european cement research academy

Next ECRA events:

- Trends in Secondary Abatement Techniques
  20-21 June 2013
- Continuous Emission Monitoring
  10-11 September 2013

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NEWSLETTER

ECRA celebrates its 10th anniversary

It is now ten years since a small group of representatives from the cement industry took the initiative to found ECRA with the aim of creating a completely new European platform to communicate and exchange the latest research findings in cement and concrete technology.

ECRA now has over 45 members worldwide, and as we enter our next decade we remain more committed than ever to continuing our success in creating and disseminating knowledge from research, and, in the long-term, to facilitating and accelerating innovation in the cement industry.

From the beginning, ECRA has placed a strong focus on offering seminars and workshops presenting the latest research findings on technology developments. Over the past ten years we have provided nearly seventy such seminars and workshops which have taken place in numerous different countries. Many guest lecturers have contributed with their expertise, and many member companies have made it possible for seminar participants to visit their cement plants. Most of all, the participants themselves from all over Europe and even further afield ensure that each ECRA seminar and workshop is a truly international event.

It has also always been the Academy's clear aim to encourage research and even undertake its own research projects on issues which are of general importance to the industry as a whole. The dominant project in this respect is without doubt ECRA's CCS project on CO_2 capture and storage, which started in 2007 and has recently begun its fourth phase.

At this special milestone in our history we would like to thank our members and the research institutes, universities and other external partners who play a part in ECRA's success through their cooperation and support of its work.

CO_2 to Energy: ECRA collaborates with the University of Mons

New academic chair will create a centre of scientific expertise in the field of carbon capture and re-use in cement production

On 24 April 2013 ECRA and the University of Mons (UMONS) in Belgium signed a significant agreement to enable the establishment of an academic chair entitled "CO_2 to Energy: Carbon Capture in Cement Production and its Re-use".

Since 2007 ECRA has been examining the technical and economic feasibility of CCS technology as a potential application in the cement industry, laying particular emphasis on the global perspective of its research and also on the aspect of sustainability.

UMONS, within the framework of its Research Institute for Energy, has for several years been developing multidisciplinary and applied research activities related to carbon capture and storage, as well as more generally to absorption and adsorption techniques for the gas separation and purification in industrial applications.

Now ECRA and UMONS have joined together to create the new chair within the University, which will be financed by ECRA. The main objective of the chair is to create a centre of scientific expertise in the specific field of carbon capture and re-use in cement production, and to promote research and innovation. It will support research activities by financing fellowships for postdoctoral researchers or PhD students, visiting professors and experts. Graduate students will also be associated with the scientific activities of the chair within the framework of masters' theses and internships.

Professors and researchers from UMONS will share their scientific expertise with experts from ECRA, who will contribute their own expertise and provide funding for the chair's activities. A scientific committee with representatives from ECRA and UMONS will manage the chair's activities and guide its development.

The scientific framework of the chair will contain studies related to CO_2 capture processes applied to the cement industry, and the subsequent potential use of CO_2 as new fuels. A particular research focus will be placed on:

- oxygen production and the subsequent comparison of different production technologies
- flue gas treatment for CO_2 capture, including not only oxyfuel combustion, but also pilot studies and projects on post-combustion technologies
- the re-use of CO_2 which can be achieved by various processes which convert CO_2 into methanol or methane, taking advantage of renewable electrical energy.

ECRA and UMONS celebrate their cooperation. From left to right: Marc Frère (President of the Research Institute for Energy - UMONS), Paul Lybaert (Dean of the Faculty of Engineering UMONS), Daniel Gauthier (Chairman of ECRA), Calogero Conti (Rector of UMONS), Martin Schneider (Managing Director of ECRA).

New environmental legal requirements for the European cement industry

IED and BAT Conclusions document set stricter standards to regulate emissions

European environmental law affects the activities of more than 233 installations producing cement with a total number of around 300 kilns. Over the past decades the European cement industry has continually optimised existing abatement technologies and established new technologies to reduce emissions such as dust, nitrogen oxide (NO_x), ammonia (NH_3), carbon monoxide (CO) sulfur dioxide (SO_2), mercury (Hg) and several organic compounds emissions. As a consequence, significant improvements in air quality and environmental protection have been achieved.

The state of technology requirements and emission limit values in Europe is regulated by the Industrial Emissions Directive (IED). The IED entered into force on 6 January 2011. The Directive unites a total of seven previously separate environmental directives, including the Directive on Integrated Pollution Prevention Control (IPPC) and the Waste Incineration Directive (WID), which have been fundamentally revised in an almost three-year revision process.

