X-RAY AND THERMAL ANALYSIS OF CEMENTS AND CONCRETE FOR EVALUATION OF CEMENT ADDITIVES AND CONCRETE ADMIXTURES

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Cement additives and concrete admixtures have been in use since the 1930s to improve the quality of building material components. Important quality enhancements include strength, set time, freeze-thaw behavior, color, workability, durability and increased grinding efficiency. The effect of additives on the properties of cement and concrete depend to a large extent on the composition of the cement. Therefore, detailed analysis of cement can help improve the additives used to optimize the performance of cement and concrete.

Rietveld analysis of x-ray powder diffraction patterns is a powerful tool in the analysis of cement samples due to its ability to give precise quantitative analysis of crystalline phases and total amorphous content despite similar chemical composition. Verifying the accuracy poses a particular challenge due to the extremely complex nature of cement mixes. Various approaches to verify the accuracy will be presented, including the use of thermal analysis and selective dissolution techniques.

Worldwide manufacture of cement accounts for about 5 % of total world CO_2 production. To mitigate the problem, cement can be replaced by secondary cementitious material (SCM), primarily fly ash and blast furnace slag, without adverse effects in the concrete. Both fly ash and blast furnace slag are industrial waste products and pose a challenge to the x-ray diffractionist as both are either poorly crystalline or amorphous. Attempts to validate the composition of cements containing secondary cementitious material will be presented.