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DISCUSSION

A DISCUSSION OF THE PAPER "UNAMBIGUOUS DEMONSTRATION OF DESTRUCTIVE CRYSTAL GROWTH PRESSURE" BY S. CHATTERJI AND N. THAULOW[1]

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Introduction

This interesting paper and the discussion (1–3) clearly demonstrated that crystallization pressure may occur with much additional space available. This idea is still not well recognized by much research, as discussed by Dr. Hime (2). This means that whether the crystallization process increases solid volume is not an important issue.

There is some evidence showing that a solid-volume reducing reaction can still cause obvious expansion (4,5). It is well known that the following dedolomitization is a solid-volume reducing process.

$$CaMg(CO_3)_2 \ + \ 2MOH = Mg(OH)_2 + CaCO_3 + M_2CO_3$$

where M represents Na, K or Li. It causes a 4.3% volume reduction. However, when pure dolomite particles (0.015–0.8mm) mixed with Portland cement, with dolomite and cement ratio 4:1 and compacted with 300MPa pressure, the compacts showed obvious expansion when dedolomitization occurred. The same result was also observed for the following alkali-magnesite reaction, while the net solid volume might reduce 12.3% from calculation (4):

$$MgCO_3 \ + \ 2MOH = Mg(OH)_2 + M_2CO_3.$$

Further results showed that the expansion of compacts highly correlated with the degree of reaction in the compacts (4).

An interesting experiment was carried out by Prof. Gillott in the early 1960s (6). Using a specially designed cell containing dolomite powder and alkali solution, the volume of the system could be monitored accurately. No expansion was observed after obvious dedolo-

[1]Cem. Concr. Res. 27, 811–816 (1997).
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mitization. The main difference between the cell test and the compact bar test is that dolomite particles were loosely gathered in the cell rather than tightly packed in the compacts.

These results agreed quite well with the findings by Chatterji and Thaulow (1) that there exists a critical crystalline amount for crystal growth pressure to occur. Further, it is reasonable to predict that this critical amount is related to the space available. The larger the space available, the higher the critical amount will be. Therefore, the expansion of dedolomitization failed to be recorded in Gellott’s cell test, although considerable amount of dedolomitization was detected. Similarly, Dr. Idorn (7) stressed recently that no expansion was observed when ettringite crystals deposited in air pores or cracks.

The difference between crystal growth from melt and from chemical reaction is obvious. The formation and growth of crystalline products from chemical reactions are usually controlled by the diffusion of reactants and the characteristics of these products. For dedolomitization, products usually produce in situ. But the crystals are extremely fine and sometimes poorly crystallized in reactive aggregates. Therefore, in this case, the expansion might be a combination of several expansive forces rather than pure crystallization pressure.

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