Coal Combustion Products in Europe - an update on Production and Utilisation, Standardisation and Regulation -

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ABSTRACT

In 2008, about 59 million tonnes of CCPs were produced in Europe (EU15). The production in all the European members states is estimated to be about 100 million tonnes. The utilisation of CCPs is well established in some European countries, based on long term experience and technical as well as environmental benefits.

Standards or other specifications are subject to regular revision by CEN or national authorities. At present, the European standards EN 450-1 and EN 450-2 are under revision. With their revision a higher share of co-combustion will be regulated. With the revision of the standards for hydraulic road binders (EN 13282) and hydraulically bound mixtures (EN 14227) revised rules for the use of CCPs will be established. With the revision of the aggregates standards also the essential requirements No3 (ER3) regarding environmental issues will be implemented.

The utilisation of CCPs in Europe is being influenced by standardisation and environmental legislation. In December 2010, the Waste Directive had to be implemented in the European member states. By this, each member state had to define which CCP is a “by-product” and when a material will leave the waste status. By December 1, 2010, the producers of CCPs have registered their product according to the REACH regulation. This is the pre-condition to place a product on the market based on new chemical law.

This paper gives an update on production and utilisation of CCPs in Europe as well as on standardisation and regulation.

INTRODUCTION

Coal combustion products (CCPs) are produced with the production of electricity in coal-fired power plants. Coal ash is a synonym for the combustion residues boiler slag, bottom ash and especially fly ash from different types of boilers. These ashes form the major part of all coal combustion products (CCPs) which consist also of desulphurisation products like spray dry absorption product and FGD gypsum.

In 2007, about 61 million tonnes of CCPs were produced in Europe (EU15). The production in all the European member states is estimated to be about 100 million

tonnes. The utilisation of CCPs is well established in some European countries, based on long term experience and technical as well as environmental benefits. The CCPs are mainly utilised in the building material industry, in civil engineering, in road construction, for construction work in underground coal mining as well as for recultivation and restoration purposes in open cast mines. The majority of the CCPs is produced to meet certain requirements of standards or other specifications with respect to utilisation in specific areas.

The use of CCPs has several environmental and technical benefits. It has developed by the years and is based on requirements of standards or other specifications which are subject to regular revision by CEN or national authorities. At present, the European standards EN 450-1 and EN 450-2 fly ash for concrete are under revision. Also under revision are the new revised standards for hydraulic road binders, for hydraulic mixtures, for aggregates and for lightweight aggregates.

The utilisation of CCPs in Europe is being influenced by environmental legislation and by the liberalization of the electricity market. At present, the most important discussion focuses on the definition of CCPs. With the revision of the Waste Directive also “by-products” and “end-of-waste” are defined. By-products will from the beginning not be subject to waste legislation; end-of-waste materials are resulting from the recovery of waste. For non-waste-materials the REACH regulation has to be considered and substances which are not waste are subject to REACH.

PRODUCTION OF CCPS

The ECOBA statistics on production and utilisation of CCPs /1/ reflect the typical combustion products such as fly ash (FA), bottom ash (BA), boiler slag (BS) and fluidized bed combustion (FBC) ashes as well as the products from dry or wet flue gas desulphurisation, especially spray dry absorption (SDA) product and flue gas desulphurisation (FGD) gypsum.

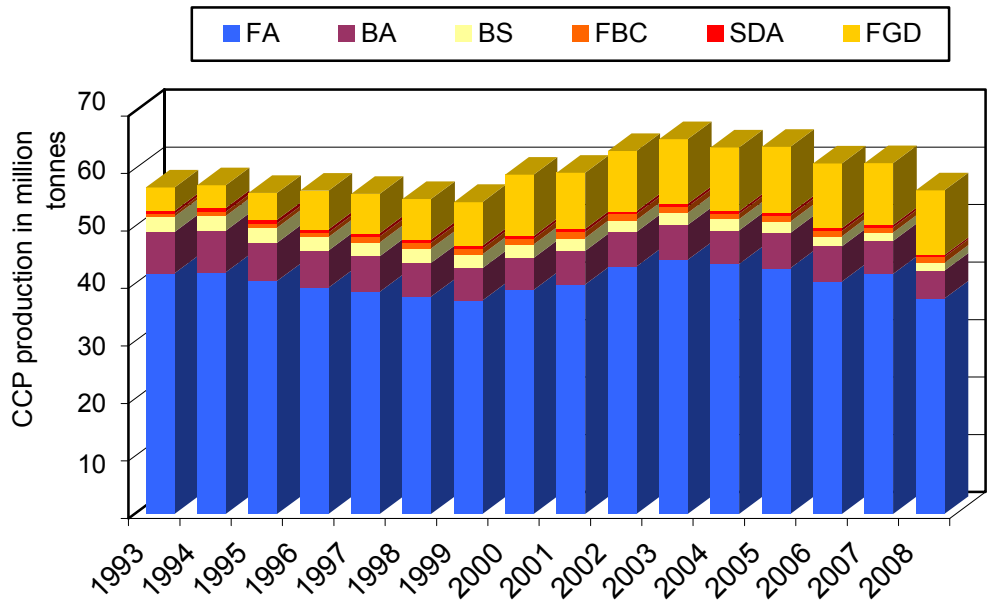

Figure 1 Development of the CCP production in Europe (EU 15) from 1993 to 2008

In figure 1 the development of CCP production in EU 15 member states from 1993 to 2008 is shown. The total amount decreased from 57 million tonnes in 1993 to 55 million tonnes in 1999 and rose again to 64 million tonnes in 2005 due to higher production of electricity and heat by coal combustion.
In 2008, the amount of CCPs produced in European (EU 15) power plants totalled 56 million tonnes, about 3 million tonnes less compared to 2007. This reduction was caused by smaller production by coal combustion in some countries due to the industrial crisis and a higher production by hydro power. In 2008, all combustion residues amounted to about 79 % and the FGD residues to about 21 % by mass /1/.

