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Editorial

M.A. Lacasse

(2010 February Issue)

The February issue of Construction Materials provides six articles primarily focused on “new”, enhanced concrete materials. Indeed in this issue, considerable depth of technical information is provided on innovative concrete materials in particular on concrete materials that incorporate rubber, other polymer-based compounds or mineral additives. The development of new concrete materials will no doubt continue at a rapid pace given the ever increasing technological interest for cement manufacturers to reduce their “carbon footprint” and minimize their contribution to green house gases. Hence there is an increasing need for reductions in cement content of concrete; the use of supplementary materials, or other novel substitutes that provide sufficient strength without compromising the long-term performance of the concrete, are actively being developed and evaluated. Hence this issue is of particular importance on providing information on the different concrete composites products being developed, and also offers further understanding on their applicability, performance attributes and limitations in respect to durability and longer-term performance.

The briefing note prepared by Bungey [1] provides a highly useful introduction to recent and on-going work and some collaborative efforts carried out between Liverpool University and Queen’s University Belfast. Whereas work at Queen’s primarily addresses technological issues related to the recycling of construction and demolition waste materials for use as aggregates in concrete, the studies carried out at Liverpool have focused on the manufacturing of low-cost unreinforced precast products such as paving blocks and slabs. It is reported that emphasis has been placed on the influence of constituents on the long-term performance of the newly developed materials and in this, the use of large-scale trials to support laboratory testing has proven to be highly useful in determining durable products.

Recycling materials for use in concrete is not in itself innovative as there has been on-going research in this area for several years. Consider however, the recent ban on the disposal of used tyres in landfills in the UK, and thus the potential availability of granulated rubber for recycling. Paine and Dhiri [2], describe an extensive collaborative research project commissioned by the UK government and carried out at the Universities of Bath and Dundee on new applications for granulated rubber in concrete. The interest here of course was to develop a disposal route for the granulated rubber as it was perceived that several useful concrete-based products incorporating the recycled rubber could be developed that had enhanced freeze-thaw resistance and improved thermal resistance as compared to products manufactured with normal concrete. The authors suggest that the preliminary results from these studies have helped demonstrate the commercial viability of these products.

The issue of recycling tyres is one that is of importance not only on the UK, but around the globe and the work by Ling et al. [3] on rubberised concrete paving blocks attests to this interest. In this article, greater emphasis is placed on evaluating the long-term strength of the product given technological interest for the commercial production of paving blocks. As the authors point out, and as is generally

understood, the tendency is for a reduction in strength with the additional of granulated rubber – what was of importance to the technical solution however, was whether a paving block manufactured in a continuous semi dry –cast commercial process using vibration and high pressure curing would result in a consistent product having dimensional stability and adequate long-term compressive strength. The results from this work provide relationships between compressive strength, flexural and splitting tensile strength however, the long-term strengths relationships alluded to refer to strength development of the various products just over a year in specified curing conditions and not to longer term behaviour as might be beneficial in estimating the expected life of the product. Nonetheless, these studies have shown that useful rubberised concrete paving blocks can be produced provided the rubber content did not exceed 10%.

Aspects related to the strengthening of concrete with the addition of latex are the subject of the paper prepared by Prasad et al [4]. As the authors aptly indicate, latex modified concrete has been extensively studied since the early seventies as a means to enhance the mechanical, physical and chemical resistance properties as compared to what may be attained from normal concrete. In this work, their focus was on developing a better understanding of the resistance of latex-modified concrete to uniaxial cyclic compressive loading for concrete incorporating varying amounts of latex up to a maximum of 15% by weight of cement. On the basis of the results derived from this study, analytical expressions were developed to express the stress-strain envelope from which permissible stress levels in compression were ultimately developed. Such information provides a necessary component of information needed for the design of latex modified concrete and block masonry units in construction.

As is quite evident from the previous papers, the incorporation of rubber aggregate and polymer-based additives to concrete can be used for strength development of concrete. Polymer-based additives in combination with pozzolanic admixtures may also be used to enhance resistance to and retard deterioration from chemical and biological agents as reported by Soroushian et al. [5]. Their work relates to an extensive laboratory and field study of the resistance of concrete to the corrosive conditions in a sewer environment. Interestingly the authors note that the aggressive nature of the environmental conditions to concrete in a sewer are in part due to environmental regulations that have limited discharged into sewers of toxic heavy metal waste. This in turn has led to reductions in sulphate-reducing bacteria thereby increasing sulphide production that as a consequence has brought about a corresponding increase in microbial-induced corrosion activity [5]. The addition of a polymer to seal or fill capillary pores reduces water absorption, permeability and the rate of vapour transmission in concrete, thus enhancing the resistance to microbial-induced corrosion activity, the degree of effectiveness being dependent on the type of polymer used. The pore structure may also be altered to enhance the resistance to acid attack with the additional of mineral additives such as silica fume and fly ash. Accordingly the paper reports on preliminary results and comparisons between laboratory testing and direct exposure to actual sewage in San Diego, CA; on the basis of these results, practical recommendations are made in respect to the type of formulations that are most effective in retarding microbial-induced corrosion of concrete. The authors indicate that further work related to the microstructure and chemistry of different formulations is needed to identify the underlying mechanisms responsible for changes in engineering properties observed from the tests.

The final paper by Sivakumar and Santhanam [6] discusses the permeability of hybrid-fibre-reinforced concrete. The intent of the work was to determine whether the addition of different types of hybrid fibres (steel fibres and non-metallic fibres such as glass, polypropylene, polyester) to concrete could effectively retard the onset of cracking when under a compressive load and thereby limit corresponding increases in permeability. Results showed that, as might be expected, the additional of fibres reduced cracking and likewise the permeability as compared to concrete without the fibres with the non-metallic fibres more effective in this respect as compared to metallic fibres. The authors indicated that the development of micro-cracks in concrete was hindered in relation to fibres of shorter length, higher aspect ratio and lower specific gravity.

Several papers in this issue focused on providing results of mechanical or physical tests as is typically done when developing and assessing products for their commercial viability– some offered insight into how the microstructure of the concrete was affected by the addition of rubber, polymers or minerals. Although studies that provide engineering results are of course highly useful, a more complete understanding of results and implications in respect to long-term performance must necessarily relate to the microstructure of the material.

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