Present Situation and Perspectives of CCP Management in Europe

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INTRODUCTION

ECOBA - the European Coal Combustion Products (CCPs) Association is an association of power plant operators and CCP marketing companies in Europe.Traditionally since 1993 ECOBA representatives have been reporting on production and utilization of CCPs in Europe as well as on the actual progress in and obstacles to utilization at the Symposia of the American Coal Ash Association. This report includes again an update on production and utilization figures, the recent progress in European standarization work, the new item of co-combustion of biomass and waste in coal fired power plants, the impact of co-combustion on CCP properties and new developments in legislation.

PRODUCTION OF CCPS IN EUROPE

The ECOBA statistics on production and utilization of CCPs reflect the typical combustion products 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 desulphurization, especially spray dry absorption (SDA) product and flue gas desulphurization (FGD) gypsum.

The amount of CCPs produced in European (EU 15) power plants totalled 65 million tonnes in 2003. Figure 1 shows the proportions of the different CCPs produced. Almost 68 % of the total CCPs are produced as fly ash. All combustion residues amount up to 81.9 % and FGD residues up to 18.1 % by mass.

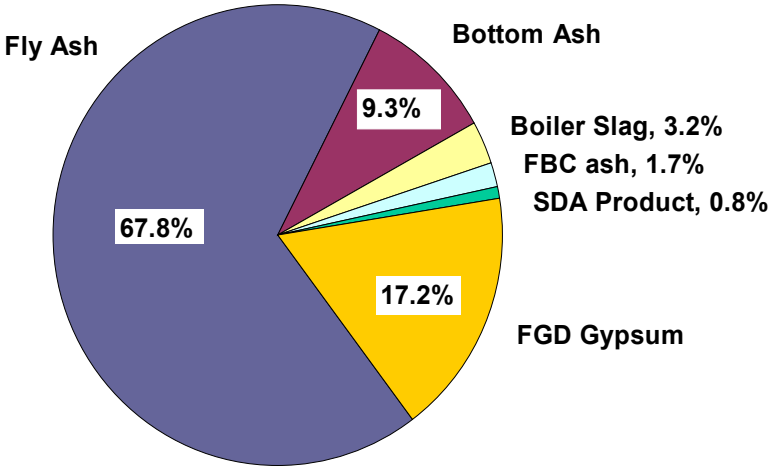


Figure 1: Production of CCPs in Europe (EU 15) in 2003
(total production 65 million tonnes)

UTILIZATION AND DISPOSAL OF CCPS IN EUROPE

Most of the CCPs produced are used in the construction industry, in civil engineering and as construction materials in underground mining (52.4 %) or for restoration of open cast mines, quarries and pits (35.9 %). In 2003 about 8.0 % were temporarily stockpiled for future utilization and 3.7 % were disposed off (figure 2).

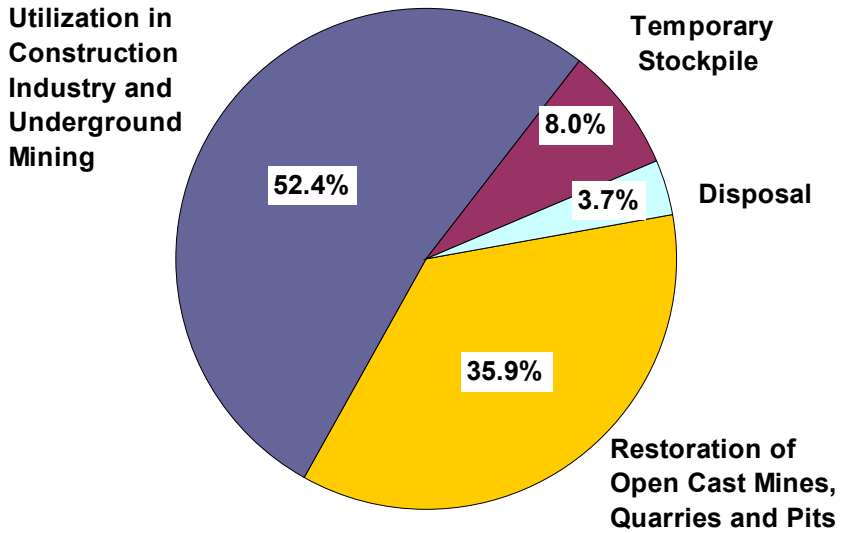


Figure 2: Utilization and disposal of CCPs in Europe (EU 15) in 2003
Total amount 65 million tonnes

The rates for utilization and disposal of the specific CCPs in 2003 are shown in figure 3.

