european cement research academy

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NEWSLETTER

Contents

Next ECRA events:

- Alternative Fuels: Quality Surveillance and Impact on the Production Process
  6–7 April 2016

- Emissions Monitoring
  7–8 June 2016

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The use of alternative materials in the European cement industry

Legal requirements, quality surveillance and impacts of the use of alternative fuels

Over the past decades the use of suitable alternative materials has been an issue of growing importance for the European cement industry. The recovery of alternative fuels has increased from around 2.5 % in 1990 to approximately 39 % of the overall fuel energy demand in 2015. CEMBUREAU's low-carbon roadmap states that this level should be increased further to approximately 60 % by 2050. Moreover, the increased use of suitable alternative resources fits very well into the European Circular Economy Package which was published on 2 December 2015 by the European Commission. Alternative fuels are subject to very sophisticated quality assurance systems. Both an environmentally safe and sound operation of the production process and suitable product quality are therefore safeguarded.

Despite the advances in both the recycling and cement industries in Europe, large quantities of valuable resources still end up in landfill, resulting in lost revenues and opportunities. Currently, it is estimated that more than 9 million tons of plastics alone end up in European landfills every year. By contrast, cement kilns around Europe provide an opportunity to increase the use of alternative fuels. The European cement industry could therefore make a valuable contribution towards the increased use of suitable resources. Moreover, the clinker burning process offers a unique opportunity for the simultaneous recovery of energy and the recycling of resources. The co-processing of alternative materials therefore also fits excellently into the umbrella term "resource efficiency" used by the European Commission to describe material and energy efficiency (**Fig. 1**).

Legal requirements

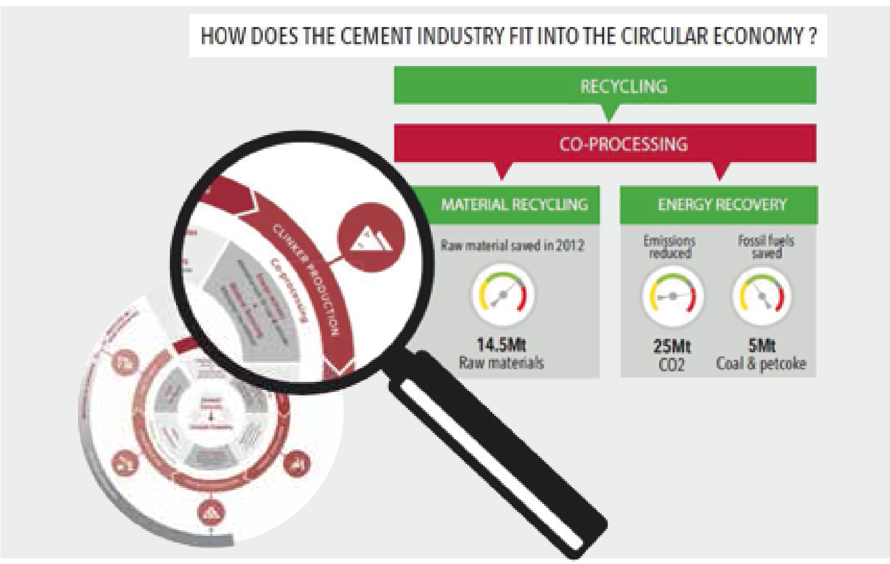
Cement kilns in Europe recovering waste as a fuel are subject to the European Directive on Industrial Emissions (2000/75/EU). Besides the general requirements on the environmentally reliable operation of an industrial facility, annex VI of the Industrial Emissions Directive (IED) covers the requirements on dedicated waste incinerators and so called co-incineration plants (i.e. industrial facilities such as cement kilns using alternative fuels). This means that co-incineration plants have to be operated according to the same environmental standards as dedicated incinerators. The idea of continuous control and monitoring of the emissions of the respective industrial facilities is also aimed at by the IED, specifically in annex VI.

In most cases, a specific pre-treatment of the waste intake material has to be carried out in order to provide a suitable alternative fuel for the clinker burning process. Over the past years, the cement industry has developed suitable pre-treatment procedures, often in co-operation with waste management companies. These comprehensive and sophisticated processes allow even mixed waste streams to be converted into high quality alternative fuels (**Fig. 2**). In this context, it is very advantageous if quality control and testing procedures are incorporated directly into the waste pre-treatment procedures.

