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The Influence of Silicone based Water Repellents as Admixtures on the Rheological Properties of Cement Slurry

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1 Introduction

Silicone based water repellent products are widely used as admixtures in cement mortars given their compatibility and long term performance. Moreover, this application method is less sensitive to cracking compared to a post-construction application [1,2]. The most traditional method consists of adding the water repellent product to water, but Mukhopadhyaya et al [3] show some promising results using hydrophobic aggregates in rendering mortar.

Despite these benefits, some modifications are usually observed in the rheological properties of fresh mortar according to the type of water repellent and its concentration, as well as the cement composition. Based on laboratory results using the squeeze-flow method, Maranhão et. al. [4] showed that a concentration higher than 1% w/w of sodium methyl-siliconate with respect to the water content, accelerated the mortar consolidation kinetics and heat hydration during the first 30 minutes, reducing the mortar pot-life. Moreover, the consolidation effect was more important for mortars based on white cement. The influence of the type of aggregate was not addressed within this study.

2 Methodology and results

The investigation concerns the influence of the water repellent sodium methylsiliconate as admixture on the rheological properties of the cement slurry during the two first hours. The water repellents were added at a concentration of 0, 0.25, 0.50, 1.0, 5.0 and 10 % w/w with respect to the water content. It was also used two liquid/cement ratio (1.00 and 1.87) and three cement types: (i) white Portland cement; (ii) blast furnace composite cement (around 30% of slag); and. (iii) Portland cement composite with 50% of fly ash.

Rheological properties were measured using a rotational rheometer with parallels plates (model AR 2000,TA Instruments) that had been successfully used in the past [5]. The behavior was evaluated under flux (speed up rate of 0 to 150 s^{-1}) and under oscillatory conditions (frequency of 1Hz and rotational rate of $1x10^{-4}$, for 110 minutes).

The results shows that: (i) a water repellent (WR) concentration higher than 1% w/w results in an increase of the mixture stiffness characterized by an important G' increases (storage modulus); (ii) a WR content lower than 1% w/w reduces the slurry viscosity (Figure 1); (iii) the agglomeration process seems to be more important than coagulation, characterized by a high G'/ G" ratio (Figure 2); and, (iv) the addition of a WR has a more pronounced effect on the viscosity of the slurry in comparison to the W/C ratio.

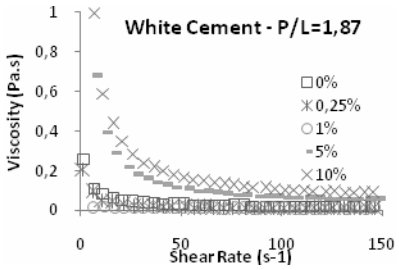

Figure 1: The influence of water repellent concentration on the mortar viscosity at different shear rates.

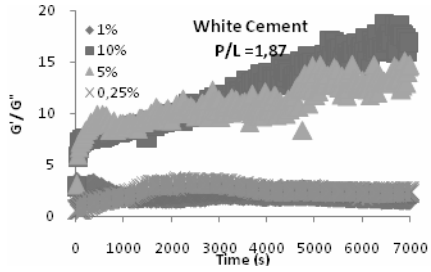

Figure 2: Ratio of (G' / G") that characterize the agglomeration process over time.

3 Conclusions

The use of sodium methylsiliconate in concentrations higher than 1%, showed an important influence on the viscosity and other rheological properties of the cement slurry, increasing the stiffness by the agglomeration phenomenon. The cement type had less influence on these properties as already observed in a previous study [4].

References

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