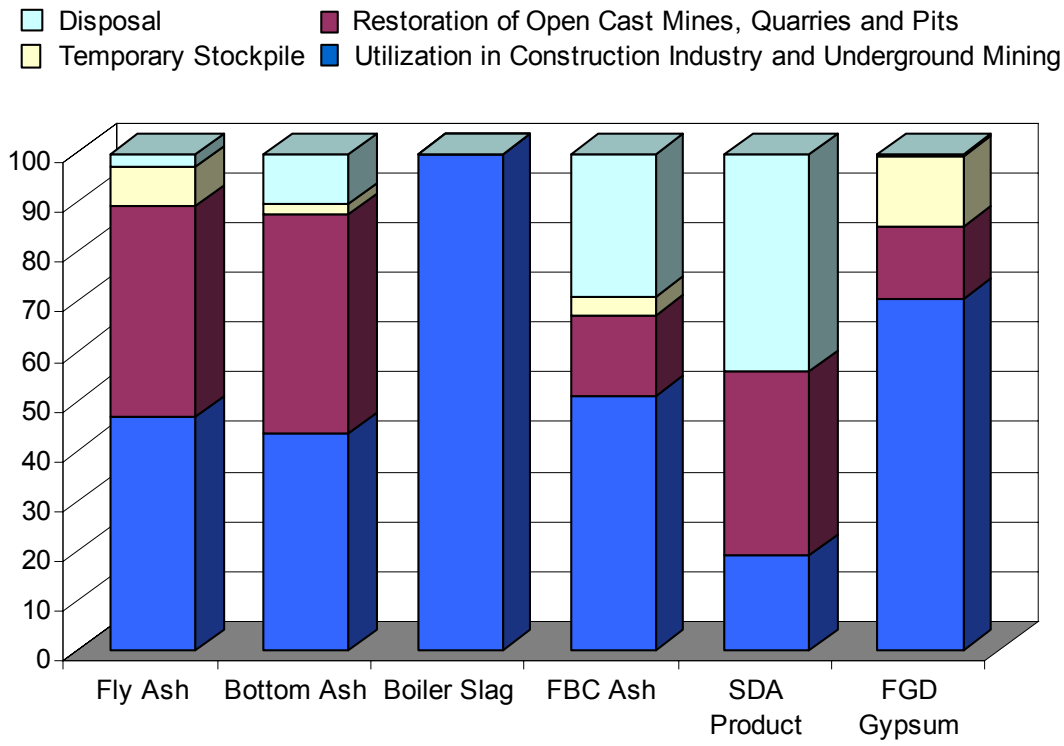


Figure 3: Utilization and disposal of CCPs in Europe (EU 15) in 2003

47 % of the fly ash, 44 % of the bottom ash, 100 % of the boiler slag and 51 % of the FBC ash were utilized in the construction industry and in underground mining. Less than 3 % of the fly ash, 10 % of the bottom ash and 29 % of the FBC ash had to be disposed off.

In dry and semidry desulphurization processes 0.49 million tonnes of SDA product (spray dry absorption product) and in wet FGD approximately 11.3 million tonnes of FGD gypsum (flue gas desulphurization gypsum) were produced in 2003.

A decrease in utilization of the SDA product down to about 19 %, only, compared to 40 % in 2002 took place. About 37 % of SDA were used for reclamation purposesand about 44 % were disposed off.

The utilization rate of FGD gypsum in the construction industry amounted to almost 71 % due to the high demand for this product by the cement and gypsum industries. About 14 % were temporarily stockpiled for future utilization while approximately 1 % was sent to disposal.

