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The effect of fine pozzolanic and other particles on the hydration of C_3S

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The authors give some valuable results to help explain the effect of fine particles on hydration rates, a phenomenon known for some time, but of topical interest with the increasing use of microsilica in Portland cement grout, mortar and concrete.

Our own tests^{1,2} on OPC/microsilica pastes at lower water/cement ratios than those used by the authors have given similar effects; Fig. 1 shows conduction calorimetry results obtained with a Wexham calorimeter, with the paste subject to high shear mixing before placing in the calorimeter cell. Even at very low levels of microsilica addition the alite peak is advanced and enhanced. Have the authors obtained any results other than those at 20% addition of the fine silica? This is somewhat higher than a typical dosage of microsilica in concrete.

We also found a significant compressive strength increase at 24 h with the addition of microsilica; the difference between the microsilica and the plain OPC mixes subsequently reduced before increasing again after about 3 days—typical results are shown in Fig. 2. We attributed this latter increase to a pozzolanic reaction, and the 24 h increase to enhanced C_3S , or more strictly alite, hydration. The timing of these effects seem to be broadly in line with those of the authors in their Figs 1 and 2. We have not made any further interpretation of our results in terms of solution chemistry or microstructure development, and it would be instructive to know if the authors think their explanations of mechanisms of pure C_3S behaviour would also apply when it forms part of the more complex Portland cement.

It may also be of interest to note that we have found similar enhancement of early hydration when adding microsilica to high alumina cement grouts.³ In attempting to achieve high strength at low water/cement ratios, a superplasticizer was necessary to achieve

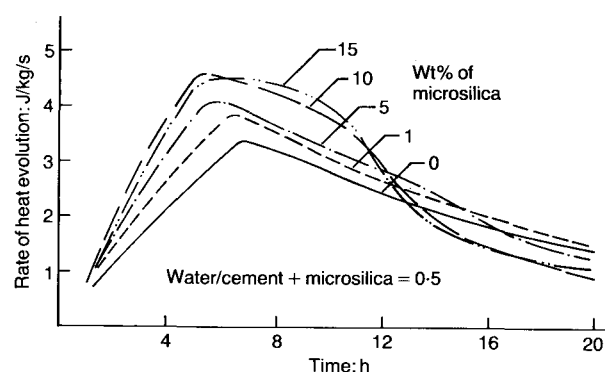


Fig. 1. Calorimetric curves for ordinary Portland cement pastes with microsilica substitution

fluidity, and this resulted in significant retardation. Incorporation of microsilica enhanced the hydration sufficiently to overcome this retardation (Fig. 3). Any comments by the authors on the mechanisms involved would be interesting.

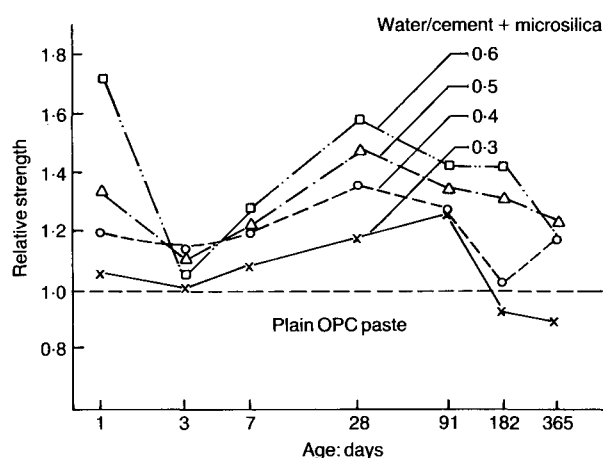


Fig. 2. The effect of 10 wt % microsilica substitution on the development of compressive strength relative to plain OPC pastes

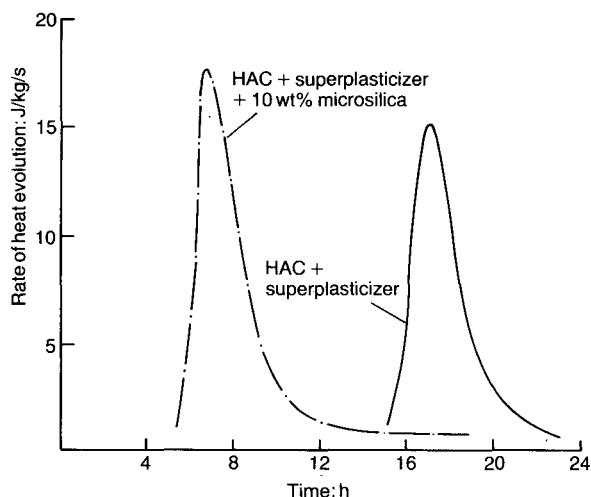


Fig. 3. Calorimetric curves for superplasticized high alumina cement pastes with and without microsilica substitution: superplasticizer = naphthalene formaldehyde, dosage = 1.44 wt %

References

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Reply by the authors

We thank Dr Domone for his interesting observations. We have not studied the effects of relatively small additions of microsilica and are interested to note Dr Domone's evidence that an accelerating effect on OPC hydration exists for smaller additions although the effect is proportionately smaller. We consider it likely that, for OPC as, we believe, for C_3S , the mechanism of accelerating is a solution-chemical one. The case of high alumina cement is sufficiently different however that we hesitate to comment on Dr Domone's observation in this case.