The effect of the particle size differentiation of lignite fly ash on cement industry applications

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ABSTRACT

The chemical and mineralogical composition of lignite fly ash varies as a function of the prevalent conditions in both the processes of power production and lignite mining. The differentiation of the qualitative and quantitative composition of the Greek calcareous lignite fly ash, as a function of its particle size distribution, is verified in this paper. According to the results of the conducted research, a fine-grained fraction of considerable amount presents properties that obstruct the sustainable exploitation of lignite fly ash in cement industry applications. On the other hand, the same grain fraction (because of its hydraulic properties) can be utilized in other sort of applications, based on different criteria. The coarse-grained fraction (which reflects a low proportion to the total fly ash output) presents the same undesired characteristics as well. However, the intermediate grain fraction (75-150μm) indicates the highly desirable properties regarding the utilization of fly ash as pozzolanic additive in the production process of cement. In addition, the mechanism of the formation of the intermediate grain fraction strongly prevents the factors that cause the variation of its quality. It is therefore the optimum part of the whole amount of lignite fly ash, to be utilized as additive in cement manufacturing.

The chemical and mineralogical composition of the different lignite fly ash grain fractions was defined by means of XRF and XRD respectively. STIM and RBS methods were applied for the determination of particle size and matrix composition, while PIXE was used for the quantitative analysis of minor and trace elements. The Loss on Ignition tests were carried out by TGA. The different FA grain fractions were subjected to N2 adsorption using BET Method in order to determine their specific surface area (SSA). The critical temperatures for the physical and chemical conversions have been defined by oxidizing atmosphere tests and the specific gravity after the application of SG-ASTM C642.

The transportation cost of fly ash and the variation of its quality are the major factors that restrain the utilization of this material in the production process of cement industry.

Through this paper, the authors try to contribute to the crucial goal of the expansion of the utilization of lignite fly ash in Greek cement industry by proposing a more effective way of using this material, mainly by taking advantage of its basic chemical and mineral properties.

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