

While, as I have said, the phenomenon of alkali-aggregate reaction has been known for many years, it is so complex and like the amoeba, takes on so many different forms, that it is very imperfectly understood and its identification and characterisation, let alone its prevention and control, is an exceedingly difficult matter. For this reason, it has rightly been investigated in depth and has been the subject of many conferences. Notable among these conferences has been a recent series of small but very significant meetings of scientists from various countries. The first of these took place in Koge, in Denmark in 1974 with 23 delegates and 13 speakers. The second was in Reykjavik in Iceland in 1975, the third at Wexham Springs in the United Kingdom in 1976 with 48 delegates and the fourth at Lafayette, Indiana, in the United States in 1978. The sixth is scheduled for May 1983 in Copenhagen. In most of these, South African scientists from both the public and private sectors have played a role and it is fitting that this meeting should be held in South Africa and also fitting that it should take place in Cape Town since the problem of alkali-aggregate reaction is most widespread in this area where the replacement value of structures involved is in excess of R55 million.

The first step to organise this conference was taken in January 1979. Questionnaires were sent to overseas scientists to gauge their feelings on such a conference and the response was so good that we decided to go ahead with it. Here I would like to pay tribute to those overseas colleagues, many of whom are present today and whom we look forward to having with us, both as fellow scientists and people. Without their support and that of the South African Technical Steering Committee guiding the local research in this field, and the sponsoring bodies it would have been difficult to have organised this conference.

The South African research on alkali-aggregate reaction really commenced in 1977 at the National Building Research Institute. Once the nature and extent of the problem became apparent the agencies concerned in both the public and building sectors were approached for their collaboration and support. It is with, I believe, justifiable pride that it can be said that, without exception, all concerned gave the whole project their support and not only have sponsors of this research contributed so far R300 000 to augment the domestic resources of the NBRI, but equally important, they have participated in the work of the Steering Committee which guides the research and have also made available data and their own manpower to assist. They have also generously provided financial support in contributing to the expenses of some of the participants. The names of the sponsors are given in the conference documentation.

I said earlier that this conference is important and I would like to share with you my reasons for saying so. It is an important occasion, not only because it is the very first time that a conference on alkali-aggregate reaction is being held in this country, not only because during today and the rest of the week no less than 37 significant papers on the subject ranging from highly academic to down-to-earth practical aspects of the matter will be presented and discussed by literally the best informed authorities in the world, but most importantly because as a direct result of the conference,

everyone will gain some benefit. New knowledge will be made known, an exchange of information will take place and new ideas will be generated at the conference sessions and outside of them over cups of tea and glasses of beer. All this will benefit not only the participants and the organisations which they represent, but indirectly and in the course of time, literally millions of people all over the world as it will make possible every year savings to not only those living today but also to generations yet unborn, of many millions of rand, marks, pounds, guilders and various kinds of dollars, francs and other currencies not represented at this conference. These savings would not be possible if this new knowledge were not generated, made known and applied. It also illustrates three things about science, technology and research, which, to me, seem extremely important. The first is that because of its basic objectivity and universal relevance, research is, like modern communication, transport and commerce, an enormously powerful factor in promoting international understanding, goodwill and co-operation. It knows no parochial, political, racial or national boundaries. Secondly, and this is a basic difference between on the one hand a research finding or a technological breakthrough and on the other hand a profitable business deal or a personal triumph, a research finding goes on conferring its benefits to all concerned, year after year, in perpetuity, while a business or personal achievement is a once only occurrence and generally only benefits one group or person, sometimes to the detriment of others.

Thirdly, research and technology can upgrade the quality of life of all by making it possible for mankind to live happier, longer, fuller, healthier, more comfortable, more convenient and more interesting lives. Here, however, there is something about our fabulous present day technology that worries me, and that is that, particularly today, too many citizens take it for granted and/or blame many of the problems we face on science. Is it not time that we realised that any such problems that we have are not attributed to science but are a direct consequence of man's abuse of knowledge because of his lack of judgement or inability to always apply it beneficially. In this respect there is a significant but not always appreciated distinction between on the one hand what one might call 'double edged knowledge' such as chemistry or nuclear physics which, depending on how one uses it, can either kill or cure, and on the other hand what I like to call 'benign knowledge' like how to build better houses or structures or produce more or better food, which can really only be used to the benefit of mankind. Research on alkali-aggregate reaction, as small as its impact might be, falls into this category. It seems to me that the answer, insofar as there is an answer, is for us to choose or educate our policy makers in both private and public sectors better, especially in respect of science and technology because no sensitive, intelligent and ethical person, who understands technology will readily abuse or misuse it, or allow it to be abused or misused.

