

European Technical Approval for mixed coal ash: A Portuguese experience

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1 Introducing EDP – Energias de Portugal. The production branch

EDP – Energias de Portugal is the main player in Portuguese energy sector and a reference company in the Iberian market, with a strong presence in Brazil and considerable investments in the USA.

EDP in the Iberian Peninsula is present in the whole electricity value chain and also in the value chain of the gas sector.

At the present days, is a world top player in renewable energies.

In Portugal the generation branch, EDP Produção, has the installed power of 10 200 MW, where 1 180 MW are in Sines coal combustion power station, 4 units, placed in the south.

In a regular year Sines production is about 9000 GWh, representing almost 20 % of the Portuguese needs of energy.

The coal combustion is over 3 700 000 ton, producing about 360 000 ton of fly ash, 35 000 ton of bottom ash and 210 000 ton of FGD gypsum.

All the quantities of produced fly ash are sold to the cement and concrete industries.

This presentation is about a technology change and its impact in the coal combustion products (CCP) management.

2 The wet bottom ash system

When Sines power station started its operation, boilers were equipped with a wet bottom ash removal system.

In a system like this, ash is collected in a water-filled hopper at the bottom of the furnace. When a sufficient amount of bottom ash drops into the hopper, it is removed by means of high-pressure water jets and conveyed by sluiceways either to a disposal pond or to a decant basin for dewatering and then transported for disposal.

The operation of this system revealed some disadvantages:

- Water consumption
- Effluent treatment
- Handling of ash and disposal management
- Power Consumption.

For several times it was evaluated the replacement of the wet ashtray with a dry type, but this option seemed to be too expensive.

3 Dry bottom ash equipments

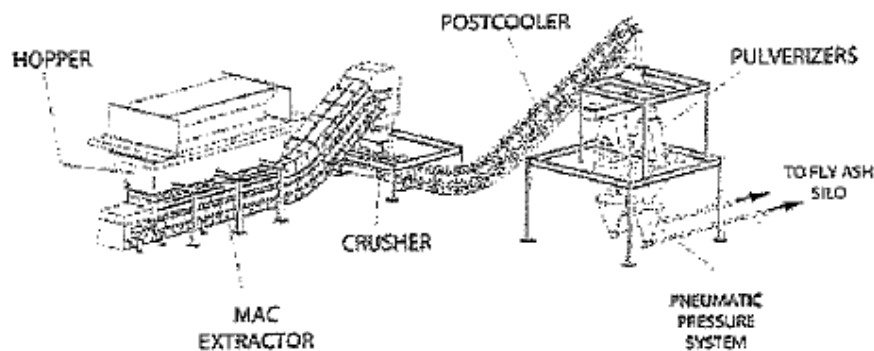
In 2003 a new study was done, based on the industrial use of the obtained bottom ash.

It was considered the solution proposed by Magaldi, who presented technical and economic advantages, with an option to crush and mill the dry ash removed from the bottom of the boiler, mixing it with the ash from the economizer and from air heaters and introducing them into the fly ash circuit, after the electrostatic precipitators.

Dry bottom ash possesses the same physical and chemical properties of fly ash, and the mixture would comply with EN 450-1 requisites.

To take a decision, Ecoba and VGB were listened, we spoke with the main CCP customers and we visited a power station in Spain (LosBarrios, Cadiz, of Endesa), and in Italy (Fusina, Venice, of ENEL).

Between 2004 and 2008, the wet systems were replaced with the dry ones.



(Source: Magaldi)

EDP Engineers worked together with Magaldi to solve the negative aspects, like the replacement of the hammers of the mills every 3 months, which was too expensive. Now the all system is working in a satisfactory way.

4 The standard conformity

The question was whether the coal ash obtained with this process accomplishes with the standards EN450-1 and 197-1 of the concrete and cement.

The managers came to 2 conclusions:

- You can't consider that the mixture is covered by the standards as far as the definition of fly ash is concerned
- Its physical and chemical characteristics are completely equivalent to fly ash characteristics.

The modification was first made in 2 groups who stayed in service with the mixture during 2 years, between 2004 and 2006, with the clients acceptance.

