

## **Production and Utilisation of Coal Combustion Products (CCPs) in Europe**

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### **ABSTRACT**

In 1999, 55 million tonnes of Coal Combustion Products (CCPs) were produced in Europe (EU 15). The CCPs include combustion residues like 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. All combustion residues amount up to 85.1 % and FGD residues up to 13.9 % by mass.

The CCPs are mainly utilized in the building materials 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. The major part of the CCPs is produced to meet certain requirements of standards or other specifications with respect to utilization in certain areas. Due to different boundary conditions regarding climate, taxes and legal situation the utilization rate of CCPs is differing in single European countries.

### **ORGANIZATION AND WORK OF ECOBA**

ECOBA was founded in 1990 by European energy producers to ensure full beneficial and high grade utilization of all CPPs. Therefore ECOBA is active in the development of European standards and is represented on a number of CEN committees. The objectives of the association are to:

- a) encourage the development of the technology for the use of all products from coal-fired power stations, both on the industrial and the environmental levels, with regard to relevant industrial and environmental demands;
- b) promote the mutual interests of their members, internationally and particularly within the framework of the European Organisations, which are of a scientific, technical, ecological and legal nature;
- c) establish and/or develop the necessary legal/regulatory measures for the recognition, acceptance and promotion of the use of all products of coal-fired power stations as valuable recoverable resources;

- d) participate in international activities, including co-operation within the framework of the European Organisations, and
- e) ensure the exchange of information and documentation among the various national and international bodies.

Today, the association has 17 full members from 11 European Countries, all generators of power, and is closely co-operating with comparable associations on other continents. The American Coal Ash Association (ACAA), the Coal Combustion Products Interest Group (CCPIG) of the Canadian Electricity Association (CEA), the Centre for Coal Utilization in Japan (CCUJ) and the National Coal Ash Board of Israel (NCAB) are affiliated members to ECOBA. Besides that, ECOBA is a foundation member of the worldwide CCP Council, a forum for the international exchange of information on CCP via the internet.

ECOBA members consider coal ashes and desulphurization products produced in coal-fired power plants valuable raw and building materials, which can be utilized in multiple environmentally-compatible way. It is the task of ECOBA to propagate this message especially against legislative and standardizing institutions and to communicate the economic and ecological benefits. Therefore ECOBA has installed working committees on communication and marketing of CCPs, on environmental issues and on standardisation. ECOBA is active in the development of European standards, especially in the European standard EN 450 "Fly Ash for Concrete", and is representing the producers of CCPs in a number of CEN committees (Concrete - CEN TC 104, Aggregates – CEN TC 154, Road Materials – CEN TC 227 and Gypsum and Gypsum Based Products – CEN TC 241).

## **PRODUCTION OF CCPs IN EUROPE**

Coal Combustion Products (CCPs) are produced in coal-fired power stations which burn coal or lignite. CCPs are produced during the coal combustion process and also as a result of desulphurisation of flue gases from the power station boilers.

The ECOBA statistics on production and utilization of CCPs reflect the typical combustion products fly ash, bottom ash, boiler slag and ashes from fluidized bed combustion (FBC) as well as the products from dry or wet flue gas cleaning, especially spray dry absorption (SDA) product and flue gas desulphurization (FGD) gypsum.

In this paper the statistics for the member countries of the European Union (EU 15) in 1999 are presented.

In 1999, 55 million tonnes of Coal Combustion Products (CCPs) were produced in Europe (EU 15). Almost 69 % of the total CPPs are yielded as fly ash. All combustion residues amount up to 85.1 % and FGD residues up to 13.9 % by mass.

## **UTILIZATION AND DISPOSAL OF CCPs IN EUROPE**

Most of the CCPs produced were used in the building materials industry, in civil engineering and as construction materials in underground mining (55.6 %) or for restoration of open cast mines, quarries and pits (33.1 %). In 1999 around 2 % of the CCPs were temporarily stockpiled for future utilization and 9.2 % were disposed of only.

