steel and coal.
- identifying new suitable materials to reduce the clinker to cement ratio – indeed, the "traditional" SCMs blast furnace slag and fly ash are expected to decline with the decarbonization of the steel and power sectors. It is therefore necessary to look at other SCMs to be integrated in cement production.
- In addition, cement operators need to carefully assess the impact of clinker substituting materials on the cement and consequently on the concrete qualities.
- Standardisation also plays a facilitating role accompanying our efforts to lower the clinker-to-cement ratio. The European cement sector has indeed been affected by the blockage of the harmonised standardisation process at the EU level, which resulted in a delay in placing new lower carbon cements on the market. The situation has led the sector to explore a non-harmonised route for developing the new standard EN 197-5, which will allow the penetration of lower carbon cements in the EU market to contribute to the decarbonisation of the construction value chain through 2050. A new non-harmonised standard EN 197-6 is in the decision phase. Solutions to get the harmonised system working again would help achieve lower clinker-to-cement ratios.
- Finally, it is important to remind that a typical time period for the technical dossier and the adequate quality assessment of new materials need 4-5 years for the non-harmonized standard preparation.
- Public policies at EU and national level also play an important role for the availability of SCMs (please see question 6).

5. What are your concrete ambitions and plans to use more SCMs and to reduce the clinker-to-cement ratio?

According to CEMBUREAU's Carbon Neutrality Roadmap the EU clinker to cement ratio will reduce from an average 77% in 2017 to an average 65% in 2050. In carrying out these reduction efforts, the industry will need to continue and accelerate the exploration of alternatives for the two major

[3] https://www.cembureau.eu/media/ez5mwmpq/220502-ecra-alternative-raw-materials-study.pdf

replacements (granulated blast furnace slag and fly ash from coal fired power plants). The cement industry is conscious that the phase-out of coal fired power plants will limit the supply of fly ash (currently 10% of total substitutes) and the decarbonisation of the steel process might decrease the availability of blast furnace slag (currently 33% of total substitutes).

Already today, a large share of the total substitutes are natural pozzolans, limestone or burnt oil shale and non-traditional substitutes such as calcined clay and silica are being assessed. Further research is ongoing to look at other materials which could be used in the future such as pozzolan materials from waste streams and slag from other industries. Depending on national legislation and market conditions, these substitutes can also be added at the concrete manufacturing stage.

At CEMBUREAU we are convinced that a better standardisation process for new cements based on performance indicators in combination with the existing standardisation process will have an encouraging effect on the markets. Cement companies and R&D institutes are focusing their efforts on substitution of clinker in cement with new materials like calcined clay and concrete fines. Other materials, sometimes only regionally available, are being investigated.

6. What are the successful policies at EU and national level to further increase the of ARMs and SCMs?

A central part of the EU's Green Deal is the Circular Economy Action Plan, published in March 2020, which focusses on improving recyclability and re-use of products to reduce the overall amount of waste. The Action Plan provides an opportunity to support the review of EU waste policy to ensure greater circularity throughout the EU economy. Complementing the Action Plan, CEMBUREAU believes that:

- Waste landfilling should be either banned across the EU or highly taxed by Member States and the export of waste outside of the EU should be minimized.
- An EU-wide harmonized model for separate waste collection could simplify waste management, improve efficiency of resource flows and ensure better access to secondary materials for business.
- Financing the high investments needed for the unimpeded ARM supply and substitution.

Furthermore, the national standardisation of new cements, e.g., via European Technical Assessment (ETA) is an important lever. At regional level it is important that the permitting application is facilitated so that cement plants are able to perform tests with new materials and use them in clinker and cement production.

7. Some EU companies already have a considerably lower clinker in cement ratio. Why are such targets not achievable across the EU cement industry at this point in time?

Indeed, some companies use significant volumes of clinker substitution materials, particularly through joint ventures with steel companies to provide blast furnace slag as an alternative way to reduce the clinker-to-cement ratio. CEM-III C, which in some EU countries is seen as a normal cement, already has similar clinker-to-cement ratios as these products. It is very important to consider that such solutions are not scalable as the limited availability of SCMs is not sufficient to have a significant contribution to the majority of the cement products in Europe.

8. Why is the clinker-to-cement ratio in the EU higher than in a country like India?

An absolute comparison of India and the EU is misleading, because one needs to consider the specific conditions in each region.

The objective in cement manufacturing is always to secure a robust performance at the construction site. However, the cement standards which are used to assess the performance of the cement (including the clinker-to-cement ratio) are not uniform worldwide. The Indian BIS cement standard differs in several aspects from the European EN or the American ASTM cement standard. Obviously, the Indian cement standard is adapted to the Indian conditions with respect to the market, available materials, and ambient conditions. This results in significant differences with regard to the fineness, the electrical consumption of the cement grinding as well as to the cement content per cubic meter of concrete and the respective water-to-cement ratio. Overall, despite the Indian clinker-to-cement ratio being lower than in the EU, the cement content per cubic meter of concrete for comparable concrete products is higher. Consequently, to have a meaningful assessment of the carbon footprint, it is necessary to consider the impact of the whole value chain (clinker-cement-concrete manufacturing).

9. What could be the impact on the public health of the use of secondary raw materials in cement manufacturing?

Ensuring health and safety for employees and stakeholders is one of the most important priorities of the cement industry. The use of ARMs & SCMs in the production process is performed in full respect of EU and national legislation.

The framework for the use of alternative raw materials in the cement production process consists of a wide range of controlling and monitoring measures. These measures cover the legally foreseen approval of the technical knowledge and the reliability of the plant operator, the precondition that the installation must comply with the approved technological state of the art as well as the high national standards for the protection of the neighborhood. For example, in Austria already in the year 2016, technical guidelines for the use of alternative raw materials in installations for the production of cement have been developed. These guidelines follow a precautionary principle under which the use of alternative raw materials is subjected to certain limit values for chemical elements in the respective raw materials and additional provisions for the use of raw materials with organic content. Furthermore, strict requirements for the process of sampling and analyzation of the respective materials and specific conditions for the location of their feed into the kiln, the minimum temperature required, and the admissible amounts have been developed. With this overall framework health and safety for employees and stakeholders as well as high environmental standards is guaranteed.

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