

Haraldur Ásgeirsson:

AN EPILOGUE

The author of this short comment is not well enough informed in this special field of science to judge the specific value of the congress papers which are printed here. It is hoped, however, that these papers represent some progress and an increase in knowledge in this important science.

The writer appreciates that general progress has occurred in Iceland due to the discussions that took place at the symposium and in succeeding discussions and correspondence. We in this country have been seriously concerned about the durability of Icelandic concretes, since we are aware of the potential reactivity of the aggregates and the extremely alkaline cement which is used. Therefore we have good reason to be appreciative.

In presenting H. Vivian's paper at the conference special attention was requested for his second conclusion, that "too much alkali may diminish alkali-aggregate expansion." Conference participants were requested to comment on this, because of special local interest. H. Vivian was also notified through correspondence.

The author has received the following two comments on this point through correspondence:

1. From H. Vivian in a letter 1975.09.29:

"Increments in the alkali content of cements increase the rate of silica reaction. Increments greater than some arbitrary and variable amount do not increase mortar or concrete expansion; they reduce expansion. The amount of alkali that causes significant reaction and expansion of 1:2 mortar specimens in less than 1 year lies between 0.6% and 2% total $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ expressed as a percentage by weight of cement. There are very good reasons why rapid

mortar expansion occurs when the cement alkali content increases. Large amounts of alkalis react rapidly with opal and produce reaction products that absorb water and rapidly transform from the gel to sol state. This transformation may occur in a series of superficial changes. The sol as it forms penetrates into the spaces in the cement paste surrounding the reacting particle, does not exert expansive forces on the paste and consequently does not expand the specimen."

2. From S. Diamond in a letter 1975.09.02

"You may recall that during the conversations I expressed the notion that perhaps one of the reasons that comparatively little damage had taken place in Iceland so far, inspite of the high alkali content of the cement and the considerable reactivity of the aggregate, might be that the cement was too high in alkali. You asked for some documentation, and I am enclosing what I can find.

The basic idea is that the reaction product gel is formed in-situ at a reasonably low water content, takes up water, swells and exerts pressure which leads to damage. However, the mechanical rigidity of reaction product gels, if they are at all like alkali silicates studied in the laboratory, is a function not only of their water content, but of their composition. At a sufficiently high sodium to silica ratio (within the gel) the gel becomes fluid, (i.e. of very low viscosity) at a low water content. Such gels, unless completely confined, cannot exert mechanical pressure, but simply dissipate themselves into the pores of the surrounding cement paste, cracks, etc.

It is reasonable to suppose that the alkali-silica ratio of the reaction product formed is a function of the alkali content of the cement. If the cement has a high enough alkali content the pore solution will be very highly concentrated in alkali cations and the reaction product formed will be richer in alkali compared to silica. In consequence, it may be rendered non-expansive."

Even though these are post-conference comments it is considered proper to include them in this publication. Therefore this epilogue is included in the conference proceedings.