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Discussion

A discussion of the paper "Kinetics of the hydration reactions in the cement paste with mechanochemically modified cement ^{29}Si magic-angle-spinning NMR study" by K. Johansson, C. Larsson, O.N. Antzutkin, W. Forsling, H.R. Kota and V. Ronin☆

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1. Introduction

The authors have monitored the reaction rate of the cement silicate phases (alite+belite) in cement/silica fume pastes by ^{29}Si NMR. The cement/silica fume binders were reported to contain 95% OPC and 5% silica fume. According to the authors, one of the cement/silica fume blends was ground in a vibrating mill while the other blend was homogenized in a rotating drum. The authors report that the 'vibration milling' process accelerates the hydration reaction by 15% to 20%. The authors present an obscure theory for the effect of 'vibration milling'. To cite them, 'the fine homogenization/redistribution of small silica fume particles with the formation of thin SiO_2 layers around the C_3S crystals that accelerates the pozzolanic reaction and promotes growing of more extensive nets of the hydrated products.' They apparently believe that 'formation of thin SiO_2 layers' and 'growing of more extensive nets of hydrated products' is responsible for the increased hydration rate and the increased strength they claim is provided by 'vibration milling'.

2. Discussion

The study is clarifying to the point that it shows that 'vibration milling' promotes the rate of cement hydration (i.e. leads to increased degree of hydration). However, this is achieved by conventional milling techniques as well. Increased cement hydration results in reduced porosity as reaction products fill up the pore space. The reduced porosity leads to increased strength. Why have the authors not considered this fundamental knowledge in their efforts to explain the claimed strength increase of 'vibration milled' cement? A 15% to 20% increase in the degree of hydration may result in a similar or higher percentage increase in strength [1–3].

Unfortunately, the authors have not discussed how the 'vibration milling' process affects the fineness of cement. Increased cement fineness, brought about by milling, increases the hydration rate of cement and thus the strength [4]. The most reasonable explanation to the accelerated cement hydration of 'vibration milled' cement may not be 'a homogenization/redistribution of small silica fume particles in the vicinity of C_3S crystals' as suggested by the authors, but simply increased cement fineness. Why have the authors not considered the obvious possibility of increased cement fineness on the increased rate of cement hydration?

The authors have compared the effect of 'vibration milling' with no milling. The interesting question though is whether 'vibration milling' provides improved cement properties compared with conventional milling techniques. Have the authors performed, or will they perform this type of comparative experiments?

References

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