In this context, I am sure of one thing, and that is that this week is not going to be abused, misused or dull and in expressing the hope and conviction that we will all have a highly fruitful and enjoyable week, it gives me much pleasure to declare this conference open.

ADDRESS OF WELCOME

Prof V L Granger
Faculty of Engineering, University of Cape Town, South Africa

Ladies and gentlemen, it is my pleasure and privilege to welcome you on behalf of the CSIR to this important conference. It is, indeed, always a great pleasure to welcome visitors to the Mother City. To many, Cape Town is a major sea port, the Legislative Capital and South Africa's premier summer resort, steeped in a wealth of tradition and time-honoured charm, the most beautiful gateway to Southern Africa. She is certainly all these things; but also immeasurably more — a great, dynamic, complex and fast developing city.

From the programme you may have noticed that the 38 papers were contributed by 52 distinguished scientists from no less than 11 different countries besides South Africa — an index of the importance of our theme.

Although normally considered by engineers the most durable and the soundest of materials, concrete must, under certain conditions, be listed with many other structural and construction materials which, because of corrosion under a wide variety of conditions, cost South Africa vast amounts annually — perhaps as much as R300 m — in direct losses alone.

The useful lives of utilities and amenities such as concrete roads — might well be greatly shortened. However, the safety of our energy systems has implications for society of an entirely different order.

Construction of Koeberg Nuclear Power Station underlines this heavy responsibility. Modern engineering projects, such as reactors, offshore structures and pipelines are technology based, involving many disciplines. Big hydro-electric dams

must be built to last; deterioration and failure of a great concrete dam could result in untold devastation and loss of life.

Particularly in the United States, many serious and extensive concrete failures have been attributed to deleterious interaction between certain aggregates and the cement in mortars and concretes.

Until recently, we in South Africa have been complacent about this problem. Indeed, a quotation from South Africa's leading concrete handbook reflects the general experience: 'Fortunately the phenomenon of alkali-aggregate reaction does not occur in this country and no detailed consideration need therefore be given . . .'

Over very many years, concrete construction in the Western Cape has made use of crushed aggregates from the Malmesbury hornfels and greywackes with local cements without any reported reactivity. Yet within the last decade there has been a rash of such occurrences. Clearly, then, deposits which are, or may be, reactive in some degree do occur. Examination of these when used with present-day cements, assessment of possible harmfulness, and the development of testing techniques are of vital concern. We therefore look forward to a most rewarding, timely and relevant conference.

A very warm welcome, once again. I trust that those of you who are visitors to South Africa will build lasting happy memories of your visit and will have gained a sympathetic understanding of the interplay of pressures and disruptive mechanisms, not only in concrete, but also in our complex and wonderful society.

OPENING ADDRESS

Prof T L Webb, SBL, Unisa, Pretoria, South Africa

Mr Chairman, ladies and gentlemen, first I would like to thank you for inviting me to open this important conference on alkali-aggregate reaction in concrete. It is and has for many years been a worldwide problem — it is serious, widespread and insidious and costs the building and construction industries, and through them, the country, a great deal of money. Basically it involves a chemical reaction between the alkalis present in Portland cement and certain minerals in the stone and sand used to make concrete. This reaction, which is slow and generally takes place over years, results in the expansion of the concrete, with cracking and weakening and ultimately can lead to its failure and disintegration.

My first personal contact with it was some 20 years ago, when as a result of suspecting that it might be of some importance in South Africa, I made enquiries in a number of

countries while on an overseas study visit. I recall with mixed feelings and claustrophobic terror a day in Denmark when Dr Idorn, one of our distinguished overseas visitors with us today, put me into a small boat and took me on a conducted tour of exploration of almost submarine concrete structures. We meandered through kilometres of pitch dark cavernous passages, with concrete sheet piling to the left and right of us, with a concrete roof sometimes only 50 centimetres above the gunwales of the boat and with Dr Idorn waving his flash-light to only slightly break the Stygian gloom and saying, more or less alternatively: 'Isn't this a beautiful example of alkali-aggregate reaction' and 'mind your head' — Thank you Dr Idorn for teaching me something about alkali-expansion, for demonstrating that all Scandinavians still have the spirit of the Vikings, and most importantly, for saving me from concussion.