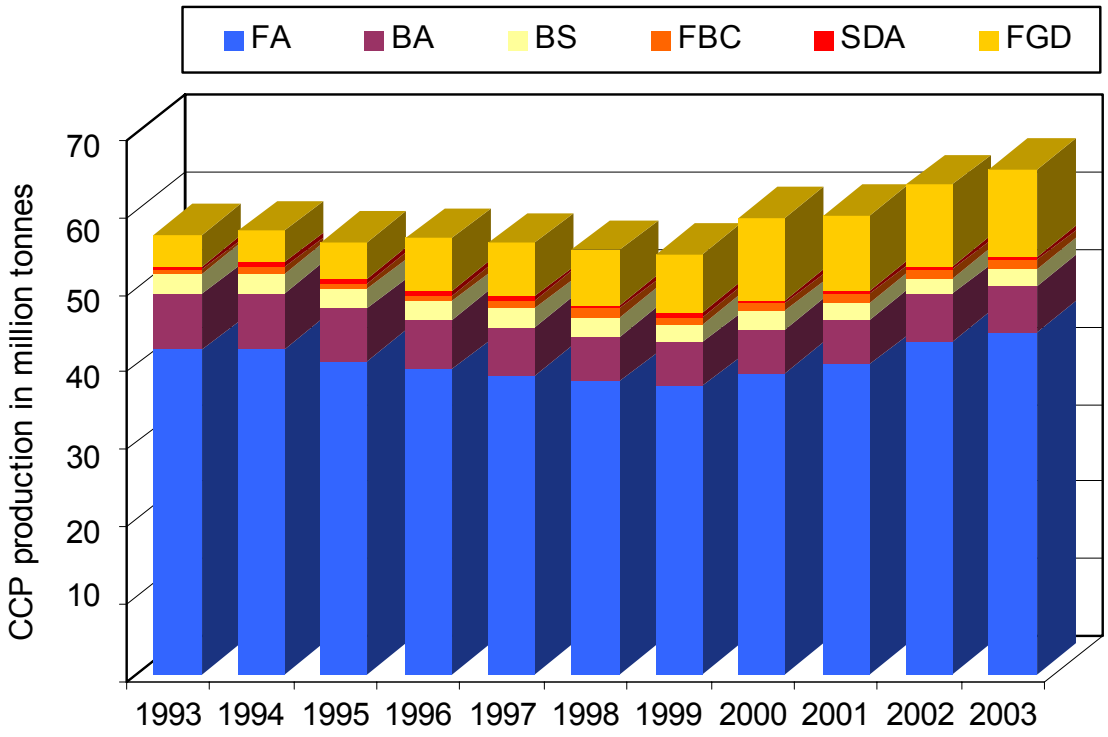
In the majority of cases CCPs are used as a replacement for natural materials and therefore they offer environmental benefits by avoiding the need to quarry or mine

natural resources. CCPs also help to reduce energy consumption as well as emissions to atmosphere, for example CO_2, which result from the manufacturing process of the products which are replaced.

More detailed information on the utilization of the specific CCPs can be taken from the figures A1 to A6 in Annex I to this paper.

DEVELOPMENT IN PRODUCTION AND UTILIZATION OF CCPS

The development of CCP production in the European countries (EU 15) from 1993 to 2003 is shown in figure 4. The total amount of CCPs decreased from 57 million tonnes in 1993 to 55 million tonnes in 1999. Since then production increased again to 65 million tonnes in 2003 due to the increasing amounts of fly ash and flue gas desulphurization products.



FGD = flue gas desulphurization gypsum; SDA = spray dry absorption product; Other = fly ash and slag from coal gasification, sulfur, sulfuric acid; FBC = fluidized bed combustion residues; BS = boiler slag; BA = bottom ash; FA = fly ash

Figure 4: Development of CCP production in Europe (EU 15) from 1993 to 2003

The utilization rate of fly ash and bottom ash in the construction industry and in underground mining have increased continually through the years (see figure 5). In total, the utilization rate of fly ash has increased from 34 % (1993) to 47 % (2003), for bottom ash the utilization rate rose from 25 % in 1993 to 44 % in 2003. In 1999 a

maximum utilization rate of 48 % for fly ash and 44 % for bottom ash was registered. The decrease of the utilization rate for fly ash and bottom ash from 1999 to 2000 can be attributed to a higher production accompanied with a constant utilization of 18.2 million tonnes of fly ash and of 2.5 million tonnes of bottom ash.

This increase of the utilization rate in the construction industry and in underground mining was accompanied by a decrease of the utilization rate in the restoration of open cast mines, pits and quarries and a decrease in disposal on special disposal sites.

