ecra

european cement research academy

Newsletter 6/2003

Contents:

Next workshop to come:

- Plant Examinations
  December 2-4, 2003

For details see: http://www.ecra-online.org

Performance of CEM II Cements

Portland composite cements attract further attention through research activities

Blended cements validation as suitable binders for concrete is required at a European level. A large evaluation within the European network "European construction in service of society (ECO-Serve)" therefore should contribute to a even broader use of blended cements. With the objective of promoting the application of blended cements, the project contributes to the development of "clean processes and technologies" by reducing CO_2 emissions.

The cement industry is one of the energy-intensive sectors of industry and, as energy costs account for a high proportion of the cost of cement production, has always endeavoured to reduce fuel and electric power consumption. The imposition of specific climate protection targets in the early 90s added a further aspect. As the process technology potential of CO_2 reduction through further optimisation of kiln and grinding systems is virtually exhausted, the manufacture of cements with several main constituents assume particular significance. As a result of the reduction in clinker content, CO_2 emissions during the manufacture of these cements are lower than with Portland cement.

European cement market

Ecological and economical reasons initiated a change in the development of different types of cement throughout Europe. CEM I cements are being increasingly replaced by CEM II cements which contain other main constituents in addition to clinker. **Fig. 1** gives a survey of the European cement sales for the year 2001 according to Cembureau statistics. Portland cement continues to play the dominant role in the 52,5 strength class, but in the 32,5 and 42,5 cement strength classes there have been substantial moves towards CEM II cements. Portland limestone cements are most frequently used, followed in second place by Portland composite cements CEM II-M with more than two main constituents. CEM II-M cements have shown the greatest increase in recent years.
However there are partly considerable differences regarding cement types in various European countries. Besides regional selling conditions this also has to be attributed to restrictions in view of the application of some of the Portland composite cements. The broadening in the use of blended cements therefore seems to have further development potentialities on a European level.

The ECO-Serve network

On November 15th 2002, the European Thematic Network "European Construction in Service of Society" (ECO-Serve) was established. One of the specific objectives of the ECO-Serve project is the reduction of the adverse environmental impact of the pavement and concrete construction industry on the external environment. The specific objectives of ECO-Serve will be met through initiation of a number of clusters; four clusters addressing technical issues and one addressing the issues of management, communication and exploitation of results. Further information is available on the ECO-Serve website "www.eco-serve.net". One of the technical clusters deals with the production and application of cements with several main constituents. The cement industry is represented through participation of Norcem, Italcementi, Schwenk Zement KG and the Research Institute in Düsseldorf. Apart from allowing an exchange of information between the participants from different European countries, which is to provide for the Europe-wide availability of research results obtained at national level, this programme also serves to determine those parameters of concretes made from cements containing several main constituents that are relevant to durability.

Durability of concrete with blended cements

In general, all cements in accordance with EN 197-1 are suited for producing concrete acc. to European concrete standard EN 206-1. With regard to the durability of the concretes made with these cements, however, differences induced by the cement type used have to be taken into account depending on the area of application. The concrete standards of some European countries lay down correspondingly different application rules depending on the expo-

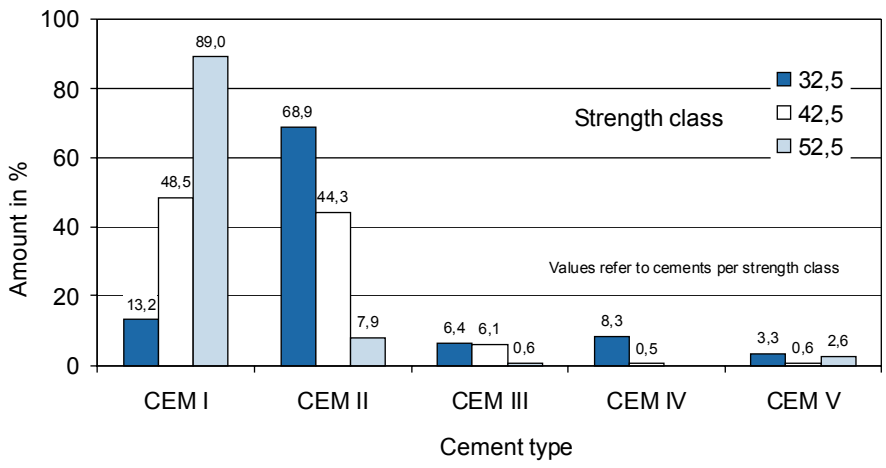


Fig. 1: European cement sales for 2001 (acc. to CEMBUREAU statistics)

sure class that a structural element is to be classified in. Restrictions regarding the applicability of cements have been imposed on a number of CEM II-M cements previously not standardised. These restrictions merely relate to application in structural elements exposed to freeze-thaw and chloride attack in particular. The Research Institute therefore started extensive investigations to determine the properties of concretes containing new CEM II cements. First results show, that concrete with Portland composite cements (CEM II-M) with up to 35 wt. % limestone and blastfurnace slag show a durability comparable to wellknown cements which have been used in widely any kind of exposure. As an example **fig. 2 and 3** show results on the carbonation and the chloride migration coefficient of concrete using these CEM II cements compared to approved cements. The results indicate, that concretes with these cements have an adequate resistance to carbonation- and chloride-induced steel corrosion in concrete for components in building construction.