When Sines got the certification with the CE mark for the fly ash, in 2006, many successful tests have been made with the product. However it was taken the option to stop the circuit of injection for bottom ash and fly ash mixing.

In the other 2 units the system was not fully installed, allowing only the dry removal of bottom ash, but not the mixing with fly ash.

Summarizing, at this moment, the installation is

- Unit 4 - 2004, Complete
- Unit 2 - 2005, Complete
- Unit 1 - 2007, with extractor, crusher, and mill, but without injection (for bottom ash and fly ash mixing)
- Unit 3 - 2008, only extractor.

To certify the product for incorporation in concrete, as a type II addition, in 2007 EDP started a process with "Laboratório Nacional de Engenharia Civil" to obtain an European Technical Approval (ETA) for the mix of fly ash and, up to 10%, milled bottom ash.

An ETA allows a construction product with an associated Attestation of Conformity to be placed on the market with CE marking.

An ETA can be granted when any of the following conditions apply:

- no relevant Harmonised Standards for the product exist
- no mandate for such a Standard has been given by the European Commission
- the European Commission considers that a Standard cannot be developed (yet)
- a product deviates significantly from the relevant Harmonised Standards.

5 Introducing Laboratório Nacional de Engenharia Civil

The Laboratório Nacional de Engenharia Civil – LNEC (National Laboratory for Civil Engineering) is a state owned research and development (R&D) institution founded in 1946.

It works in the various domains of civil engineering, giving it a unique multidisciplinary perspective in this field. The main goals of the LNEC are to carry out innovative research and development and to contribute to the best practices in civil engineering.

LNEC also plays a key role in advising the government in technical and scientific matters of civil engineering, as an unbiased and independent body.

The Laboratory has, at present, 630 staff, of which 44% hold a university degree and 25% are researchers with a PhD or equivalent qualification. It also has about 100 science research fellows with grants awarded by LNEC.

6 The steps in the ETA process

A European Technical Approval (ETA) for a construction product is a favourable technical assessment of its fitness for an intended use, based on the contribution made by this product to the fulfilment of the six Essential Requirements, as stated in the Construction Products Directive (CPD) for the construction works in which the product is installed.

According CPD, these requirements are:

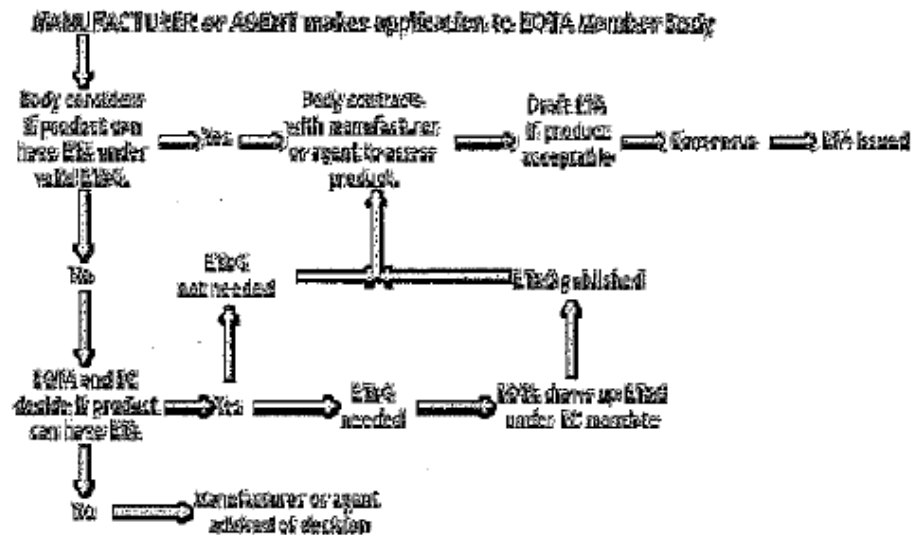
- Mechanical strength and stability
- Safety in the event of fire
- Hygiene, health and the environment
- Safety in use
- Protection against noise
- Energy economy and heat retention.

LNEC is the Portuguese notified body to issue ETAs for any construction product under the CPD, and is a member of the European Organisation for Technical Approvals (EOTA).