UTILISATION OF CCPS

The CCPs are mainly utilised in the building material industry, in civil engineering, in road construction, for construction work in underground coal mining as well as for recultivation and restoration purposes in open cast mines. In 2008, about 54% of the total CCPs are used in the construction industry, in civil engineering and as construction materials in underground mining and about 37% for restoration of open cast mines, quarries and pits. About 2.4 % were temporarily stockpiled for future utilisation and about 7 % were disposed off (see figure 2). The rates of utilisation, temporary stockpile and disposal for the single CCPs are given in figure 3.

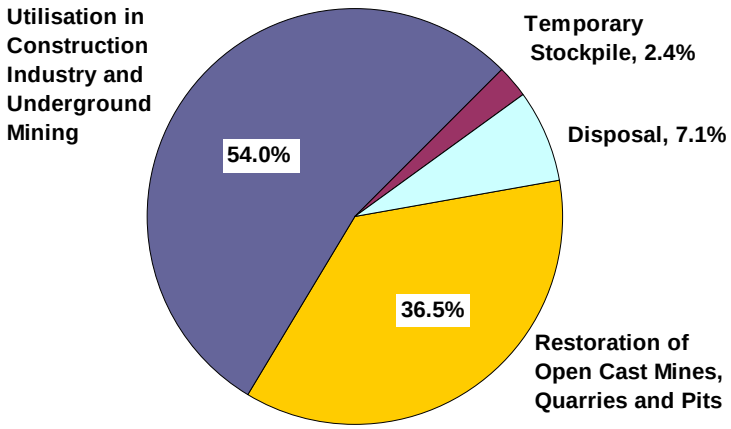

Figure 2: Utilisation and disposal of CCPs in Europe (EU 15) in 2008

The fields of utilisation of specific CCPs in 2008 in EU 15 are described below. Figures regarding the utilisation of specific CCPs in 2007 in EU 15 countries are given in Annex 1.

Fly ash

Fly ash is obtained by electrostatic or mechanical precipitation of dust like particles from the flue gas and represents the greatest proportion of the total CCP production. Depending on type of coal and type of boiler siliceous, silico-calcareous or calcareous fly ashes with pozzolanic and/or latent hydraulic properties are produced throughout Europe. The utilisation of fly ash across European countries is different and is mainly based on national experience and tradition.

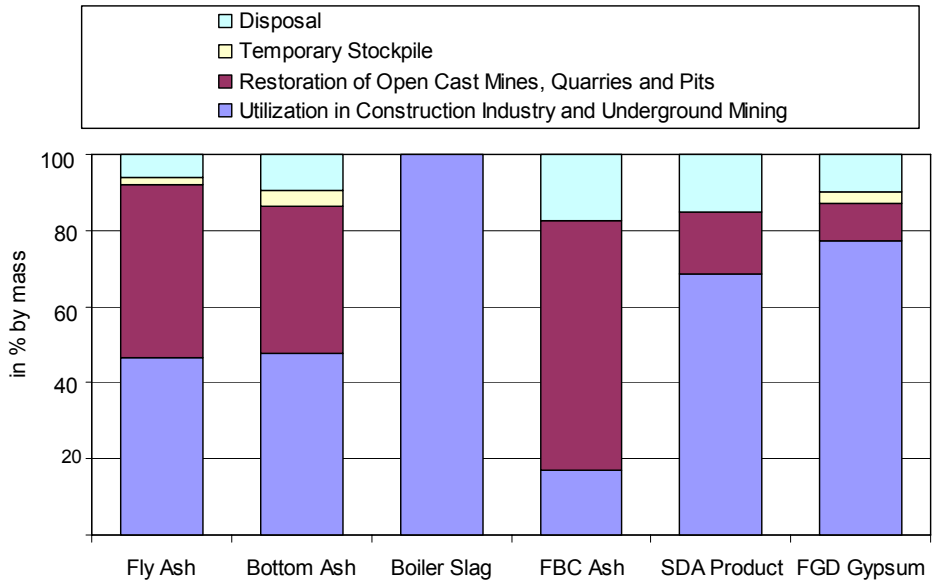

Figure 3: Utilisation, temporary stockpile and disposal of coal ash in Europe (EU 15) in 2008

In 2008, about 18 million tonnes of fly ash were utilised in the construction industry and for production purposes in underground mining. Most of the fly ash produced was used as concrete addition, in road construction and as raw material for cement clinker production. Fly ash was also utilised in blended cements, in concrete blocks and for infill (that means filling of voids, mine shafts and subsurface mine workings) (see figure A1 in Annex 1).

Fly ash is the most important CCP with nearly 68 % of the total amount. Approximately 32 % of the total fly ash produced in Europe is used as cement raw material, as constituent in blended cements and as addition for the production of concrete. This means that it is a main constituent of the cement or it replaces a part of the cement necessary for the production of concrete. The amount of fly ash used as an addition for concrete increased from 2.3 million tonnes in 1993 to 5.9 million tonnes in 2007 (see figure 4).

The application as concrete addition constitutes the highest added value for fly ash so the European Standard EN 450 "Fly Ash for Concrete" is particularly important for the marketing of fly ash. The standard was first published in 1994 and the revised standards EN 450-1 /4/ und EN 450-2 /5/ entered force on January 1, 2007. The new standard covers also fly ash from processing plants, which is produced by e.g. classification, selection, sieving, drying, blending, grinding or carbon reduction. This is because in some countries fly ash has been processed according to national regulations for years or, in some cases, decades.