CCP utilization is differing in the single European countries due to different boundary conditions regarding climate, taxes, legal situation etc. In some EU countries the utilization rate for CCPs is as high as 100 %, whereas in other countries the utilization rate is not exceeding 10 % due to existing unfavourable conditions.

The rates for utilization and disposal of different CCPs in 1999 are shown in figure 1. As much as 45 to 48 % of the combustion residues were utilized in the construction industry and in underground mining, 37 to 40 % in restoration of open cast mines, quarries and pits, up to 2 % were stockpiled and between 10 to 19 % were disposed of.

Around 86 % of both SDA product and FGD gypsum were utilized in the construction industry and in underground mining. For restoration of open cast mines, quarries and pits 7 % of the SDA product and nearly 6 % of FGD gypsum were used. Furthermore 6 % of the FGD gypsum are stored in temporary stockpiles for future use. Around 7 % of the SDA product was used as a sulfur fertilizer (shown in figure 1 as "Other Uses"), which is an application of rising importance.

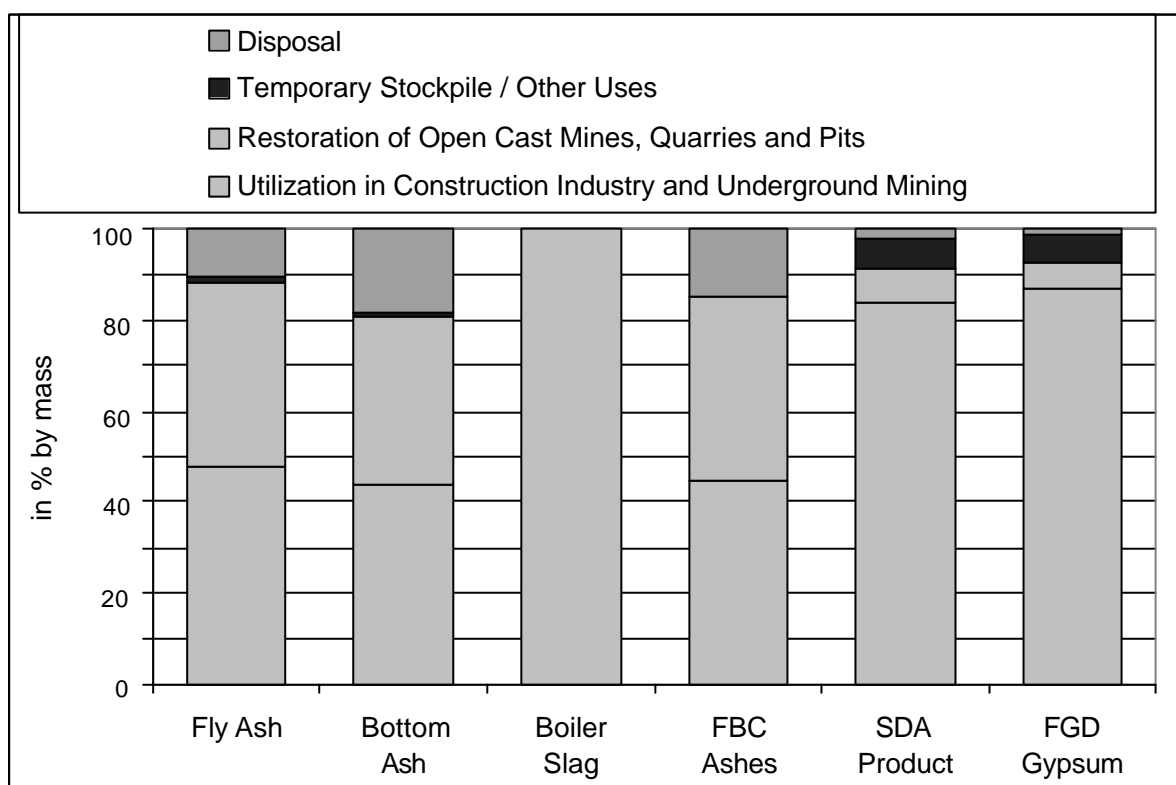


Figure 1: Utilization and Disposal of CCPs in Europe (EU 15) in 1999.