In conjunction with an Attestation of Conformity procedure (which is intended to ensure that the product specification set out in an ETA is maintained by the manufacturer), ETAs allow manufacturers to place "CE marking" on their products.

Although in certain circumstances it may be possible for an ETA to be issued on the basis of a Common Understanding of Assessment Procedure (CUAP) agreed among EOTA members (according to the art. 9.2 of the Council Directive 89/106/EEC), in most cases an ETA for a product will be granted to a manufacturer based on the assessment principles set out in an ETA Guideline for the relevant product sector. When a European Technical Approval has been issued it is valid in all European Economic Area (EEA) countries, for a period of five years, renewable thereafter.

The procedures for requesting, preparing and granting of ETA, are established in the Common Procedural Rules for European Technical Approval, issued by the European Commission (EC), and the process flow chart is as follows:



(Source: EOTA)

For the preparation of this ETA it was first examined whether any of the existing CUAP could cover the modified fly ash modified. It was found that the only existing CUAP on fly ash covered fly ashes incorporating co-combustion materials in a proportion higher than that allowed in EN 450-1.

There was thus need to draft a new CUAP, following the recent model already adopted by European Committee for Standardization (CEN) and with reference to the established in EN 450 parts 1 and 2, which was sent for comments in May 2009 and finally endorsed in December 2009.

In the discussion period, the points which have raised questions or comments concerned notably the designation of the modified fly ash and the need to characterize the bottom ash under the factory production control.

The proposed designation "composite" didn't seem appropriate because it may be understood as a mixture of distinct materials when the modified fly ash and the bottom ash have basically the same chemical composition therefore the designation "modified fly ash" prevailed. The principle that it was not necessary to test separately the bottom ash also prevailed, because the dry bottom ash is produced in the same process as the fly ash and the properties of bottom ash to be assessed are controlled in the final product.

Meanwhile, a study was initiated for characterization of bottom ash, fly ash and modified fly ash, covering its chemical and physical characterization, as well as to analyse the influence of the modified fly ash on the properties of concrete, with reference to the results obtained only with fly ash.

The ETA is in the final phase of elaboration, and it is sent for comments during the month of April 2010.

7 Fly ash new management

Presently the system for dry ash removal is installed in all 4 boilers, at Sines PP, but only in 2 of them the system is fully equipped for dry bottom ash removal and mixing with fly ash.

In the other two units, the system is equipped only for dry bottom ash removal, but not for mixing with fly ash.

The fly ash presently produced is certified and CE marked in accordance with EN 450 – 1 and is totally sold for type II addition for concrete and also for cement production in accordance with EN 197-1.

EN 197- 1: establishes, on 5.2.4 – fly ashes (V,W), that fly ash, intended to be used as a major constituent of cement, is obtained by electrostatic or mechanical precipitation of dust-like particles from the flue gases of furnaces fired with pulverised coal.

This definition thus excludes the use of „modified“ fly ash as a main constituent for cement production.

For this reason and in order to provide the needs of our clients, the power plant will maintain the separate production of fly ash and bottom ash in two units.

Once the ETA for modified fly ash is granted, the power plant will produce and manage two certified ash products:

- Fly ash in accordance with EN 450-1;
- Modified fly ash in accordance with the applicable ETA.

8 Conclusion

The decision to install the Magaldi system revealed significant advantages in water economy and in the wastewater treatment: about EUR 500 000 per year.

Bottom ash market valorisation turns the economic and financial evaluation of the investment project with a positive return.

In the future, once the ETA for modified fly ash is granted, it will have a beneficial effect on ash disposal and in the Sines landfill.

The environmental impact of CO₂ reduction on cement industry is also positive.

The additional quantities of coal ash used in the cement and concrete industries allow to face the decrease in fly ash production derived from the reduction of generation from coal combustion plants.

References

- [1] ECOBA: Statistics on Production and Utilisation of CCPs in Europe in 2007
- [2] MAGALDI News: Issue 13, 1/2008
- [3] EN 450 - Fly ash for concrete: Part 1 and 2
- [4] EN 197 – Cement: Part 1
- [5] Common Procedural Rules for European Technical Approval
- [6] EOTA – (www.eota.be)