Fig. 2: Carbonation of concrete with Portland composite cements compared to approved cements

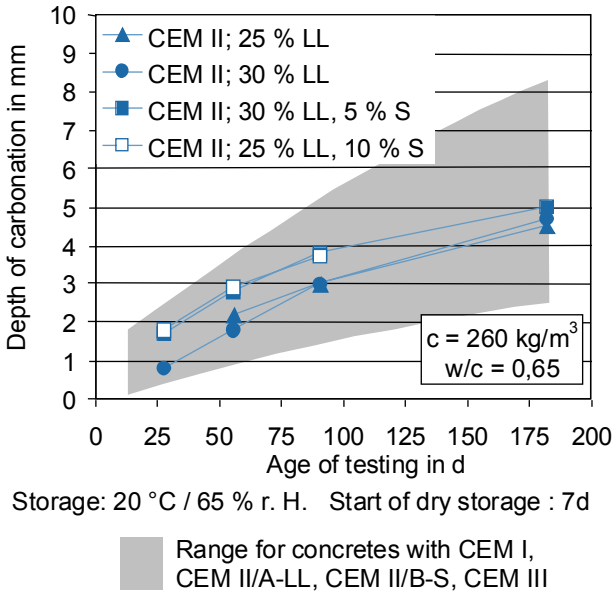
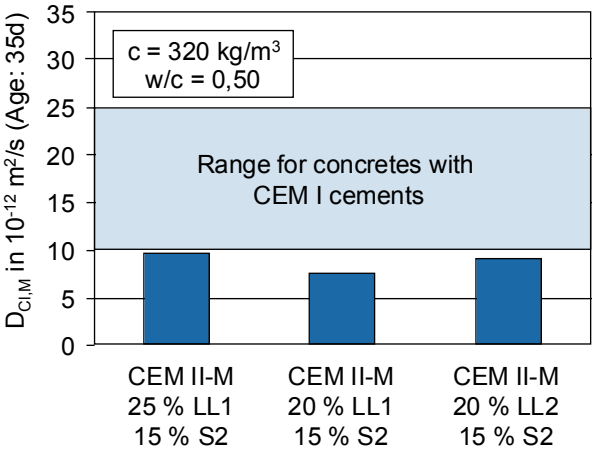


Fig. 3: Chloride migration coefficient $D_{Cl,M}$ for concrete with Portland cements and Portland composite cements with lime-stone (LL) and blast furnace slag (S)



Planning, Performance and Evaluation of Plant Examinations

Workshop imparts methodologies of kiln balances and measuring techniques

The optimisation of the cement kiln plant operation with respect to economy, efficiency and environmental impact can be realised by performing energy and mass balances as well as mill examinations. To achieve useful and comparable results, standardised methodologies have to be used and trials have to be prepared, carried out and evaluated very properly. The workshop imparts VDZ methodologies based on specification VT 10 "Executing and Evaluation of Kiln Performance Tests".

Purpose of plant investigations

In cement plants kiln performance tests do not only serve to gather data on the performance of the kiln system (e.g. clinker output, fuel-energy consumption) but are also for instance carried out for proving warranty performance data. Performance tests are also important to create a reliable basis for the optimisation of individual system components. For example, the utilisation of secondary fuels usually entails higher chlorine input into the kiln, which in some cases results in malfunctions due to increased coating formation in the kiln inlet section and the lower cyclone stages. A kiln trial, aiming at the investigation of material cycles, can be a reliable basis for the design or the upgrading of a bypass system. Balance investigations for trace elements can be carried out to get more knowledge about the behaviour of heavy metals in the kiln plant. For the installation of emission abatement techniques like SNCR (Selective Noncatalytic Reduction) for NO_x reduction it is recommended to measure the gas composition and temperature profile in the riser duct to find the optimum position of injection nozzles. The investigation of cement mills can help to find the causes of quality problems which are due to malfunctions of the grinding plant.

Planning of plant trials

The reliability of measuring values depends on a successful realisation of a performance test. In the planning phase of a plant trial many de-

tails have to be considered. The essential operating data should already have been determined during the planning phase. All circumstances of the performance test and all samplings and measurements, which have to be carried out, should be fixed in a measuring plan. The inspection of the measuring sites prior to a plant trial is also necessary to ensure the success of the examination. During the workshop an example of the planning procedure of a performance test will be demonstrated. Further the used methods for the measurement of mass and volume flows, dust concentrations, heat losses, gas analysis and the methods of taking representative samples will be presented. Beside the necessary measurements for the performance test it is mostly recommendable to make additional measurements and samplings in order to evaluate the kiln operation and the level of material cycles.

Evaluation of energy and mass balances

An English version of the specification VT 10 ”Executing and Evaluation of Kiln Performance Tests” will be distributed to the participants of the workshop. Based on the given evaluation equations, the formulation of mass and energy balances will be demonstrated with a practical example. First a mass balance is drawn up in order to check the precision of the determined mass flows. Then the calculation of the main parts of the energy balance will be presented. The participants have the possibility to apply the specification and the given equations by themselves with a practical example. Another topic of the evaluation of kiln trials are investigations of material cycles and characteristics of balances of trace elements.

Fig. 2: Sampling in a ball mill

Examination of cement mills

A separate part of the workshop deals with examinations of cement mills. The basis for the optimisation of a grinding plant is also a performance test. The methods to determine the efficiency of comminution and separation will be presented and possibilities of improvement will be discussed.

Sampling and measuring techniques

Taking representative samples and sample preparation is of decisive importance for the chemical analysis. Beside samples of solids, taken from belts or at the discharge end of conveyers, also dust samples from gas streams have often to be taken. During a practical training several measuring techniques (e.g. measurement of volume flow and dust concentration) and the procedure of sample treatment for comminution, homogenisation and preparing average samples will be imparted to the participants.

Fig. 1: Measurement of tertiary air volume flow