ELSEVIER

TECHNOLOGY TRANSFER

Questions to Richard D. Gaynor, Executive Vice President, National Ready Mixed Concrete Association/National Aggregate Association, Silver Spring, Maryland

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Mr. Gaynor, a few months ago you gave me the opportunity to spend some very illuminating time with you discussing, among other issues, the problem of knowledge transfer. I believe the readers of the ACBM should have the opportunity to share your views and I am delighted you agreed to answer a few questions.

Question: Service life of concrete structures is an important issue, primarily as it relates to infrastructure concrete such as highways, bridges, pavements, etc. Why is it that some relatively new structures deteriorate prematurely? Do we use the available knowledge and technology properly? If not, what is the reason we are unable to apply new technologies at a faster rate? Does the quality of overall education relate to this? Is management of technology a problem?

Mr. Gaynor: The concrete in some transportation and parking structures does deteriorate too rapidly. In the past 10 years or so we have made great strides in understanding corrosion of reinforcement and alkali silica reactions and have known how to minimize scaling and freezing and thawing for even longer. Today we can build "permanent pavements" and "permanent structures." Too often we have focused on making as many miles of pavement as we can with the available funds and have chosen to discount society's long-term expectations and future traffic demands. It is difficult to develop a 10, 20, or 100 year perspective with annual budgets and 2 or 4 year election cycles.

We continue to use concretes that will fail to provide the service life that will be expected of them in the future. However, the amount of such concrete is decreasing rapidly.

There are two basic reasons why change is never easy: (1) the slow pace of technology transfer; and (2) the impact of changing standards on the multitude of parties from owners, designers, specifiers, contractors, subcontractors, material suppliers, and the supporting industries, who have each built their businesses on the preexisting standards, and may be adversely impacted by change.

The second part of your question relates to "quality of education" and "management of technology." In the traditional sense, formal education continues to face its share of challenges, but it isn't more than a contributor. The exciting change that is taking place is the move to train and empower workers and focus on partnering and the customer's needs.

The other part relates to management of technology, whatever that means. Here the change is for each researcher to be given, and to accept, the responsibility to become an active participant in implementing his results at the next technical level. It isn't a pure basic versus applied research issue; it is more complex.

Implementing new technologies takes too long—but not always. High range water reducers took 15 years, but doubling the definition of commercial high strength from 6,000 to 12,000 psi took only half that long. It is interesting that the specter of restrictive standards did not greatly retard the acceptance of these materials; they were used by knowledgeable parties as the need was perceived.

Question: You represent two large businesses, the ready mix concrete industry and the aggregate industry. What is your position with respect to the alkali-silica reaction (ASR)-related deterioration of concrete? How serious is the problem? What should be the actions taken by the aggregate and cement industries?

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Do we need additional research or are the technologies for prevention of ASR available but inadequately used?

Mr. Gaynor: The example of ASR is an excellent example. On the east slope of the Allegheny Mountains, from Maine to Georgia, we have a whole suite of metamorphosed, quartz-rich rocks that are a major cause of reduced service life of structures. Additionally, the gravels in the Atlantic coastal plain tend to contain reactive cherts and microfractured quartz. My view is that in highway structures exposed to deicing salts, ASR, combined with a modest effect of freezing, is the major reason why we have to repair too many of these structures after 10 to 25 years. Today we know how to make 100 year structures and get them at lower cost. We know about the need for entrained air and use it. We also know that if we use fly ash or ground granulated slag in sufficient amounts with our high alkali cements, we will greatly extend pavement life and make "permanent pavement" a practical reality.

Much of the credit for this change in our perception comes from a simple uranyl acetate test developed by Ken Hover's group at Cornell and work done under SHRP. This same technology is applicable in other states, but is somewhat more complicated by a scarcity of type F fly ash and resistance by specifiers to use of the 25 to 40% of class C ash that is often required.

Question: Standards play an important role in introduction and proper use of technologies. Nevertheless, I believe, standards can also be a barrier to innovation and new product introduction. What is your overall opinion on this issue, with special focus on ASTM standards for cement and concrete? Do we have the needed test methods, and are they adequate?

Mr. Gaynor: Standards writing organizations do move slowly, and there should be a quicker way to do it, but to repeat this cliché does them a disservice. In the United States, this is nothing more than a process to develop a consensus of the "experts" that is trusted by the "affected." The Civil Engineering Research Foundation (CERF), in their HITEC program, is attempting to speed up the process. It has great potential, but in fact it depends on the volunteer of expert task groups (ETG) to guide the research and evaluation and already there is a shortage of "experts." The HITEC process, if extended, may slow the existing consensus-building structures.

Too often cement and concrete are commodities, all gray and the same. Today's standards reflect that mentality. The exciting changes are beginning to force us to develop a focus on the customer's needs, partnering, and RMC 2000. We do need tests that better define the performance of cement and cement-admixture combinations, for strength, for setting time, and for the potential for early cracking.

Impatience with standards falls short of the mark. I wonder if HITEC had been in operation, if it could have prevented the demise of shrinkage-compensated cement in the late 60s and early 70s. Perhaps shrinkage-compensating cement was just a product ahead of its time. Certainly it had its own suite of problems, but it could do much to solve the number ONE complaint ready mixed concrete producers receive: cracking.

Question: ASTM is committed to move toward performance rather than prescriptive specifications? Some of our colleagues consider you to be an active opponent of such action. Please explain your position, specifically with respect to the recently approved new standard for blended cement and the still-debated standard for Portland cement.

