Influence of feldspar powder on morphology of ettringite crystal grown in a solution

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Ettringite is a rare natural mineral. This material is, however, a very important mineral in cement technology because it relates to an early-stage hydrate of Portland cement. The growth of ettringite within the matrix of any solidified body poses significant structural problems. In particular, morphologically, ettringite crystallizes into an acicular crystal habit with a large aspect ratio. The growth of these acicular crystals can exert substantial dilative stresses on the object, which results in microcracking, swelling and, eventually, failure. Thus, it is most important to clarify the various factors that control the morphology and affect the rapid growth. Many efforts have been performed to clarify the morphology change of ettringite by additiing various materials such as chemical admixtures for stable and high perfomance concrete and related materials. In particular, the effect of calcite in promoting the growth of ettringite is widely known both experimentally and empirically. It has been reported that the presence of limestone stabilizes ettringite and that the amount of ettringite increases in cement containing limestone powder. Why the growth of ettringite crystals is promoted in the presence of calcite, however, has not yet been clarified. Limestone (calcite) will be increasingly used in concrete as a filler in the future, and thus, it is important to clarify the mechanism.

We have studied to clear this reason by using in-situ observation method, which is an extremely effective method for clarifying the growth behavior of crystals in a solution. In-situ observation of ettringite crystal with calcite demonstrates that spherulite with calcite in its core is formed first followed by the generation of acicular crystals. It may be concluded that the acceleration of ettringite crystal growth on adding calcite may result from the rapid generation of spherurites as a result of the decrease in the activation energy of nucleation and the growth of a high density of acicular crystals by secondary nucleation. In-situ observation of ettringite crystal growth with various materials such as plagioclase and orthoclase, as well as calcite has also been carried.

In this study, in-situ observation results of ettringite crystal growth in a solution containing a small amount of plagioclase, orthoclase and other materials are reported compared with calcite, and the cause of promoting of ettringite crystal growth is also discussed.