New Industrial Emissions Directive

The main objective of the IED is to introduce uniform environmental standards in Europe and, in particular, achieve a better implementation of the so-called Best Available Techniques (BATs). This should provide a higher environmental protection level throughout Europe and also reduce distortion of competition between individual member states as only a few states had fully implemented the provisions of the former IPPCD and WID.

The technical requirements for cement plants using waste as fuels are specified in Annex IV of the Directive. Compared to the former WID the emission limit values have not been significantly modified (see Fig. 1). However, the use of BATs has been strengthened: To receive a permit it is mandatory for IED installations to apply BATs, and the emission limit values (ELVs) must be set within the scope of the so-called "BAT Conclusions" document. The scope for exemptions has been considerably reduced and requires special justification.

Member states had to implement the new IED provisions by 7 January 2013. Regardless of the status of implementation into national law, the provisions of the IED have been in application since 7 January 2013 for new installations and will apply from 7 January 2014 onwards for existing installations.

BAT and the new BAT Conclusions document

The determination of BATs is the result of an exchange of information between EU member states and the industries concerned, the so-called "Seville Process". Its regulations are laid down in the IED. The BATs as well as their associated emission levels (BAT-AELs) are described in BAT reference (BREF) documents which are revised on a regular basis. The BREF document for the cement industry was last updated in May 2010 after a 4-year revision process.

Fig. 1 shows the emission levels determined in the BREF document when BATs are applied compared to the emission limit values of the new IED. As mentioned above, the competent authorities are required to set emission limit values in such a way that the actual emissions of a plant are in the range of these BAT-AELs.

As a reference document for setting permit conditions, the new IED foresees the creation of a BAT Conclusions document for each industry. The cement industry was one of the first sectors for which BAT Conclusions were drawn up and then finally published in the Official Journal of the EU in April 2013 (http://eur-lex.europa.eu/JOIndex.do). Now, within four years of the publication of the BAT conclusions, the local authority has to reconsider and, if necessary, update all permit conditions and ensure that the installation complies with them. With respect to the existing BREF document, the technical contents as well as BAT-associated emission levels have not been altered in the BAT Conclusions.

Trends in secondary abatement technologies: The most challenging issues

In order to comply with the new IED and BAT Conclusions provisions as well as further environmental legal requirements such as the National Emissions Ceiling Directive and the Air Quality Directive, the European cement industry is further developing existing and new secondary abatement technologies. In many cases this requires significant investment in new environmental technology. It will be an ongoing process to technically and economically cope with the present and future environmental challenges.

Daily average values [1]	ELV [mg/Nm³]		BAT-AEL range [mg/Nm³]	
	IPPC / WID	New IED	Old BREF 2001	New BREF 2010
Total dust	30	30	20 – 30 (kiln firing)	< 10 – 20 (kiln firing)
HCl	10	10	–	10
HF	1	1	–	1
NO_x	800 / 500 existing / new kilns	500 (800 possible for long and lepol kilns until 01/2016)	200 – 500	< 200 – 450 (500) [2] (preheater kilns) 400 – 800 (long and lepol kilns)
Cd + Tl	0.05	0.05	–	< 0.05
Hg	0.05	0.05	–	< 0.05
∑ Sb - V	0.5	0.5	–	< 0.5
Dioxins + Furans (ng/Nm³)	0.1	0.1	–	0.05 – 0.1
SO_2	50 raw material exemptions possible	50 raw material exemptions possible	200 – 400	< 50 – 400
Total organic carbon	10 raw material exemptions possible	10 raw material exemptions possible	–	–
CO	ELV can be set by the competent authority	ELV can be set by the competent authority	–	–

[1] For Dioxins + Furans, Hg, metals and in case of spot measurements of HCl and HF: average over the respective sampling period
[2] BAT-AEL is 500 mg/Nm³, where after primary measures/techniques the initial NO_x level is > 1000 mg/Nm³

Figure 1: Emission limit values for cement plants according to the new Industrial Emissions Directive and Best Available Techniques-associated emission levels according to the BAT reference document.

Continuous monitoring of industrial emissions

Ambitious challenges for industrial emissions monitoring through new legal requirements

The implementation of stricter environmental standards in Europe is a major driving force for the latest developments in the field of industrial emissions monitoring. In this context, the Industrial Emissions Directive (2010/75/EU) plays an important role. Based upon Article 13 (5) of this directive, legally binding conclusions on Best Available Techniques have to be implemented, also in the cement industry (Commission Decision 2013/163/EU). Both documents define the future playing field for emissions monitoring in the industry, especially for those plants co-processing waste fuels.