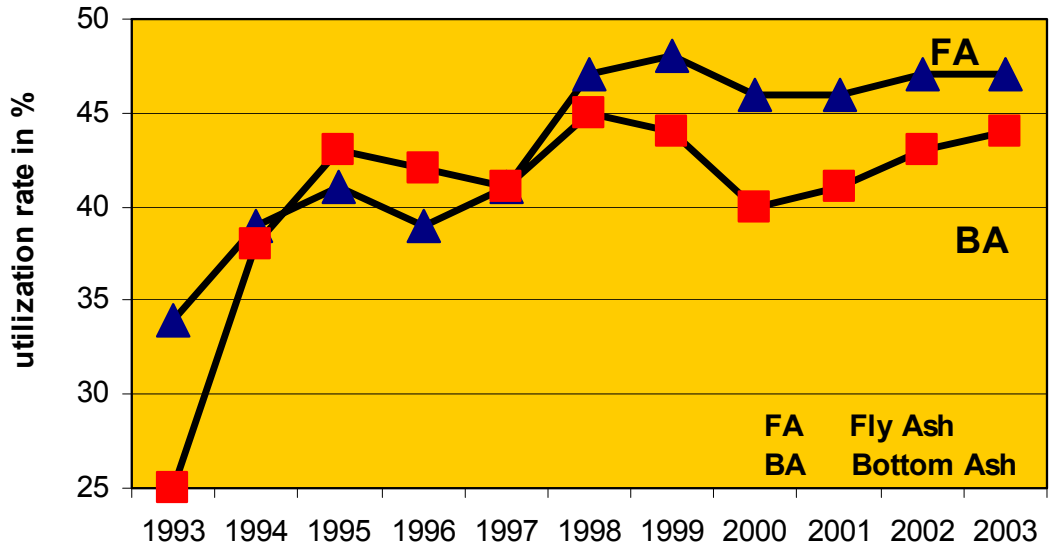


Figure 5: Development of the utilization rates for fly ash and bottom ash in Europe (EU 15) from 1993 to 2003

Ten new members, most of them from Eastern Europe, joined the EU in June 2004. Coal or lignite is used as a fuel for power production in eight of these ten countries. The total amount of CCPs produced is estimated at about 30 million tonnes annually. Exact figures are not available by now. Most of the fuel burned is sub-bituminous coal or lignite. It is obvious that in those countries the status of utilization and the utilization rates are different.

NEW STANDARD EN 450 - FLY ASH FOR CONCRETE

With almost 70 % of the total, fly ash is the most important CCP. Approximately 30 % of the fly ash produced in the EU 15 are used as concrete addition and are replacing a part of the cement in concrete. The European Standard EN 450 “Fly ash for concrete” is of particular importance for the marketing of fly ash because the application as concrete addition provides the highest added value for fly ash.

Category	LOI in % by mass	
	min	max
A	-	5.0
B	2.0	7.0
C	4.0	9.0

Table 1: LOI Categories of the revised EN 450

For the first time, the European Standard EN 450 was published in 1994. It refers to siliceous fly ash, only. Siliceous fly ash is defined by a content of reactive CaO of less than 10 % by mass i.e. it is similar to class F fly ash according to ASTM C 618. In autumn 2004, CEN members voted in favour of a revised version of the standard, which has to be published by the CEN members (i.e. the national standardization bodies of the member states) by august 2005. Some fundamental amendments have been included in the revised version of the standard. The most important ones from the point of view of the producers are:

- introduction of three categories of loss on ignition (LOI) (table1)
- introduction of two classes of fineness
- the acceptance of fly ash obtained from co-combustion of certain types of biomass and waste (table 2)
- acceptance of fly ash processed e.g. by classification, selection, sieving, drying, blending, grinding or carbon reduction or by a combination of these processes in an adequate production plant as fly ash according to the standard

1	Vegetable material like wood chips, straw, olive shells and other vegetable fibres
2	Green wood and cultivated biomass
3	Animal meal
4	Municipal sewage sludge
5	Paper sludge
6	Petroleum coke
7	Virtually ash free liquid and gaseous fuels

Table 2: Types of co-combustion materials of the revised EN 450-1

The former EN 450:1994 has been divided into two parts, EN 450-1 dealing with definitions, specifications and conformity criteria, whereas the new part EN 450-2 covers the conformity evaluation of fly ash for concrete. A system was established, which includes a regular factory production control, internal quality control and auto control testing of samples as well as an evaluation of the results of the auto control testing, an audit testing of sample, an inspection of the production plant and a production control by a notified certification body.

