

distribution, surface area, and the "reactivity" of additives are of importance.

I could continue reviewing the other topics discussed but would like to use the short time remaining to bring up an important issue and to make a few recommendations.

The issue I would like to bring up is the question of the gap between the researchers and engineers. After listening to the three days of presentations by researchers and engineers, I find this gap growing and feel that something must be done now. Part of the problem is in communications and proper feedback. The available scientific knowledge (and there is a substantial amount of it available) has to be properly reviewed by the researcher and its meaning transferred to engineering practice. The scientists must learn to appreciate "the real world" problems and the constraints the engineers are facing in the field. The engineering community, on the other hand, must help to focus the research efforts by better understanding the chemical aspects of the problem, the instrumental capabilities available, and must educate the researchers as to its real needs. In addition, we all have to improve our communication with experts in relevant fields, such as corrosion, materials science, etc.

In view of the above, I would like to recommend that:

1. A comprehensive review of the scientific aspects of the alkali-silica reaction mechanisms should be prepared before the next Conference in Canada. Such review (or reviews) could be published in a special issue of Cement and Concrete Research or as a special chapter in the Cements Research Progress published annually by The American Ceramic Society, and it should become compulsory reading for all participants of the next conference.
2. During the next Conference, special sessions should be held on the chemical, physical, engineering, and testing aspects of the problem followed by a well prepared and professionally managed session on technology transfer.
3. We should consider development of internationally acceptable criteria for detection, testing, and characterization of the damage caused by the alkali-silica reactions.

Mr. Chairman, this concludes my short review of the second Session. I would like to use this opportunity to thank you personally, the Organizing Committee, and all the participants for contributing to a very successful conference. Thank you.

My session included six interesting papers and, in summary, I have selected one essential conclusion from each presentation.

Prof. Della Roy had discovered an apparent relationship between expansion and the ratio of alumina to silica dissolved by alkaline solutions, whereby a reduced alumina/silica ratio was associated with greater expansion. Also experiments with beltane opal and glassy basalt had confirmed the effectiveness of GGBFS at preventing expansion due to alkali-reactivity.

Dr. Frank Buttler created some controversy when he highlighted some difficulties of the mortar-bar test procedure, in particular the aspect of "leachability". This loss of alkalis during the test was less in the case of mixes containing PFA, but nevertheless PFA was found to be effective at reducing expansion.

Dr. Fred Glasser has carried out careful studies to establish the effect of various additives of the chemical composition of the concrete pore solution. PFA did not alter the pore solution, GGBFS increased the alkali content, natural pozzolan increased alkalis sharply, whilst high-surface-area silica increased sodium slightly and potassium greatly.

Mr. Harold Vivian reminded us that flyash materials are variable and only some are suitable for preventing alkali-reactivity. Comparatively large replacements are needed for complete inhibition (say 40 per cent), when other concrete properties, such as strength and durability, may be adversely affected.

Prof. Ervin Poulsen presented some examples of alkali-reactivity problems in Danish swimming pools, and emphasised the role of sodium chloride. These difficulties were not predicted by mortar-bar tests, but concrete specimens had been more reliable.

Dr. Chatterji proposed the use of cements free in calcium hydroxide to prevent alkali-reactivity. The use of a pozzolanic diatomaceous earth, to consume the calcium hydroxide, had been found to be effective at preventing expansion with reactive Danish sand, even in the presence of sodium chloride.

In conclusion, I would like to support dr. Jan Skalny's plea for more successful communication between scientists and engineers on the subject alkali-reactivity. There is also a problem of international communication: working parties in different countries each separately struggle to achieve a consensus for coping with alkali-reactivity. I wonder if there could be support for an international working party to achieve international agreement between scientists and practising engineers.