Bottom ash

Bottom ash is a granular material removed from the bottom of dry bottom furnaces operated at furnace temperatures of 1000 to 1200°C. Bottom ash is much coarser than fly ash. About 2.4 million tonnes of bottom ash were used in the construction

industry. Out of this about 37 % was used as fine aggregate in concrete blocks and in concrete, about 41 % in road construction and filling applications and about 16 % in cement production (see figure A2 in Annex 1).

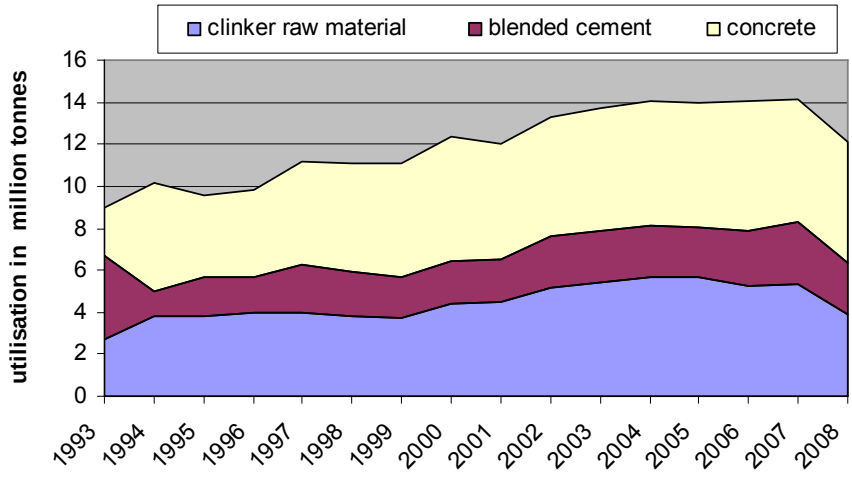

Figure 4: Development of the use of fly ash as a clinker raw material, for production of blended cement and as an addition to concrete from 1993 to 2008

Boiler slag

Boiler slag is a vitreous grained material derived from coal combustion in wet bottom boilers operated at temperatures of about 1600°C. Due to the high furnace temperature the coal ash is molten, it flows down to the bottom of the furnace and is removed from a water bath below the furnace bottom. Boiler slag is a glassy material. About 44 % of the boiler slag produced was used as blasting grid, about 30 % in road construction, about 5 % for grouting and in drainage layers and about 11 % was used as aggregate in concrete (see figure A3 in Annex 1).

Fluidized Bed Combustion (FBC) Ash

FBC ash is produced in fluidized bed combustion boilers. The technique combines coal combustion and flue gas desulphurisation in the boiler at temperatures of 800 to 900°C. As the combustion process is designed to handle different types of fuel also different kinds of sludges are often co-combusted (sewage sludge, paper sludge, etc.).

FBC ash is rich in lime and sulphur. In 2008, about 0.2 million tonnes were mainly used for engineering fill applications (53 %), for structural fill (11 %), for infill (9 %) and subgrade stabilisation (about 6 %). About 19 % were used for sludge treatment and waste stabilisation (see figure 1d in Annex 1). It has to be noted that the total amount of FBC-ash in EU 15 countries is small compared to the amount produced at least in Poland and the Czech Republic.

Spray Dry Absorption (SDA) product

About 0.2 million tonnes of the total SDA product in EU 15 countries was utilised in the construction industry for structural fill (57 %), for infill (20 %), for plant nutrition (3 %) and as a sorbent in wet FGD (20 %; see figure A5 in Annex 1). It has to be noted that also the total amount of SDA-product in EU 15 countries is small compared to the amount produced at least in Poland and the Czech Republic.

FGD Gypsum

Out of the total of 8.8 million tonnes about 63 % was used for the production of plaster boards. Other applications include the production of gypsum blocks, projection plasters and self levelling floor screeds (30 %). In the cement industry FGD gypsum is used as set retarder (7 %; see figure A6 in Annex 1).

REVISION OF EUROPEAN STANDARDS

Revision of EN 450-1 and EN 450-2

The application as concrete addition constitutes the highest added value for fly ash. By this, the European Standard EN 450 "Fly Ash for Concrete" is particularly important for the marketing of fly ash. The standard was first published in 1994 /2/ and the revised standards EN 450-1 und EN 450-2 entered force on January 1, 2007 /3, 4/. EN 450-1 deals with definitions, specifications and conformity criteria for siliceous fly ash, which is produced by burning of pulverized coal, with or without co-combustion materials, and collected in a dry state, or which is processed by e.g. classification, selection, sieving, drying, blending, grinding or carbon reduction or by a combination of these processes. This is because in some countries fly ash has been processed according to national regulations for years or, in some cases, decades. EN 450-2 deals with the conformity evaluation of fly ash for concrete produced in power plants and in processing plants. Most important is the documentation of procedures for the production control in a works quality manual.

In EN 450-1 requirements regarding homogeneity, soundness and effectiveness are stipulated. The chemical requirements refer to e.g. the loss on ignition, sulphur-, chloride- and free-lime-content. If fly ash is produced with co-combustion the content of reactive SiO_2, the total oxide content of SiO_2, Al_2O_3, Fe_2O_3, the alkali-, MgO- and phosphate-content have to be tested. The physical parameters stipulate requirements on the fineness, variation of fineness and density, on soundness and activity index. In addition to these requirements, fly ash from co-combustion has to meet the requirement of initial setting time and fly ash of category S for water demand.

Within the ongoing revision of the standards /5, 6/ all parameters were critically reviewed and the amount of co-combustion materials will be increased to incorporate the experience gained with European Technical Approvals (ETA). All proposed changes are documented in a respective background report which will be published as CEN report after final review /7/. An overview of the requirements in the new EN 450-1 /5/ is presented in table 1.

