FEAR OF FLYING ?

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It is more clear now, than in 1974, when this series of meetings were launched, that a new kind of uncertainty is sneaking in on cement and concrete development:

> No one can envisage how building technology and construction will be operating 20-30 years ahead.

Several sectors of advanced technology have already decades ago attained such rates and extents of innovation, that the conditions of people's life are thoroughly changing all the way down the social ladder in developed and in many developing societies.

In fact, to-day school children ought to be educated so as to qualify for making their future lives under circumstances and rules, different from those we know at present, in ways we don't know much about. They will be helped or forced by technology development which has learned to operate continuously towards hitherto unknown products and market conditions.

In contrast cement and concrete research still in its entirety is geared towards the making of adjustments to existing technology and techniques. In other words, the sponsors and users of cement and concrete research are requesting assistance to preserve continuity - whilst other technology industries are making established knowledge obsolete with ever increasing velocity.

This attitude on the part of cement and concrete is in fact like a steady infliction of "Fear of Flying" upon the researchers.

Surely, one can see, that the development of organic chemistry into carbon-based polymer technology, has only incipiently commenced to find a parallel inorganic chemistry based development of silicon-based polymer technologies. This is likely to come, if not for other reasons, then due to the overwhelming availability of silicon as a primary source of natural and synthetic solid substances, compared with carbon, which is both consumed with fuels and used in materials.

Moreover, the microelectronic-industries must be assumed to go into development of system-monitored manufacturing technology for cement based commodities and for performance reliable constructions long before the cement and concrete industries themselves escalate their development in this direction.

These and other forecasts of thorough changes being under way are sustained by the needs arising from the threatening depletion of energy, capital and even resources of abundant materials, and by the increasing requests to product safety and durability of houses, bridges, nuclear power plants etc.

Altogether, these visions form the demands on the researcher that he opens the doors to future technology with

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This is much to demand in the cement and concrete research environment at the present time.

For the last two to three decades it has been design, mechanisation and dimensions of enterprises, which have attracted the development investments in cement and concrete.

Largely speaking, the materials have been good and inexpensive enough so as merely to invite adjustments in the course of the accumulation of experiences.. And some daring cement and cement using industries who have developed and marketed materials of exceptional characteristics, have suffered great disappointments of lacking interest with their customers.

The "added value" to the materials has therefore remained small enough to be handled in the conventional framework of classification and testing etc. Consequently, the research has been compelled to operate within this framework and its inborn continuity. This is where fear of flying grows.

The concept of adding value to concrete materials through their processing has a bearing on research regarding alkali-silica reactions.

The joint-venture, if one may say so, between alkalies, silica and hydroxyl ions do represent an exceptional violent availability of chemical energy at low temperatures - and we do not utilize it as added value; we don't even control it.

Clearly, we must try to achieve control, or in other words to attain a more satisfactory balance between energy input, and serviceability of concrete.

But it is still not, in our time, sufficiently effective to possess available energy in a process, and neither to convert it deliberately or to have it consumed without any benefits at all.

In fact, the state of affairs is, that one is lucky if the available energy in alkali-silica reactions is wasted. If one is unlucky, large constructions, which have required enormous energy input during erection, may become unserviceable in a few years' time.

This is, indeed, unacceptable and if the society cared more about our competence with regard to solving these problems, we would be told that: "You don't need no fear of flying." Remain on the ground and solve the problems.

Indeed, this series of meetings were launched because a few friends in research were concerned and feared that alkali-silica reaction might become a more serious problem than recognized at that time.

The character of the meetings have enabled them to remain gatherings for specialists, actively operating in this field of research. Besides the few, who have been in this business for many years, the newcomers are people who became engaged more recently, because problems with alkali-silica reactions unexpectedly proved serious enough in their regions to warrant attention for a certain period of time.

The present meeting being the fourth one, and taking place in the homeland of alkali-silica reactions, we ought to consider the cost/benefit of the work in progress and of the meetings as well.

If one imagines research on alkali-silica reactions as an object for industry investments it is an anomaly. A project on this theme appearing on the stockmarket would sell at a low course during long spells of time when there were no problems, and go high when serious deterioration showed up and caused concern about construction economy. But then go low again as soon as trouble shooting could fend off the most disquieting deviation from normalcy.

If one similarly imagines research on semiconductors or liquid crystals on the stock markets, then one would see this kind of themes go high when investors smelt new profitable innovations ahead, and go down if malfunction of electronic equipment became a market feature.

Apparently, there are therefore some disguised parameters in the process of theme and project selection within cement and concrete research, and since there at present seems to be an

upward stream of interest in founding research on alkali-silica reactions it is worth while to see which parameters of preference we are dealing with.

There is but little reason to think that the very arrangements of our four meetings have promoted much more research to be done, although it would be pleasant if this was so.

A broader view on the silica-silicon realm of technology, extracted from Roy (1978), give the following figures of the added value ladder of technology:

Sand	0.2 c/lb
Refractory brick	2.5 c/lb
Speciality glass	20$/lb
Synthetic quartz	120$/lb
Silicon chip	200,000$/lb

Behind these figures there are tremendous investments in physics and chemistry and in subsequent R&D on the basis that SiO_2 is a valuable primary resource for sophisticated technology.

Yes, one may say! But this is about advanced industries, and no arguments for more efforts or belief in value of research on alkali-silica reactions can be extracted therefrom.