The established system is very similar to the certification system for cement. By this, it is demonstrated that fly ash like cement is a produced building material rather than a waste. The fly ash produced has a guaranteed efficiency, which is taken into account in the concrete design. The fly ash producer (either the power plant operator or a marketing company) is responsible for the quality, efficiency and reliability of the product. The production process is supervised by a third party, which is notified by the building authorities. The system was established in order to enable the use of the cementitious potential of the fly ash.

CO-COMBUSTION OF BIOMASS AND WASTE

The co-combustion of coal and co-combustion materials in coal-fired power plants is a growing issue in Europe. Co-combustion is performed in several countries because of environmental or commercial considerations, e.g. the production of green power by the use of biomass as a fuel to reduce CO_2 emissions or co-combustion of waste as a measure of environmentally sound waste management. In the past, fly ash obtained from co-combustion could be used in concrete on the basis of specific national technical approvals in some of the EU member states. In most of the states this possibility does not exist. The new Standard EN 450-1 includes fly ash obtained from co-combustion of specific co-combustion materials (table 2) up to a percentage of 20 % by mass of the total fuel (i.e. co-combustion material plus coal). The amount of ash derived from the co-combustion material shall not be greater than 10 %. The suitability has to be proven by testing the fly ash from an initial co-combustion in the boiler using the highest intended amount of co-combustion material. In addition, the environmental compatibility of fly ash has to be demonstrated before its use in concrete. As requirements regarding the impact on environment are not harmonised on the European level, yet, the requirements in the place of use of the fly ash have to be met. If the limits of the standard regarding the kind or amount of co-combustion material are exceeded the producer can apply for a European Technical Approval (ETA). An ETA is granted if more detailed testing (compared to EN 450-1) of the fly ash has proven that its relevant properties are not affected by the co-combustion and that the fly ash is environmentally compatible.

ENVIRONMENTAL REQUIREMENTS

The European Construction Products Directive (CPD) from 1988 deals with the subject of emission of dangerous substances from construction products that may have harmful impacts on human health and the environment. The European Commission has mandated the European Standardization Organization CEN/CENELEC to develop harmonised assessment methods and harmonised approaches related to dangerous substances (emissions to indoor air, surface water and ground water). In parallel to this approach on European level, the national authorities in several EU member states are developing or have already developed test methods and environmental requirements. With regard to CCPs the requirements related to content and leaching of trace elements and (sometimes) organic matter are of importance. Requirements in some countries exclude the use of unbound fly ash or bottom ash e.g. in road construction or for filling and grouting purposes. As the requirements are not harmonised across Europe different limits

exist in neighbouring countries. Because of this situation export and import of fly ash between EU member states is increasing. There is a thread that the utilization of fly ash and bottom could be excluded at least for certain applications because of requirements related to environmental considerations.

LEGAL STATUS OF CCPS

In the European Waste Framework Directive from 1991 waste is defined as follows:

"Waste shall mean any substance or object in the categories set out in Annex I, which the holder discards or intends or is required to discard".

The categories in Annex I as mentioned above include:

"Q 8 residues of industrial processes (e.g. slags, still bottoms, etc.)"

and

"Q 9 residues from pollution abatement processes (e.g. scrubber sludges, bag house dusts, spent filters etc.)".

Due to this law, CCPs have legally to be considered as waste. Since the early 90ties of the last century discussions took place on the question if in certain cases a by-product from industrial processes is covered by the definition, i.e. has to be considered as waste or if waste properties could cease at a specific stage of the managing process. A typical example is FGD gypsum, which is on one hand a residue of a pollution abatement process and one the other hand it was produced from scrubber sludge by an oxidation, cleaning and drying procedure aiming at a material, which meets technical specifications of the users (gypsum and cement industry). After several years of discussion it is now generally accepted by the authorities that FGD gypsum has ceased the waste properties by the processing in the power plant.

The case is not clear for fly ash as it is argued that no processing takes place in the power plant and that the recovery operation is a final use of the materials. That would mean that the material is to be handled (collected, transported, stored) as a waste. This means, a concrete producer would use a waste to produce concrete, i.e. the ready mixed plant becomes a waste handling plant. Even if the restrictions or the additional paper work required by the authorities are not too heavy it is the image problem of the concrete, which might become an additional obstacle for the concrete producer to use fly ash.