A continuous monitoring procedure aimed at controlling the quality and characteristics of the alternative materials is also an essential pre-requisite for a continuously high substitution rate. The monitoring should cover the following three major aspects (**Fig. 3**):

- parameters concerning the production process
- parameters concerning the environment
- parameters concerning the product quality

For the production process the combustibility and the particle size and shape are very important. Moreover, the moisture content and the calorific value have to be taken into consideration. Additionally, the chlorine and sulphur content play a decisive role in the production process. The feeding behaviour and questions related to the storage of the materials on site also have to be carefully considered. From an environmental point of view, the content of heavy metals such as mercury, thallium and cadmium is a particularly important aspect. Due to legal constraints (cf. the IED), normal-



Source: CEMBUREAU

Figure 1: The role of co-processing in the circular economy

Source: ELM Recycling

Figure 2: Example of a modern pre-treatment facility

Alternative fuels have to meet specific requirements

Alternative fuels have to meet specific requirements such as:

- calorific value
- chlorine and sulphur content
- ash content
- trace elements

Suitable alternative fuels have to meet the necessities of:

- the process
- the environment
- the product (strength, durability, environment)

Figure 3: Major requirements on alternative fuels

ly many more trace elements have to be analysed in order to characterise the suitability of an alternative fuel. These data are normally set down in the respective permits. Concerning the product quality, the ash content and the actual composition of the ashes play a very decisive role. In this context, once again sulphur and chlorine have to be taken into account. Moreover, the burning behaviour can at least indirectly influence the product quality. Material which is going to be fed via the main burner should be burned completely before falling down onto the clinker in the kiln. In such cases, the quality could be affected by local reducing conditions in the kiln.

Health and safety aspects

Co-processing in the cement industry does not normally have any negative health and safety impact for the workers on site or for the surroundings. In order to guarantee this, it is important that pre-treatment processes are already targeted at reducing occupational health and safety risks which might derive from waste fuels in general. The storage and feeding systems also have to be adapted to the specific characteristics of alternative fuels in order to avoid spill over, self-ignition or any other potential risk to the environment.

Circular economy

Co-processing is unique to the cement industry. Specifically, the European cement industry has already achieved a very high replacement level of fossil fuel and primary raw materials. This can be regarded as a competitive advantage for Europe. Furthermore, the idea of co-processing and the simultaneous use of materials and energy content corresponds excellently with the major targets of the new European circular economy strategy. It should therefore be taken for granted that co-processing will be properly recognized in future regulation and guidance documents as a unique opportunity for the preservation of natural resources.

Current developments in emissions monitoring

Recent changes and advances in the field of continuous and periodic emissions testing.

There have been several developments in emissions monitoring in recent years, most notably with the introduction of the Industrial Emissions Directive (IED) 2010/75/EU of the European Parliament and the Council on industrial emissions and a revision to EN 14181, "Stationary source emissions. Quality assurance of automated measuring systems".

The IED entered into effect in January 2011 and had to be transposed by all Member States by January 2013. This new document supersedes seven previous Directives, including the Large Combustion Plant Directive (LCPD) and the Waste Incineration Directive (WID). The main aims of the IED are to protect human health and the environment by reducing harmful industrial emissions across the EU. In order to achieve this, an integrated approach, incorporating the application of Best Available Techniques (BAT), greater flexibility, inspections and public participation will be utilised. This integrated approach not only covers emissions to air, but also other aspects of the environmental performance of the plant; from emissions to land and water to waste generation, energy and raw material usage and even restoration of sites once they have been decommissioned.

BATs and BREFs

Emission limit values are based on Best Available Techniques (BAT). In order to clarify the BATs, 29 industry-specific BAT Reference Documents (BREFs) have been drawn up through cooperation between various bodies of experts and operators within the Member States. Permit conditions are then set in accordance with these BAT conclusions. Through the IED and the European Pollutant Release and Transfer Register (E-PRTR), the public has the right to access information about permits and any results of emission monitoring campaigns carried out by industry.