The requirements are related to fresh and hardened concrete. The chemical requirements concern Loss on Ignition (LOI), chloride (Cl), reactive and free calcium oxide or lime (CaO), reactive silicon dioxide (SiO_2), the sum of $SiO_2 + Al_2O_3 + Fe_2O_3$, Magnesium Oxide (MgO) and soluble phosphorus pentoxide (P_2O_5). The physical requirements concerning fineness and the maximum deviation of particle density. The performance based requirements are water requirement, initial setting, activity index and soundness.

Table 1 Properties and requirements of fresh and hardened mortar and concrete /7/

Phase	Property	Unit	Existing	Revised
workability	loss on ignition (LOI) class A class B class C	% by mass	≤ 5.0 2.0 -7.0 4.0- 9.0	≤ 5.0 ≤ 7.0 ≤ 9.0
	water requirement [1]	%	≤ 95	n.m.[5]
	fineness fraction > 45 µm	% by mass	≤ 40 (cat. N)[4] ≤ 12 (cat. S)	n.m. [5]
initial strength development	soluble phosphate (P_2O_5)	mg/kg	≤ 100	n.m. [5]
	total phosphate (P_2O_5)	% by mass	-	≤ 5.0
	initial setting	min.	2C[2]	n.m. [5]
strength development	sum $SiO_2 + Al_2O_3 + Fe_2O_3$	% by mass	≥ 70	n.m. [5]
	Reactive SiO_2	% by mass	≥ 25	n.m. [5]
	activity index 28 days 91 days	%	≥ 75 ≥ 85	n.m. [5] n.m. [5]
alkali silica reaction (ASR)	total content of alkalis (Na_2O equivalent)	% by mass	≤ 5.0	n.m. [5]
	reactive calcium oxide (CaO)	% by mass	≤ 10.0	n.m. [5]
soundness / durability	sulphuric anhydride (SO_3)	% by mass	≤ 3.0	n.m. [5]
	free calcium oxide (CaO)	% by mass	≤ 2.5[3]	[6]
	soundness	mm	≤ 10	n.m. [5]
	magnesium oxide (MgO)	% by mass	≤4.0	n.m. [5]
	chloride (Cl^-)	% by mass	≤0.10	n.m. [5]

[1] Only applicable for category S fly ash.
[2] Initial setting of fly ash cement paste shall not be more than twice as long as the initial setting time of the test cement alone.
[3] If the content of free lime is greater than 1.0 % by mass, the fly ash must be tested for conformity to the requirement for soundness.
[4] The fineness shall not vary by more than ±10% from the declared value.
[5] n.m. = not modified.
[6] If the content of free lime is greater than 1.5 % by mass, the fly ash must be tested for conformity to the requirement for soundness.

In relation to the previous standard, the following changes have been proposed.

Definition of fly ash

In the definition of fly ash the criterion for reactive silicon dioxide will be deleted due to formal reasons. The reactive silicon dioxide content will only be detected in the initial type testing for new fly ash as all test results showed that the requirement is always met.

Amount and type of co-combustion materials

The amount of co-combustion materials will be increased from 20 to 40 % and the proportion of ash derived from co-combustion material from 10 to 30 % to include the experiences gathered with European Technical Approvals over the last years. For green wood, e.g. not recycled wood, the maximum percentage of co-combustion material can be increased to 50 % by mass. The types of co-combustion materials are given in table 2. Materials not included in the list should be subject to a European Technical Approval (ETA).

Table 2 Types of co-combustion materials in EN 450-1 /5/

1	Solid Bio Fuels complying with CEN/TS 14588 including animal husbandry residues
2	Animal meal (meat and bone meal)
3	Municipal sewage sludge
4	Paper sludge
5	Petroleum coke
6	Virtually ash free liquid and gaseous fuels

Although the increased shares seems to be high it has to be noted that the rates can not be reached for all co-combustion materials. Only for green wood the co-combustion will be limited on fuel base. This was covered with the experiences from European Technical Approvals (ETAs). For other types of solid bio fuels and co-combustion materials the shares will be limited by chemical requirements (see table 3).

For other types of solid bio fuels and co-combustion materials the shares will be limited by chemical requirements. By this, it is guaranteed that the fly ash quality will not change.

Lower limits for LOI

The lower limits of the three classes of LOI will be deleted as the statistical assessment has to be evaluated by variables. This system is made for normal distributed data sets and acceptability constant together with producer and consumers risk. The system was established by D.B. Owen in 1962, but for one sided evaluations only.

Table 3 Limiting parameters for co-combustion materials according table 1 of EN 450-1 [7]

	Type	Limited by
1	**Solid Bio Fuels complying with CEN/TS 14588 including animal husbandry residues**	
	green wood	Co-combustion fuel based
	bark wood	reactive CaO
	Cacao shells	Na_2O equivalent (K)
	palm kernels	total P_2O_5
	poultry dung	reactive CaO
2	**Animal meal (meat and bone meal)**	
	meat & bone meal	total P_2O_5
3	**Municipal sewage sludge**	
	municipal sewage sludge	total P_2O_5
4	**Paper sludge**	
	Paper sludge	CaO
5	**Petroleum coke**	
	Petroleum Cokes	-*
6	**Virtually ash free liquid and gaseous fuels**	
	Industrial HC liquid	Co-combustion fuel based

* environmental regulations

Free lime content

The minimum free lime content above which soundness has to be tested will be increased from 1 % by mass to 1.5 % by mass. Further, the maximum amount of free lime of 2.5 % by mass will be deleted. The changes are based on a data compilation in European countries.

Soluble Phosphate

The determination of the content of soluble phosphate (P_2O_5), determined in accordance with the method descried in Annex C, will only be determined in initial type testing. For the continuous proof the content of total phosphate (P_2O_5) will be determined in accordance with EN 196-2 and shall not be greater than 5.0 % by mass. The modification is based on a data compilation in European countries.

