Katarzyna Synowiec
Department of Building Materials and Process Engineering
Faculty of Civil Engineering
Silesian University of Technology

DISSERTATION ABSTRACT

Forming of the properties of low-clinker fly ash – slag cements

Supervisor: prof. dr hab. inż. Zbigniew Giergiczny

Worldwide cement industry must face the growing environmental requirements towards conservation of natural resources, energy savings, as well as reduction of dust emissions and greenhouse gases, mainly CO_2. One of the major directions of action is to reduce the Portland clinker content in cement composition in favour of non-clinker constituents. The production and the use of composite cements allow to adjust to objectives of sustainable development policy, i.e. by reducing production costs, increasing the rate of wastes utilization, reducing the production of Portland clinker which is raw material and energy – intensive process, decreasing emission rate. Although the use of more and more mineral additives diminish their supplies and forces to seek alternative solutions.

Considering the potential possibilities of extending the scope of application of standardized components of cement, the limited use of calcareous fly ash was noticed, despite its considerable resources and interesting properties. The most commonly used main constituents of cements, beside Portland clinker, are siliceous fly ash, ground granulated blast furnace slag and limestone. Available in Poland in large quantities calcareous fly ash is not widely used in cement production currently, especially in the composition with ground granulated blast furnace slag. Calcareous fly ash is a by-product derived from brown coal dust burning, stands out with richer chemical and mineral composition than siliceous fly ash. Due to the chemical and phase

Synowiec

composition and its hydraulic-puzzolanic properties, fly ash reveals some resemblance in this respect to the granulated blast furnace slag.

Conducted researches and experimental work on the use of composite cements with two main components, beside Portland clinker, confirm that the physical and mechanical properties can be fully useful in the construction industry, and in certain compositions are even more favourable than cement with the addition of only one ingredient. So called synergic effect that is the positive development of the properties of cement composites is observed.

The objective of this dissertation was to determine the properties of low-clinker composite cement, containing granulated blast furnace slag and calcareous fly ash. Simultaneous use of calcareous fly ash with granulated blast furnace slag in the cement composition was applied to check how the synergy of these ingredients affect the development of the performance of the cement, which were verified with concrete tests.

The dissertation is a theoretical – experimental study. The scope involves the study of literature and experimental researches. In part I, the purpose and the scope of the dissertation were formulated. As the study of literature, which is the II part of the work, in Chapters 1 to 3, the properties of granulated blast furnace slag and fly ashes and their influence on the properties of cement composites were analyzed. Experimental part of dissertation, part III, included two stages of research, preceded by a description of the tests methods (Chapter 4) and the characteristics of the components (Chapter 5). In the first stage properties of cements, grouts and mortars with fly ash - slag cements in variable proportions of the main components were characterized, which is the subject of Chapter 6. Cements used in the second stage of the experimental part were selected using multi-criteria comparative analysis, course of conduct is described in Chapter 7. In the second stage of the study, described in Chapter 8, concrete mix with fly ash – slag cements were designed and their properties as well as hardened concrete properties were evaluated. For comparison of properties, cement with siliceous fly ash and industrially produced slag cement CEM III/A 32,5N - LH/HSR/NA were used as a reference. The introduction of industrially produced cement with known range of applications allowed to assess the effect of both calcareous and siliceous fly ash. Properties of composites with ternary cements with respect to the properties of concrete with cement containing only ground granulated blast furnace slag were assessed. Part IV contained ssummary of the study, while conclusions are the V part of dissertation.

Katarzyna Synowiec 06.06.2016