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English Version

Fly ash obtained from co-combustion - A report on the situation in Europe

Cendres volantes obtenues par co-combustion - Rapport
sur la situation en Europe

Flugasche, die unter Verwendung eines Anteils an
Mitvergrennungsstoffen gewonnen wird -
Sachstandsbericht über die europäische Situation

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Foreword

This document (CEN/TR 15677:2008) has been prepared by Technical Committee CEN/TC 104 "Concrete and related products", the secretariat of which is held by DIN.

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Introduction

The test results included in this report demonstrate, with certain exceptions, that the properties of fly ashes obtained from the co-combustion of biomass and waste used at this time, do not significantly differ from fly ashes obtained from the combustion of pure coal. In some cases, changes in the chemical composition of fly ash occur, which may be of technical relevance to concrete. These changes have to be taken into account. Examples are:

- higher content of alkalis in fly ash from the co-combustion of straw;
- increase of P_2O_5 in case of the co-combustion of sewage sludge;
- increase of vanadium and nickel content in fly ash obtained from the co-combustion of petcoke.

The requirements of the EN 450:1994 regarding harmlessness and the effects of fly ashes in concrete are met. In some cases the maximum amount of combustion materials added to the coal is limited by the requirements of EN 450.

Investigations on concrete with fly ashes from co-combustion did not show any significant change in concrete properties. This applies to properties of fresh concrete, to the efficiency of admixtures like air entraining agents and retarders, as well as to properties of hardened concrete like strength development and ingress of chloride ions into the concrete. In general, tests on the leaching of concrete with fly ash from co-combustion did also not deviate from concrete with fly ashes from pure coal. Merely in the case of co-combustion of petcoke an increase in the leaching of vanadium was found. In this case a limitation of the amount of petcoke added to the coal may be required.

Fly ashes obtained from the combustion of coal have been used as a valuable concrete constituent for more than 30 years in Europe. At the beginning, utilisation was based on national standards in Member States. The European standard EN 450 was first published in 1994 and according to this standard fly ash for concrete is defined as follows:

“Fine powder of mainly spherical, glassy particles, derived from burning of pulverized coal, which has pozzolanic properties and consists essentially of SiO_2 and Al_2O_3 , the content of reactive SiO_2 , defined and determined as described in ENV 197-1, being at least 25 % by mass.

Fly ash is obtained by electrostatic or mechanical precipitation of dust-like particles from the flue gases of furnaces fired with pulverised anthracite or bituminous coal.”

Since the beginning of the nineties coal-fired power plants started to burn co-combustion materials such as biomass and waste. As an example, sewage sludge was offered to power plant operators for co-combustion in order to get rid of the material. Power plants made it possible to remove animal meal at low costs when the production of animal food from animal meal was no longer permitted. In addition, biomass is used more and more for co-combustion in order to reduce emissions of CO_2 from the combustion of fossil fuels. In some countries power generators have been committed by their governments to co-combust biomass in order to meet Kyoto targets.

This development was taken into account when the revision of EN 450 began in 1998. Fly ash obtained from co-combustion was included in the scope of the standard by extending the definition mentioned above:

*“Fine powder of mainly spherical, glassy particles, derived from burning of pulverized coal, **with or without co-combustion materials**, which has pozzolanic properties and consists essentially of SiO_2 and Al_2O_3 , the content of reactive SiO_2 as defined and described in EN 197-1 being at least 25 % by mass.*

*Fly ash is obtained by electrostatic or mechanical precipitation of dust-like particles from the flue gases of furnaces fired **with pulverised coal, with or without co-combustion materials**, see clause 4.*

Fly ash may be processed, for example by the classification, selection, sieving, drying, blending, grinding or carbon reduction, or by combination of these processes, in adequate production plants. Such processed fly ash may consist of fly ashes from different sources, each conforming to the definition given in this clause. If one or more of incoming fly ashes are obtained from co-combustion, then the processed fly ash shall be considered as fly ash from co-combustion.

NOTE *Municipal and industrial waste incineration ashes do not conform to the definition given in this clause."*

A general principle kept in this standard is that properties of fly ash regarding their effects on, and their contribution to concrete properties may not be changed due to co-combustion. This has to be proven by suitability tests and current quality control. In addition, the environmental compatibility of concrete with fly ashes has to be demonstrated.

The data presented in this report were collected by an enquiry, which was launched by CEN/TC 104/WG 4 in January 1998. The information received was supplemented by test results obtained from additional investigations.

1 Scope

This CEN report compiles the experience collected from the co-combustion of biomass and waste by 2002. The data and the test results are given from systematic research projects and from investigations on fly ash obtained from co-combustion in different power plants in the framework of national certification processes or from other co-combustion tests. The report:

- includes the existing national regulations for the demonstration of the suitability of fly ash from co-combustion,
- gives a survey on the combustion materials used so far,
- describes the chemical composition of fly ashes obtained from co-combustion,
- lists the chemical and physical properties of the fly ashes, which are relevant to the technical and environmental properties of concrete,
- includes test results of properties of concrete with fly ashes obtained from co-combustion.

2 National regulations

2.1 General

In most countries of the EC the non-harmonized product standard EN 450:1994-09 entitled “Fly ash for concrete — Definitions, requirements and quality control” is used. The basic experience with EN 450 is very positive.

In the course of environmental regulations, power station operators are forced more and more to fire co-combustion materials alongside the usual hard coal. Some countries of the EU already gained experiences with the co-combustion of high calorific materials and transferred these into appropriate national sets of rules. Information concerning these rules is to be reported in the following after giving some essential definitions.

2.2 Terms and definitions

For the purposes of this CEN Report, the following terms and definitions apply.

2.2.1

fly ash

fly ash is a fine powder of mainly spherical, glassy particles, derived from burning pulverized coal, which has pozzolanic properties and consists essentially of SiO_2 and Al_2O_3 , the content of reactive SiO_2 defined and determined as described in ENV 197-1, being at least 25 % by mass; fly ash is obtained by electrostatic or the mechanical precipitation of dust-like particles from flue gases or furnaces fired with pulverized anthracite or bituminous coal

[EN 450:1994-09]

2.2.2

fly ash obtained from co-combustion

fly ash that is generated from firing pulverised coal, to which a certain amount of co-combustion material has been added