The modifications for tests methods are described as follows:

X-ray fluorescence analysis

The new standard EN 196-2 allows to use other methods than the classical wet chemical methods, namely X-Ray fluorescence analysis. By this, the use of the XRF-analysis need no longer to be classified as alternative method with the proof of equivalent results but will be used directly as reference method.

Fineness by wet sieving or airjet sieving

The fineness of fly ash shall be expressed as the mass proportion in percent of the ash retained when sieved on a 0.045 mm mesh sieve. The sieving can be determined in accordance with EN 451-2 with wet sieving and in future also by airjet sieving according EN 933-10.

Revision of EN 13282 Hydraulic Road Binders

The revision of the European standard for hydraulic road binders ENV 13282 /8/ resulted in the preparation of three parts. prEN 13282-Part 1 is dealing with rapid hardening hydraulic road binders /9/. These are cement based binders which follow the requirements as already known from ENV 13282. prEN 13282-Part 2 is dealing with normal hardening hydraulic road binders /10/. These binders have lower cements contents, the compressive strength has to be tested after 56 days (part 1 at 28 days). In addition to the main constituents in part 1 also a specific Fluidized Bed Combustion (FBC)-ash and a specific Basic Oxygen Furnace (BOF)-slag with defined chemical and physical parameters can be used. Furthermore, a slaking procedure was implemented to guarantee that also lime rich mixtures can be evaluated in the laboratory. For the definition of fly ash from co-combustion as defined in EN 450-1 has to be considered and the LOI content will be increased from 10 to 15 % by mass. Part 3 of the standard series deals with the conformity evaluation.

Revision of EN14227 Hydraulically bound mixtures

In June 2009, the revision of the EN 14227-series for hydraulically bound mixtures was decided. The standards under revision cover cement bound (part 1), slag bound (part 2), fly ash bound (part 3) and hydraulic road binder bound (part 5) mixtures. The revision of these standards focus the structure and the gradings of the mixtures. Part 4 deals with fly ash for fly ash bound mixtures and gives the definition and requirements for siliceous and calcareous fly ash.

Revision of aggregate standards

The European Standards EN 13055- Part 1: “Lightweight aggregates for concrete, mortar and grout” and EN 13055-2 Lightweight aggregates - Part 2: “Lightweight aggregates for bituminous mixtures and surface treatments and for unbound and bound applications” will be merged to one standard according the decision of TC 154. The new standard EN 13055 will be entitled “Lightweight aggregates for building, civil engineering and other applications”.

The standard is relevant for CE marking as lightweight aggregates for the intended use in “Concrete, mortar and grout”, “Bituminous mixtures and surface treatments” and now also in “Unbound and hydraulically bound applications”.

Most of the proposed changes are editorial. Ongoing discussion refer to the scope of the standard, the definitions considering also other aggregate standards (i.e. EN 12620, EN 13242), the test methods described in Annexes and the annex of factory production control and minimum test frequencies. The standard will serve as a first example for the implementation of ER 3 “Dangerous substances”.

LEGAL ISSUES

Revision of the European Waste Directive

In the revised Waste Framework Directive (Directive 2008/98/EC of November 19th 2008 /11/) it is stated:
“(22) There should be no confusion between the various aspects of the waste definition, and appropriate procedures should be applied, where necessary, to by-products that are not waste, on the one hand, or to waste that ceases to be waste, on the other hand.

In order to specify certain aspects of the definition of waste, this Directive should clarify:

- when substances or objects resulting from a production process not primarily aimed at producing such substances or objects are by-products and not waste. The decision that a substance is not a waste can be taken only on the basis of a coordinated approach, to be regularly updated, and where this is consistent with the protection of the environment and human health. If the use of a by-product is allowed under environmental licence or general environmental rules, this can be used by Member States as a tool to decide that no overall adverse environmental or human health impacts are expected to occur; an object or substance should be regarded as being a by-product only when certain conditions are met. Since by-products fall into the category of products, exports of by-products should meet the requirements of the relevant Community legislation; and

- when certain waste ceases to be waste, laying down end-of-waste criteria that provide a high level of environmental protection and an environmental and economic benefit; possible categories of waste for which ”end-of-waste” specifications and criteria should be developed are, among others, construction and demolition waste, some ashes and slags, scrap metals, aggregates, tyres, textiles, compost, waste paper and glass. For the purposes of reaching end-of-waste status, a recovery operation may be as simple as the checking of waste to verify that it fulfils the end-of-waste criteria.

By-products

In Article 5 conditions are given for being a by-product and in Article 6 conditions for the end-of-waste status are listed. Those definitions of “by-product” and “end-of-waste” are given in annex 2 of this paper.

Where CCPs are used directly from the power station or after short periods of storage in dedicated silos, stores and stockpiles they are, in the producers opinion, not discarded and are therefore not wastes /12/. They are fulfilling the conditions for being a by-product given in Article 5, like being an integral part of the production process, meeting certain requirements of standards or other specifications with respect to utilisation in certain areas and fulfilling relevant environmental and health protection requirements.

It has to be mentioned that in many European countries or even regions some CCPs have already been accepted as by-products by the authorities. Furthermore, it has to be noted that CCPs which are not subject to waste legislation are then subject to the REACH regulation

End-of-waste products

In Article 6 of the Directive “end-of-waste” is defined by certain criteria to be defined by the Commission. A precondition is that the waste has undergone a recovery, including recycling, operation. Recovery means by Article 3.17:
“any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy. …”

The criteria shall *include limit values for pollutants where necessary and shall take into account any possible adverse environmental effects of the substance or object*.
The Commission ordered the Institute for Prospective Technological Studies (IPTS) and DG Joint Research Centre (JRC) to develop a general methodology for determining end-of-waste (EoW) criteria. The final report was published in 2008. The methodology evaluates aggregates, compost and metal scraps. For these materials pilot studies have been prepared and discussed at stakeholder workshops. For aggregates the conclusion reads as follows:
“For secondary aggregates from iron and steel slags and ashes from coal combustion the processing does not influence to a great extent the composition and environmental risks associated with secondary aggregates. Therefore, the recovery process is not relevant as part of end of waste conditions.