In the course of a "Communication on Thematic Strategies" on the recycling of waste launched by the European Commission about one year ago, a new discussion on the legal definition of waste /non-waste/by-product and on disposal/recovery has been started. Based on some judgements of the European Court of Justice it could be possible that the definitions will be amended. If a residue of an industrial process is processed or treated for the use as a secondary raw material, if it meets certain specifications in given standards and if it is destined for utilization by a marketing

contract this material could be considered as being no longer a waste. As the European Commission is aiming at increasing recycling and use of secondary raw materials for environmental reasons there is a chance that for these materials the definition would be clarified.

SUMMARY

In Europe (EU 15) about 65 million tonnes of Coal Combustion Products (CCPs) were produced in 2003. The CCPs include combustion residues such as boiler slag, bottom ash and fly ash from different types of boilers as well as desulphurization products like spray dry absorption product and FGD gypsum.

CCPs are mainly utilized 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 mining. They are used as a replacement for natural resources. By their utilization they help to save natural resources and to reduce energy demand and greenhouse gas emissions to the atmosphere for mining and generation of products which are replaced by CCPs.

The most important development in the field of CCP utilization in Europe in 2004 was the approval of a revised European standard on fly ash for concrete. The standard covers siliceous fly ash and includes for the first time fly ash obtained from co-combustion of coal and certain co-combustion materials. The new standard introduces a quality control system for fly ash, consisting of an internal quality control by the producer and an audit testing by a certification body which is notified by the building authorities. Certain restrictions of the utilization of CCPs are caused by environmental considerations and by the legal classification of CCPs as waste. A new discussion has been launched by the European Commission on the legal definition of waste and on the question when the waste properties could cease at a specific stage of a utilization process.

Annex I

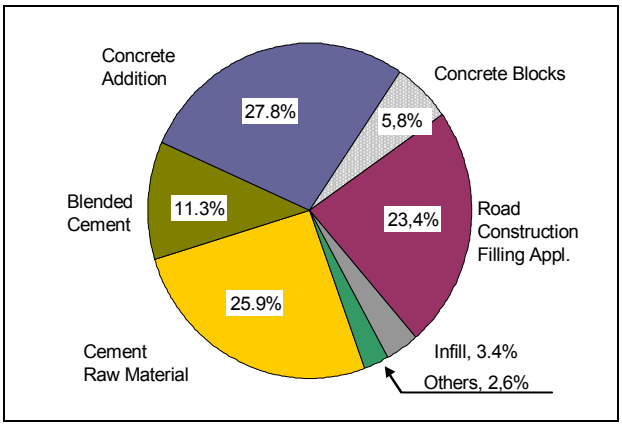


Figure A1:
Utilization of Fly Ash in the Construction Industry and Underground Mining in Europe (EU 15) in 2003
Total Utilization 21.1 Million Tonnes

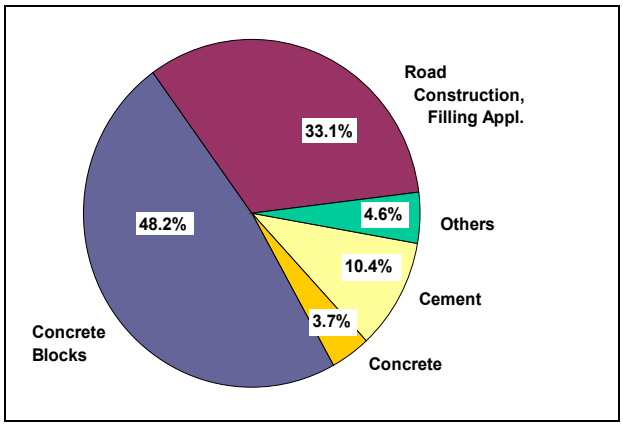


Figure A2:
Utilization of Bottom Ash in the Construction Industry and Underground Mining in Europe (EU 15) in 2003;
Total Utilization 2.7 Million Tonnes.

