

Announcement: Best paper of 2008

Every year, the editorial advisory board selects the best paper published in *Magazine of Concrete Research*. All papers published in *Magazine of Concrete Research* are eligible for this award.

On Friday 23 October 2009, ICE president Jean Venables presented the award for the best paper published in *Magazine of Concrete Research* in 2008, as selected by the editorial panel.

The *Magazine of Concrete Research* Prize was awarded jointly to: Khoury GA and Willoughby B (2008) Polypropylene fibres in heated concrete. Part 1: Molecular structure and materials behaviour. *Magazine of Concrete Research* **60(2)**: 125–136, doi: 10.1680/mac.2008.60.2.125; and Khoury GA Polypropylene fibres in heated concrete. Part 2: Pressure relief mechanisms and modelling criteria. *Magazine of Concrete Research* **60(3)**: 189–204, doi: 10.1680/mac.2007.00042.

Abstract

Polypropylene fibres are employed in concrete to combat explosive spalling in fire, but the molecular structure and the materials properties are not well understood. The current paper presents the physical, chemical, thermal and mechanical characteristics of polypropylene fibres as functions of temperature in the solid, melt and vapour states in relation to the structure and properties of heated concrete. This forms the foundation for the better understanding of the processes underlying the behaviour of the polypropylene–concrete composite that beneficially influence the risk of spalling and also provides data necessary for thermo-hydro-mechanical numerical modelling.

Abstract

Polypropylene (PP) fibres play a role in reducing pore pressures via a number of possible mechanisms which include reservoirs (e.g. air bubbles and micro-cracks) to accommodate expanding steam as well as continuous channels for moisture–vapour migration

(e.g. via pressure-induced tangential space (PITS) or through spaces vacated by vaporisation of the polypropylene fibres). In the melt stage, PP would not easily transport through the concrete pore structure but would be able to do so in the vapour stage. The effectiveness of the pressure release mechanisms depends not only on the characteristics of PP material but also on the characteristics of the fibre itself in terms of its dimensions. Aspect ratios by themselves are meaningless and the important parameters are the actual fibre diameter and length. Key parameters that could influence pore



ICE President Jean Venables with award winner Gabriel Khoury

pressure reduction are the number of fibres, the cumulative length and cumulative surface area of the fibres as well as fibre interconnectivity, all of which increase with reduction in fibre diameter for a given individual fibre length. An optimum individual fibre length would exist that allows both interconnectivity and good dispersion. Criteria for thermo-hydro-numerical modelling would depend upon the physical, chemical, thermal and mechanical properties and their interrelation with the

surrounding matrix. Smeared properties can be assumed, although meso-level modelling at the micro-metre scale simulating individual fibres and other concrete constituents would be useful, especially in modelling PITS. The assumptions made for modelling would depend upon the transformations taking place as temperature increases during a fire. These are divided into five temperature ranges of 20–100°C, 100–165°C, 165–475°C, 475–550°C and above 550°C.