The product requirements step, in particular environmental requirements, is relevant when the environmental risks associated with recycled and secondary aggregates still exist after collection/generation and the recovery process. In this case, the definition of the end of waste leaching requirements to be met by recycled and secondary aggregates provides guarantee that no additional environment impact will occur when recycled and secondary aggregates cease to be waste.

The fulfilment of technical requirements in order to guarantee that the material is suitable to enter in the aggregates market is fundamental for consumer acceptance and certainty of use."

The environmental impact of the use of CCPs has to be considered in any application. Fly ash and bottom ash as any natural minerals contain a certain amount of trace element compounds. The concentrations of some of the trace elements may be higher in fly ash than in natural minerals or products used for a certain application. In order to avoid any negative impact on the environment or on human health, regulations have been developed for the different uses of industrial by-products at a national level in the European Member States.

Here again it has to be mentioned that in some countries like in UK "Quality Protocols" were prepared to set out end-of-waste criteria for the production and use of a product from a specific waste type. Compliance with these criteria is considered sufficient to ensure that the fully recovered product may be used without undermining the effectiveness of the WFD and therefore without the need for waste management controls. The criteria might differ from country to country.

REACH Regulation

On 1st June 2007, the REACH-Regulation (Registration, Evaluation, Authorisation and Restriction of Chemicals) entered into force. By this, also each producer or importer of coal combustion products (CCPs) has to register the marketed or imported substances at the European Chemicals Agency (ECHA) situated in Helsinki. Since 1 June 2008, CCPs which are not registered can not be produced and placed on the market.
Exemption: For CCPs which have been pre-registered by 1. December 2008 the deadline for registration is extended by 1. December 2010 (production volume > 1000 tonnes), by 30. June 2013 (production volume > 100 tonnes) or 30 June 2018 (production volume > 1 tonne).

The producers/importers of CCPs have pre-registered FGD- gypsum, spray dry absorption product (SDA-product), fly ash ((FA) from hard coal/lignite), bottom ash (BA), boiler slag (BS) and fluidised bed combustion ash (FBC-ash) as well as cenospheres (CE) and ashes from biomass combustion (BMA) with the CAS- and EC-numbers of the specific substances.

The producers/importers of substances with the same EC-numbers form so-called pre-SIEFs (Substance Information Exchange Forum). Out of these pre-registered parties a „facilitator" organises the pre-SIEF communication and cares for open questions within the pre-SIEF.

The pre-registered parties agreed about the sameness of substances, defined Substance Identity Profiles (SIP) and formed Substance Information Exchange Fora (SIEF) for the preparation of joint registration dossiers with chemical, physical, toxicological and ecotoxicological data. An overview of the requested information is given in figure 5.

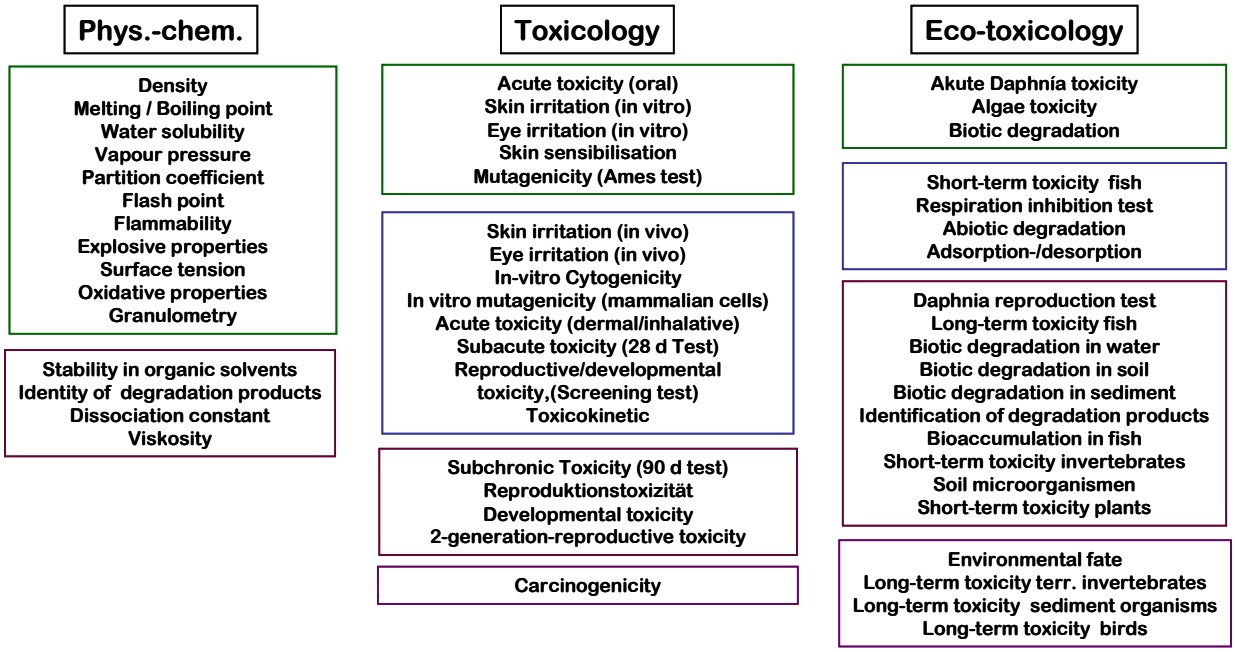

Figure 5 Overview on physical-chemical, eco-toxicological and toxicological information required to REACH

For the registration of one substance only one registration dossier with the specific registration data can be filed. The SIEF members agreed for a so-called „Lead Registrant“ who submitted the substance specific joint registration dossier to the ECHA.