Besides others, an on-going challenge for the European cement industry is the proper and sometimes even continuous monitoring of mercury emissions. Even if the application of mercury CEMs is not yet mandatory under European environmental legislation, it is quite obvious that the cement industry will have to face future tasks in this field.

The continuous monitoring of mercury emissions is extremely challenging as mercury can arise in the exhaust gas of a cement kiln in different bonding forms. Generally, a distinction has to be made between elemental mercury $[Hg^{(0)}]$ and oxidized mercury [Hg(I) or Hg(II)]. Based upon the current state of knowledge, $HgCl_2$ and Hg_2Cl_2 are the most important oxidized mercury components.

The presence of oxidized mercury in general is the major challenge for the proper operation of a continuous mercury monitor. All instruments must be able to completely reduce the mercury components to elemental Hg before the actual online analysis. The UV-photometers used in all devices can only detect the elemental form of mercury $[Hg^{(0)}]$. The complete reduction of the mercury is therefore an essential requirement for a reliable monitoring of the overall mercury emissions.

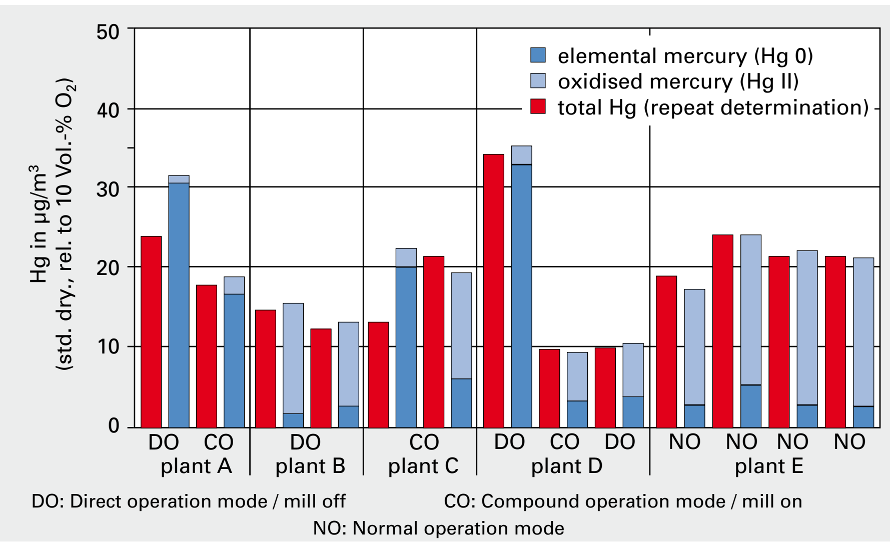
In order to cope with these challenges some plants are applying new mercury CEMs recently presented on the market. These new devices follow two routes towards safeguarding a proper operation of the CEM: In one case a thermal catalytic converter is used. Simultaneously, sample gas dilutionis applied in order to prevent catalyst contamination from occurring. This sample gas dilution also reduces possible cross sensitivity effects with other exhaust gas constituents. Furthermore, some of these devices are equipped with a gold trap in order to improve the overall sensitivity of the device in lower ranges of emission concentrations.

A completely different approach is taken by another, fundamentally new device. This instrument is equipped with a quartz cell which heats the sample gas flow up to a temperature of 1000 °C. At such a high temperature, the mercury in the sample is completely reduced to its elemental form and can be measured directly in the photometer.

Moreover, all new instruments can also be optionally equipped with automatic adjustment devices. This is important as the European Standard EN 14181 asks for a periodic quality control by the operator (QAL3). In this context it is noteworthy that based upon the IED the application of European standards is mandatory even for the calibration of CEMs.

As the bonding structure of mercury and the presence of different components can be decisive for the correct monitoring of mercury emissions, further action has been taken in the recent past in order to differentiate between elemental mercury and emissions of mercury in its oxidised form.

Fig. 1 shows an example of so-called speciation measurements at five different plants. Each speciation set was accompanied by a comparative measurement according to the standard reference method (EN 13211) of the overall mercury emissions. These additional measurements (red bars in Fig. 1) were necessary in order to assess the overall precision of the speciation. It could be clearly shown that there can be a huge variety in the ratio between elemental and oxidized mercury. So far, it has not been possible to establish any relationship between the modes of operation (mill-off versus mill-on) or other operation parameters and the bonding form of Hg in the exhaust gases.



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