### **Utilization of Fly Ash**

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

In Europe (EU 15) the utilization rate for fly ash in the construction industry is around 48 %, that one for restoration open cast mines, pits and quarries around 40 %. Most of the fly ashes produced in Europe were used as concrete addition, in road construction and as cement raw material. Furthermore they were utilized in blended cements, in concrete blocks and for infill, that means filling of voids, mine shafts and subsurface mine workings.

Approximately 30 % of the fly ashes produced in Europe are used as concrete addition and are replacing a part of the cement necessary for the production of concrete. As this application covers the highest added value for fly ash even greater shares than 30 % (up to 100 %) are directly used for the production of concrete in some countries. For this reason, the European Standard EN 450 "Fly Ash for Concrete" is particularly important for the marketing of fly ash. This standard, published in 1994 for the first time, refers to siliceous fly ash, which is produced by burning of pulverized coal or anthracite. Fly ashes from lignite or other qualities of coal can not be utilized as concrete addition by EN 450. The application of these ashes as addition to concrete have to follow national regulations.

### ***Utilization of SDA product***

In European power plants using spray dry absorption techniques for desulphurization of the flue gases about 0.5 million tonnes of spray dry absorption (SDA) product were produced in 1999. The SDA product is a mixture of the following minerals: calciumsulphite hemihydrate, calciumsulphate dihydrate (gypsum), calciumcarbonate, calciumhydroxide, calciumchloride and calciumfluoride.

Depending on the location of the SDA installation in the flue gas stream (upstream or downstream the ESP) SDA product may contain fly ash up to 60 % by mass. Due to the high content of sulphur and chlorine, SDA product cannot be used in cement bound systems used for construction purposes because of the risk of unsoundness.

SDA product is utilized in the mining industry as a component of mining mortar for stabilizing underground cavities. In the building material industry it is used as an addition in the production of sand lime bricks and has been used for the production of cement clinker in a special clinker production method (Müller-Kühne process). SDA product is also used with great success as sorbent in a wet FGD process in power plants. It has been proven that SDA product can be used without any harm to the environment as a sulphur fertilizer in agriculture. In 1999 nearly 98 % of the total SDA product were utilized in the construction industry and in underground mining. The rest of nearly 2 % is disposed of in disposal sites.

### ***Utilization of FGD gypsum***

The amount of FGD gypsum produced in Europe was about 7.6 million tonnes in 1999. With 5.7 million tonnes most of this gypsum is produced in Germany. Nearly 87 % of the total FGD gypsum produced in Europe is utilized in the gypsum and cement industry. In total 6 % of the FGD gypsum produced is temporarily stockpiled as a raw material base for future utilization.

FGD gypsum is used as raw material for a number of gypsum applications by the gypsum industry because of its purity and homogeneity compared to natural gypsum. The use of FGD gypsum reduces mining of natural gypsum, thus valuable resources are being saved and the environment is being protected. In Germany the gypsum industry has covered about 50 % of

their raw material demand by FGD gypsum in 1999. The application of FGD gypsum for anhydrite to be used in self-levelling floor screeds is very successful. For this application a raw material with high quality is required. The quality requirements, especially with regard to purity and homogeneity, can only be guaranteed with FGD gypsum, as the composition of natural anhydrite and anhydrite produced from natural gypsum is varying too much.

## **SUMMARY**

Political intentions and legislation make the utilization of coal combustion products very important to European power producers. Utilities are forced to utilize rising amounts of CCPs from power plants. Currently nearly 55 % of the CCPs are utilized in the construction industry and in underground mining, in addition nearly 33 % for restoration of open cast mines, quarries and pits. In 1999 around 2 % of the CCPs were temporarily stockpiled for future utilization and 9.2 % were disposed of only. The major part of the CCPs is produced to meet certain requirements of standards or other specifications with respect to utilization in certain areas. Nevertheless, the industry is very active in developing new and high-grade utilization fields for CCPs to maximize the economic and ecological benefits.