Consortia were formed for calcium sulfate, ashes (fly ash, bottom ash and boiler slag), for FBC-ash and for SDA product.

By 1st December 2010, the following substances were registered

- Calcium sulfate (natural and FGD gypsum)
- SDA-Product*
- Ashes from wet and dry bottom boilers (fly ash, bottom ash, boiler slag)*
- Ashes from fluidized bed combustion boilers*
- Cenospheres

* for ashes and SDA-Product new EC numbers were used for registration.

It is informed that all tests performed on CCPs resulted in no hazardous properties. Therefore, no exposure scenarios were prepared to restrict the uses of CCPs.

Legal entities being members of the joint registration referred to the joint registration dossier by a token number provided by the lead registrant.

Pre-registered parties which will register at a later stage and are not members of a consortium can contact the lead registrant or contact partners listed below and ask for a letter of access (LoA) to the joint registration dossier.

Parties not being pre-registered can also ask for a LoA. However, they have to send an inquiry to ECHA to get a company specific number for registration and contact data to the lead company which has registered the same substance.
Information regarding sameness of substances for registration of CCPs and details of consortia are available at the website of ECOBA /14/.

CONCLUSIONS

In Europe (EU 15) about 56 million tonnes of Coal Combustion Products (CCPs) were produced in 2008. The annual production in EU 27 is estimated to amount to about 100 million tonnes. The CCPs include combustion residues such as boiler slag, bottom ash and fly ash from different types of boilers as well as desulphurisation products like spray dry absorption product and FGD gypsum.

The use of CCPs contributes to sustainability and has several environmental and technical benefits. It has developed by the years and is mostly based on requirements of standards or other specifications which are subject to regular revision by CEN or national authorities. At present, the European standards EN 450-1 and EN 450-2 are under revision. Within the ongoing revision of the standards all parameters are subject to critical review. With the revision the shares of co-combustion materials, especially of green wood, will be increased. The changes will be documented in a respective background report. Furthermore, the European standard for hydraulic road binders EN 13282 with basic definitions which includes FBC ash as a main constituent will be published in an updated version with three parts. For lime rich binders a slaking procedure was developed to allow the laboratory evaluation of such binders. Also the standard series for hydraulically bound mixtures EN 14227 as well as the standard for aggregates are under revision.

The utilisation is becoming more and more restricted by environmental regulations. A European Technical Committee is working on horizontal standardised assessment methods for the release of dangerous substances from construction materials. In addition, the legal definition of CCPs as waste causes hurdles, which are unnecessarily impeding the utilisation markets, which have been developed in the last decades. With the revision of the Waste Directive a definition of by-products will be introduced for materials which are from the beginning not a waste. Materials may also leave the waste regime after a recovery operation and meeting of waste stream specific end-of-waste criteria. For coal ash as aggregate these may be based on leaching limits.

Materials not being waste are subject to REACH and have to be registered before being placed on the market from 1st June 2008. For calcium sulfate (natural and FGD gypsum), SDA-Product, ashes from wet and dry bottom boilers (fly ash, bottom ash, boiler slag), ashes from fluidized bed combustion boilers and cenospheres registration dossiers were prepared. The results of all tests showed no hazardous properties. Producers which have not yet registered can join the registration via letter-of-access.

REFERENCES

/1/ Statistics on Production and Utilisation of CCPs in Europe (EU 15) in 2007, ECOBA, 2007 (www.ecoba.org)

/2/ EN 450: Fly Ash for Concrete – Definitions, requirements and quality control, 1994

/3/ EN 450: Fly ash for concrete – Part 1: Definitions, specifications and conformity criteria, 2005 + A1:2007

/4/ EN 450: Fly ash for concrete – Part 2: Conformity evaluation, 2005

/5/ prEN 450: Fly ash for concrete – Part 1: Definitions, specifications and conformity criteria, 2009

/6/ prEN 450-2: Fly ash for concrete – Part 2: Conformity evaluation, 2009

/7/ Backgrounds to the revision of EN 450-1:2005/A1:2007 and EN 450-2:2005 “Fly ash for concrete”, 2009

/8/ ENV 13282 Hydraulic road binders – Composition, specifications and conformity criteria, 2000

/9/ prEN 13282-1:2009. Hydraulic road binders - Part 1: Rapid hardening hydraulic road binders - Composition, specifications and conformity criteria

/10/ prEN 13282-2:2009. Hydraulic road binders - Part 2 : Normal hardening hydraulic road binders - Composition, specifications and conformity criteria

/11/ Waste Directive (2008/98/EC) of the European Parliament and the Council of 19 Nov. 2008 on waste and repealing certain Directives, Official Journal of the European Union (L312/3), 22.11.2008

/12/ Joint EURELECTRIC/ECOBA Briefing: Case Study for the Commission’s Comm. on By-products and for Guidance on the Revised Waste Framework Directive, 03.2011

/13/ Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC, Official Journal of the European Union, ISSN 1725-2555 L 396, Volume 49, 30 December 2006

/14/ http://www.ecoba.com/reach_ccps.html

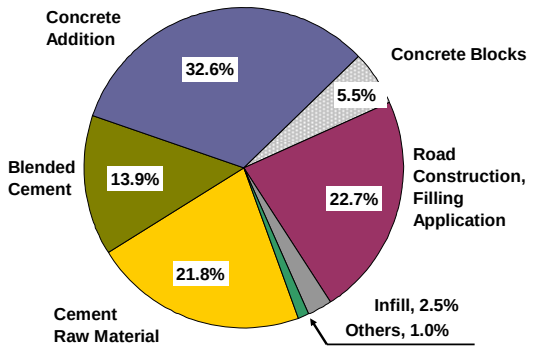

Figure A1:
Utilisation of Fly Ash in the Construction Industry and Underground Mining in Europe (EU 15) in 2008.
Total utilisation 17.7 million tonnes.