And this is exactly how things are. The availability of finances for research is not related to the quantities of SiO_2 involved, but to the progress, usefullness, profitability etc., which research can forecast to be the results of the efforts.

The electronic industries do forecast achievements to be available for customers and consumers over the next decade, and to a large extent based on SiO_2 as a fundamental substance. Teer (1978) summarize what will come on the market:

TV-transformed into a give and take
information machine
Home computers for administration
Video long play discs
Electronic files
Electronically controlled cars
Intelligent manipulators
Optical cables.

To compare: research on cement and concrete and on alkali-silica reactions has offered but few indications of what it intend to achieve and materialize of added materials' value for engineering and construction or manufacturing industries even for a longer lag time than for electronics. Therefore, in the present situation of severe capital competition, research in our field cannot be considered prosperous by the investors.

If, all the same, there are increasing investments in research on alkali-silica reactions, there must be some other arguments in function.

A few of these are traceable:

1. Research on alkali-silica reactions is being associated with energy conservation in cement industry and with utilisation of by-products.
2. Alkali-silica reactions have appeared under conditions where performance reliability is requested, e.g. in large industry works, and where very rapid deteoriation may be the consequence of their actions, e.g. in the Middle East.
3. Repair costs and consumption of materials to repair is being a nuisance to building authorities.
4. Materials manufacture and operations are now big-scale business which cannot accept big-scale losses on product safety responsibility issues.

5. Research on alkali-silica reactions cost only a micro-fraction of research in advanced industries and could be made more effective by systematic use of modern equipment, not least data-processed simulation for model scale studies.

I am not saying, that if the present meeting thoroughly scanned these five basic conditions for the research in progress, then money for enhanced activity would come flying in from investors, who by themselves would calculate a ROI potential in this work.

On the other hand, the meetings were not invented merely to secure survival of research on alkali-silica reactions. The initiators did intend to bring so much new knowledge afore that economically feasible precautions could be elucidated for practice, and reasonable performance reliability ensured under any practical conditions. From the very first meeting also the energy conservation aspects were considered important, and it was felt that ways and means for more cooperative research, if not concerted programs, might be exploited.

The meetings have undeniably been successful in creating enhanced communication and exchange of results and hypothesis, and one might envisage a continuity on this basis still for another 4 to 5 meetings. This would be beautiful in view of the cultural aspects of research as existing in its own right, but it would also be an abstraction from the real responsibility of the present work to be done.

The energy scarcity to come from about 1985, the performance reliability issue, the depletion of concrete aggregates and the social need for confidence in concrete makes it unacceptable to let alkali-silica reactions remain an unpredictability or even an uncertainty and an economic burden to industries and consumers.

It would be fitting therefore if each presentation at this meeting contains a summary of what it contributes to the large jig-saw puzzle of a broad consensus on alkali-silica reaction. A compilation of such summaries both on theory and practice could be a guidance for further work.

Most likely such state of affair conclusions would focus on the defensive aspects of alkali-silica reactions, and this is why I propose that you close your eyes for a brief minute, forget about everything sent in advance of this meeting to Sidney Diamond and think about the waste of energy in alkali-silica reactions, which I mentioned earlier.

How could this energy be trapped and utilized for improved cement processing and product development. This seems to be a "black hole" opportunity and any Prince or Princess Serendip would find honour and appreciation ahead when alkalies and silica can be made solidly interacting under control.

This would also be a beautiful realisation of the slogan:
MORE ENERGY TO DEVELOPMENT THAN TO CONSERVATION.

Naturally, any chemical scientist could say that this perspective is merely the phantasy of an old civil engineer.

However - the majority of electronic device and instruments which are commonplace today, were not produced in 1967.

Whereas, the major part of preventive measures one today can specify against alkali-silica reactions, was made available for application in 1947. In other words, less than ten years after the first identification of alkali-silica reactions the preventive measures were encircled and being applied.

It is a great pleasure today to remind you that these admirable, multisponsored achievements were exclusively American.

It is also worthwhile to recognize, that this research did much to create a system approach involving chemistry and mineralogy research in general. This is all well documentated in the proceedings and journals of ASTM and ACI of those days.

In fact many observations to be presented here the next few days have diagnostic value because they reproduce these older findings.

Some fellows from this glorious cast of USA-research, like for instance Th.E. Stanton and Levi S. Brown are now among other vanished eagles. Other ones, like for instance the Mathers and Rich. Mielenz are still offering their vast experience for guidance. One shall not fail to appreciate that the "fellowship" mentioned pioneered the study of morphology and structure of concrete - because this field of investigation has so fantastic better means of examination available now than they had access to. Surely - they had no fear of flying.
What then is left more than a continuity of repetition? Not much, I fear, if your outset is unaltered engineering, construction and industry conditions.

But since this is not reality there is more work ahead than at any time before and it is difficult because no one can really say how the users' conditions are changing, but only that they are, and profoundly so.

The depth of the challenge therefore is that research is to be called upon to form an active part in the creation of the changes, and not merely to be available when bad consequences appear as deterioration with loss of money, energy and materials.

It seems clear, that beyond the access everybody has to much better means of research than those abovementioned American Pioneers, you also now have the strength by accumulation of knowledge and ideas from all over the world, so that there is much more and varied input to be put together intelligently than ever before. Please use the opportunity and

DO NOT FEAR FLYING!