Standard reference methods

Alongside the implementation of the IED there have been numerous amendments to existing standard reference methods and the introduction of several new European standards. Of these and of most relevance to the cement industry are EN 14791 (oxides of sulphur), EN 14792 (oxides of nitrogen), EN 15058 (carbon monoxide), ISO 15713 (hydrogen fluoride), EN 14789 (oxygen), EN 14790 (water vapour) and EN 16911 (velocity and volumetric flow).

Figure 1: Multi-component device setup.

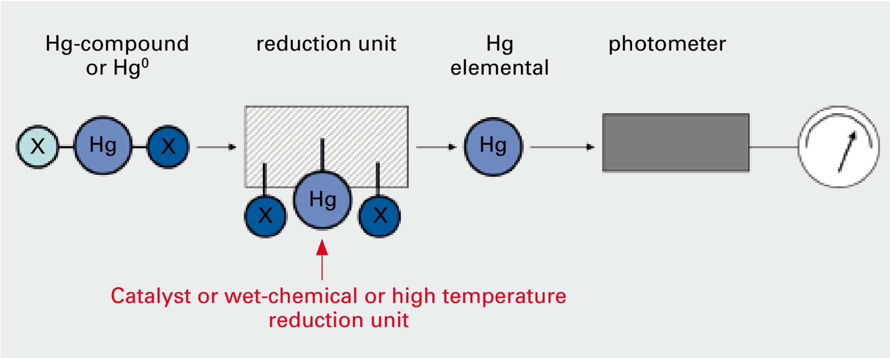


Figure 2: Principles of continuous mercury monitoring

Figure 3: Periodic sampling systems

Also of great importance was the publication in November 2014 of a revised version of EN 14181 (Quality Assurance of Automated Measurement Systems). After ten years of working with the standard and after feedback from many sectors of industry, the standard was reviewed and amended to incorporate changes such as: a new method for when pollutant concentrations are so low that it is not possible to verify the performance of the AMS (reference materials, along with test data from the QAL2, can now be used); the identification and reporting of outliers and a reduction of the required number of QAL2 test points where circumstances dictate; greater flexibility for carrying out QAL3s in relation to the development of control charts; expansion of functional check and QAL2 requirements for the reference parameters oxygen and water vapour.

Updates were also made to guarantee consistency with other standards such as EN 15267 (Air quality. Certification of automated measuring systems. Performance criteria and test procedures for automated measuring systems for monitoring emissions from stationary sources) and EN15259 (Air quality. Measurement of stationary source emissions. Requirements for measurement sections and sites and for the measurement objective plan and report).

The role of CEMs

Since the introduction of the original EN 14181 document in 2004 there has been significant growth in the use of continuous emission monitors (CEMS) or automated measurement systems (AMS). Where previously it was sufficient to monitor for just dust, NO_x and SO_x, the implementation of the IED now focusses on additional components such as TOC, CO, HCl and HF. Therefore, there is a growing trend within the cement industry to install multi-component gas analysers. Many systems, for example those based on the principle of Fourier transform infrared spectroscopy (FTIR), are able to measure a huge range of different stack gas components and as such offer a certain amount of "future-proofing" which proves very attractive to potential operators, especially when considering the capital costs of installing a measuring system. As the requirements of legislation evolve over time, such systems can easily accommodate any changes in measurement scope that may be required. **Fig. 1** shows a typical multi-component device setup.

Much work has also been done on the application of continuous mercury monitoring devices in the cement industry. Although the use of such instruments poses substantial challenges, not least in terms of long-term stability and maintenance, a huge amount of progress has been made in recent years. **Fig. 2** illustrates the principles of continuous mercury monitoring.

Periodic sampling techniques

Periodic sampling techniques have also undergone many changes in response to ever-stricter emission controls and the growing necessity for using such methods in the calibration and verification of AMS. Refinements include changes to the number of in-stack sample points, sample storage and transportation, blank sample values, measurement uncertainty calculations, laboratory detection limits and emission limit values. **Fig. 3** depicts examples of the types of equipment used in periodic sampling.

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