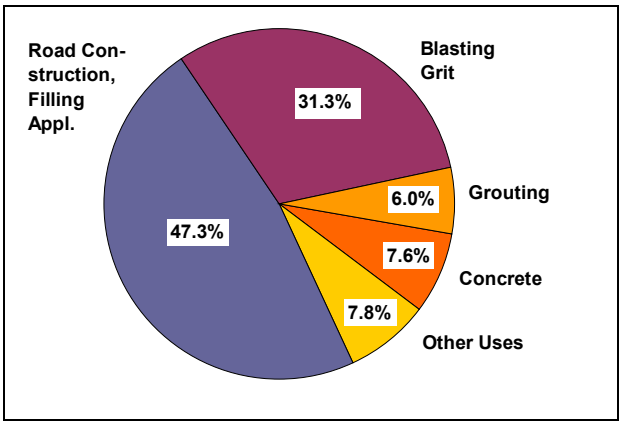


Figure A3:
Utilization of Boiler Slag in the Construction Industry in Europe (EU 15) in 2003;
Total Utilization 2.1 Million Tonnes.

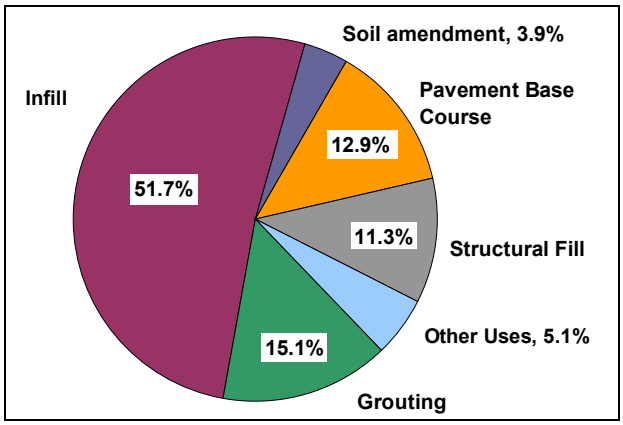


Figure A4:
Utilization of FBC-Ashes in the Construction Industry, Underground Mining in Europe (EU 15) in 2003;
Total Utilization 0.5 Million Tonnes.

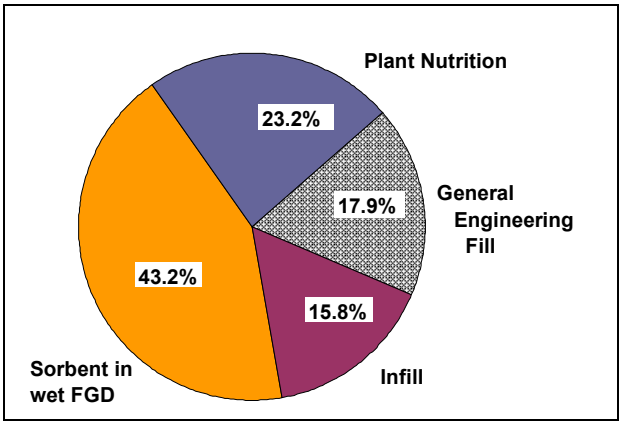


Figure A5:
Utilization of SDA Product in the Construction Industry and as Sorbent in Wet FGD in Europe (EU 15) in 2003;
Total Utilization 0.1 Million Tonnes.

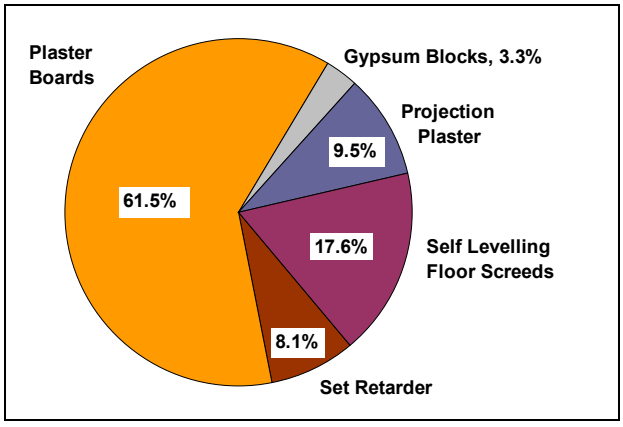


Figure A6:
Utilization of FGD Gypsum in the Construction Industry in Europe (EU 15) in 2003;
Total Utilization 8.0 Million Tonnes.