

Comparison of Reactivity tests on Pozzolanic Materials

Aneeta Mary Joseph^{1,2} Natalia Alderete^{1,3} Yury Villagran Zaccardi³ and Nele De Belie¹

¹ Magnel Laboratory for Concrete Research, Ghent University, Technologiepark Zwijnaarde 904, B-9052 Ghent, Belgium

² Strategic Initiative Materials (SIM vzw), project ASH-CEM within the program 'MARES', Technologiepark Zwijnaarde 935, Ghent B-9052, Belgium

³ LEMIT, CONICET, 52 entre 121 y 122 s/n, 1900 La Plata, Argentina

Introduction

Pozzolanic materials/SCMs are inorganic materials that, when used in conjunction with Portland cement, contribute to the properties of the hardened concrete through chemical reaction e.g. hydraulic or pozzolanic activity. Conventional reactivity tests like Chapelle's test and Modified Chapelle's test estimate the reactivity of SCMs with calcium hydroxide in accelerated conditions. But these tests have some disadvantages induced due to highly accelerated conditions (90 °C and 16 h) and high deviation from actual conditions (high water content and the solution contains only $\text{Ca}(\text{OH})_2$). To overcome these limitation new reactivity tests have been developed called R3 tests, which are conducted in model binder paste with SCM, calcium hydroxide (CH), calcium carbonates, alkali hydroxides and sulphates. The cumulative heat of hydration of these pastes till 7 days at 40 °C is determined using isothermal calorimeter and is used as an indicator of the reactivity of SCMs [1]. Chapelle's test, Modified Chapelle's test and R3 calorimetry have been conducted on a set of SCMs. The SCMs used include 2 calcined clays, 2 calcareous fly ashes, 3 siliceous fly ashes, 2 slags, a natural pozzolan and an inert quartz filler.

Results and Discussion

Fig 1 & 2 show that CH consumption is relatively low for slags despite the high heat of hydration. This is due to the latent hydraulic properties of slags, consuming very little CH when reacting. Heat of hydration is a better indicator of reactivity when SCMs with a wide range of compositions are studied. Moderate CH consumption for quartz in Chapelle's test indicates carbonation of CH during the course of the experiment.

Conclusions

The results of both Chapelle and Modified Chapelle tests are comparable with R3 calorimetry for certain SCMs such as calcined clays, fly ashes and natural pozzolans, while they are non-comparable for slags. The lower costs of Chapelle's methods make them interesting if a proper calibration is performed.

References

- [1] F. Avet, R. Snellings, A. Alujas Diaz, M. Ben Haha, and K. Scrivener, "Development of a new rapid, relevant and reliable (R3) test method to evaluate the pozzolanic reactivity of calcined kaolinitic clays," *Cem. Concr. Res.*, vol. 85, pp. 1–11, 2016.

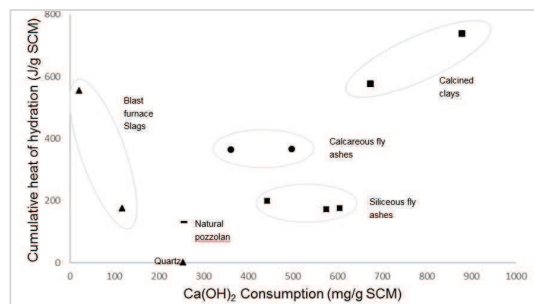


Figure 1: Comparison of Chapelle's test and R3 Calorimetry

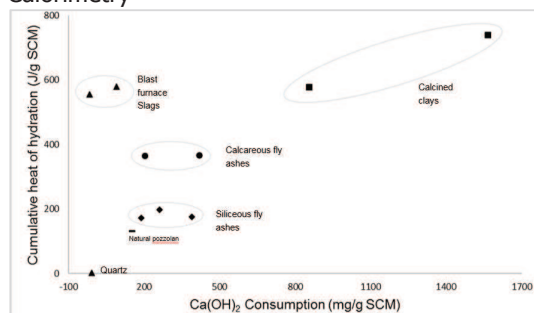


Figure 2: Comparison of Modified Chapelle's test and R3 Calorimetry