Mr. Gaynor: In ASTM Committee C1, consensus is clearly for a performance C 1157 that has no defined level of strength performance. I suppose I have chosen to be one of the more vocal opponents of the "performance" specification, C 1157. My position is that I favor performance specifications, but do not favor watered down nonperformance versions of present specifications. The present C 150 minimum 7-day strength requirement is 2800 psi. The industry average strength is almost twice that, 5000 psi! Ready mixed concrete producers can use almost any cement as long as the strength level is consistent and it is reasonably uniform, or if not, when they know when the cement has high or low strength. Using more variable cement is more difficult and isn't for all producers, but clearly working with such a cement manufacturer can produce a win-win situation.

I have resisted proposals to intergrind limestone in cement simply because I see minimal technical merit and little, if any, corresponding benefit for the concrete specifier or ultimate customer. I also see potential problems when those fines become a part of fines either already in the aggregate or generated by grinding during mixing concrete. A new C 1157 with commitment to strength performance and uniformity of air content would be a step forward.

Philosophically, I would prefer performance specifications, but I doubt we need cement with 20 or 30% interground filler as exists in some centuries. The issue is not BTUs or CO_2 per ton, but psi per BTU or CO_2.

Question: Many people quietly express the view that numerous of the SHRP "products" are redundant, not new, and will not be implemented. First of all, do you agree with this view, and secondly, what do you propose to avoid such things happening in similar future initiatives, for example, the new CERF initiative? What are, in your view, the best mechanisms for improving the focus of the research and development activities, and what should be done to accelerate the subsequent technology application?

Mr. Gaynor: It is easy to be critical of SHRP products on Monday morning, but as with any research, there will be successes, failures, and everything in between. I applaud the FHWA push to implement SHRP products.

The CERF initiatives in high performance materials and HITEC promise to coordinate and consolidate sources of research funding much more broadly then the strictly highway focus of SHRP. HITEC focuses on implementation of innovative technology and it may be a faster, more economical way to develop the technical consensus.

CERF brings a much broader group of researchers and practitioners together to plan, execute, evaluate and implement the technology than was possible in the planning phase of SHRP.

Question: What do NRMCA and NAA do to accelerate adaptation of new technologies? What mechanisms of technology transfer do you use? In promoting new technologies, how seriously do you take into consideration technical, environmental, energy, and "quality of life" issues as compared with business/financial considerations?

Mr. Gaynor: The National Ready Mixed Concrete Association (NRMCA) and the National Aggregates Association (NAA) have, since the early 1920s, had their own research laboratory and technical staff who work with technical societies and groups such as ASTM, ACI, TRB, FAA, FHWA, etc. to develop standards and transfer emerging technology to its members. This year they will sponsor their 49th Annual Short Course on Concrete and Concrete Aggregates.

NAA, with the National Stone Association, formed the Aggregate Foundation for Technology Education and Research with a $4 million endowment donated by the industries. They now support the Center for Aggregates Research at the University of Texas and Texas A & M University. We think this support of academia has great promise.

The NRMCA, working cooperatively with 58 independent state associations, provides a wide variety of technical material and attempts to represent them on a national level.

Clearly, none of this effort is enough, but the ready mixed concrete industry has made great strides in the past 50 years since World War II. It has, evolved and continues to evolve, from an industry made up of over 5000 individual family-owned businesses that were largely focused on operations and trucking and that relied on their state DOTs and cement and aggregate suppliers to proportion their mixes to one where the concrete producer is becoming, or has become, the technical expert on the job. Industry consolidation, growth, and the ACI programs have greatly escalated the process.

The most exciting development in the ready mixed concrete industry is the RMC 2000 Vision. It started almost a year ago as a rump group that saw ready mixed concrete as a commodity product that was driven by price rather than value to its customers.

The vision urges individual RMC companies to:

- be a customer-driven, service-oriented, company;
- be environmentally responsible and operate in a safe and healthy mode;
- train and empower employees to anticipate customer needs; and
- develop partnerships with customers, suppliers, and community.

Question: Finally, what message would you like to send to our academic research community? Should they concentrate on background research or focus on "selling" the available knowledge to the field engineer? Should they do both, and if yes, in what proportion? What is the main problem with respect to the field applicability of academic innovations?

Mr. Gaynor: The idea I would like to leave with the academic research community is that they need to get much closer to their customers. Too often we see a whole series of papers that explore a very highly technical area which lacks a definable bridge to an application or product. Get the practitioners involved early in formulating the research, and ask the questions that need to be explored with a clear view of where that might take you if it turns out as you might expect. Be prepared to accept the unexpected.

There are lots of questions that need answers. Some are much neglected. The following three are currently my favorites.

1. All concrete cracks and it is a universal complaint. Slabs crack early and drying shrinkage is rarely a principal or initial cause. Why?
2. Uniformity of set time is the finisher's greatest day-to-day problem. It is greatly complicated by the use of admixtures. Why and how does it vary with a change in delivery time from 20 to 60 minutes? How well do we understand setting reactions and how they are modified by periods of agitation?
3. Do we really understand the effect of drying on compressive strength of cores, and is concrete dried to equilibrium at 50% RH really stronger than saturated concrete? In cores? In columns? In beams?

Mr. Gaynor, I would like to thank you for openly answering my sometimes complex and provocative questions. However, I believe it is time to discuss controversial issues openly and I know our readers will appreciate your cooperation. Many thanks again.