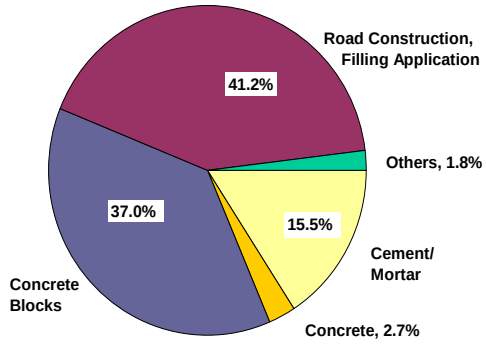

Figure A2:
Utilisation of Bottom Ash in the Construction Industry and Underground Mining in Europe (EU 15) in 2008.
Total utilisation 2.4 million tonnes.

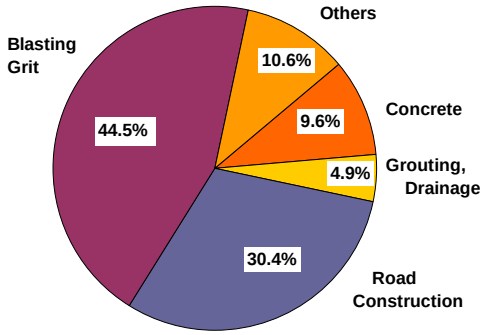

Figure A3:
Utilisation of Boiler Slag in the Construction Industry and as Blasting Grid in Europe (EU 15) in 2008.
Total utilisation 1.4 million tonnes.

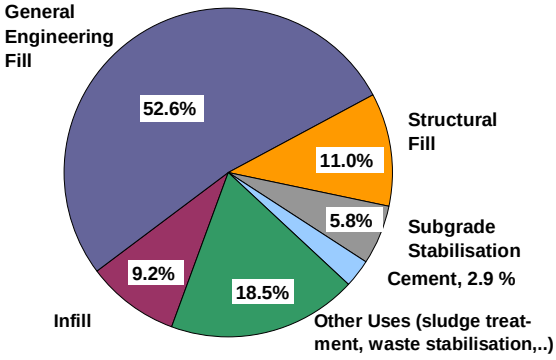

Figure A4:
Utilisation of FBC Ash in the Construction Industry and Underground Mining in Europe (EU 15) in 2008.
Total utilisation 0.2 million tonnes.

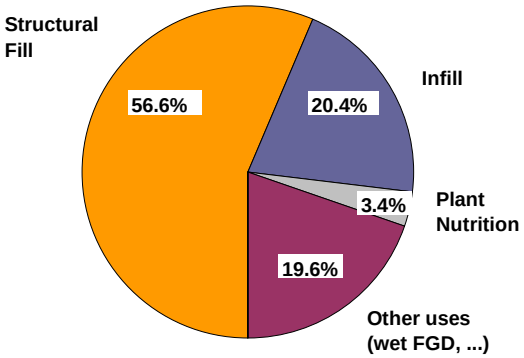

Figure A5:
Utilisation of SDA- Product in the Construction Industry and Underground Mining in Europe (EU 15) in 2008.
Total utilisation 0.2 million tonnes.

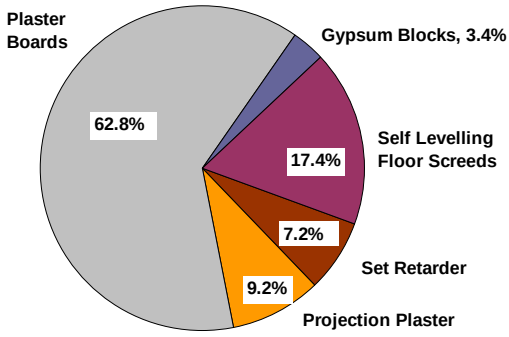

Figure A6:
Utilisation of FGD gypsum in the Construction Industry in Europe (EU 15) in 2008.
Total utilisation 8.8 million tonnes.

Annex 2

Article 5
By-products

1. *A substance or object, resulting from a production process, the primary aim of which is not the production of that item, may be regarded as not being waste referred to in point (1) of Article 3 but as being a by-product only if the following conditions are met:*
   (a) further use of the substance or object is certain;
   (b) the substance or object can be used directly without any further processing other than normal industrial practice;
   (c) the substance or object is produced as an integral part of a production process; and
   (d) further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.
2. *On the basis of the conditions laid down in paragraph 1, measures may be adopted to determine the criteria to be met for specific substances or objects to be regarded as a by-product and not as waste referred to in point (1) of Article 3. Those measures, designed to amend non-essential elements of this Directive by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 39(2).*

Article 6
End-of-waste status

1. *Certain specified waste shall cease to be waste within the meaning of point (1) of Article 3 when it has undergone a recovery**,** including recycling**,** operation and complies with specific criteria to be developed in accordance with the following conditions:*
   (a) the substance or object is commonly used for specific purposes;
   (b) a market or demand exists for such a substance or object;
   (c) the substance or object fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products; and
   (d) the use of the substance or object will not lead to overall adverse environmental or human health impacts.

   The criteria shall include limit values for pollutants where necessary and shall take into account any possible adverse environmental effects of the substance or object.
2. *The measures designed to amend non-essential elements of this Directive by supplementing it relating to the adoption of the criteria set out in paragraph 1 and specifying the type of waste to which such criteria shall apply shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 39(2). End-of-waste specific criteria should be considered, among others, at least for aggregates, paper, glass, metal, tyres and textiles.*
3. ……