ABSTRACT

This dissertation considers the issues related to the shaping of the composition of modern concrete, taking into account ecological requirements. Limiting the consumption of non-renewable natural resources and reducing the level of dust and greenhouse gas emissions, mainly CO_2, accompanying cement production are measures necessary to achieve climate neutrality of the cement industry. Currently, the most effective way to reduce CO_2 emissions in cement production is to replace Portland clinker (K) with non-clinker main components in its composition. In Poland, the most commonly used non-clinker main components of cement are industrial by-products: granular blast furnace slag (S) and silica fly ash (V). Limited availability of granulated blast furnace slag (S) and silica fly ash (V) on the domestic market causes increasing use of limestone (LL, L) as a non-clinker component of the main cement.

The study conducted in the dissertation describes the information and requirements related to the use of low-emission cements. The dissertation presents examples of innovative applications of low-emission cements and analysis of the factors limiting their wide application in construction.

In the research part of the dissertation, the influence of non-clinker main components on the properties of cement in the three-component systems K-S-LL, K-V-LL and K-S-V was analyzed. The possibility of shaping the properties of Portland ternary cements CEM II/C-M(S-LL) and CEM II /C-M(S-V) and ternary cement CEM VI (S-V) produced in industrial conditions was assessed. The influence of the lowered w/c ratio and the maturation temperature on the properties of the above cements was determined. The possibilities of using the above-mentioned low-emission cements in ordinary concrete, in concrete intended for prefabrication, in: self-compacting concrete (SCC) and high-strength concrete (BWW), as well as in frost-resistant and massive concrete, was assessed. In the research as reference cements were used Portland cements CEM I and metallurgical cement CEM III/A. Attention was paid to the environmental aspects related to the use of low-emission cements, especially the level of CO_2 emissions.

The obtained test results prove that with the appropriate shaping of the concrete composition and the use of currently available admixtures, low-emission multi-component cements can be successfully used in many areas of civil engineering, where so far Portland cements CEM I and multi-component Portland cements CEM II/A, B have dominated.

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