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Studying the Effect of Pozzolan on Cement Hydration by Isothermal Analysis

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ABSTRACT

Cement plays an effective role in creating industrial projects and in urbanism. It is deemed necessary to find characteristics going in line with the intended purpose. Therefore, in this study we minimizes energy and gaz emiisions by adding pozzolan to the ordinary cement, which also reduces the cost of cement production. Moreover the added product is available since is made from silicates which could interect with hydroxide calcuim to obtain wet cement for direct application.This study has been held using a measurement of different calorimeters, through measuring the culmination degree and the thermal content facing the water products decomposition. Besides, following up the Pozzolane impact on the interaction wetting and dynamism, and finding the physiochemical characteristics of cement, by means of applying the Fermi Paradigm, and calculation of the activation energy of each sample. This study concluded that using the natural Pozzlane in the blended cement affects positively the wetting in both, early and late ages.

1. Introduction

The cement industry accounts for 5% of the global carbon dioxide amount emissions, and ~~it~~ it's the second most commonly used commodity in the world is concrete, after water [1. 2]. When the Portland cement clinker is formed, there is a significant amount of CO_2 emitted from the calcination of the limestone. [6.7] In order to reduce the emission of CO_2, reduction of the cement amount in concrete production and usage of pozzolansis is an advantage [8]. The incorporation of waste in the manufacture of cement could be good approach since it allows us not only the recovery of this waste but also the reduction of greenhouse gases. These Benefits are contributing to the acceptance of culture, socially, Viability and conservation of the ecosystem as the three foundations of Sustainable development, sustainable growth [3].

element. Both their beneficial effects on the properties of concrete may explain their widespread use. [13, 14]. As well as the economic and ecological benefits of their use, [15] Pozzolans are known to boost longevity [10,14,16-18], lower hydration heat [13,17,19], Increase sulfate attack resistance [10.19.20]and reducethe energy cost per unit of cement [17.21.22]. The cement powder hydration reaction is a complex mechanism in which ion dissolution, interfacial phenomena, and solid-state reactions interact and lead to the transition in the final hydrated stages of the initial anhydrous phases. A well-known scheme, in particular [23–27]. The aim of this study is to assess the feasibility of pozzolan as a cement additive. Several cement samples were used with an addition of 25% pozzolan to different specific surfaces, the thermal analysis of these samples was measured using the Differential Scanning Calorimeter (DSC), the thermo grams obtained after analysis allowed us to determine the kinetic parameters of the hydration reaction. We also measured the degree of hydration and the activation energy, which are considered as determining parameters for cement durability and mechanical resistance.

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Table 1: *Composition of clinker oxides, gypsum and pozzolan*

Oxides	clinker (%)	Gypsum	pozzolan
CO	66.16	31.73	9.27
SiO_2	21.50	1.37	45.64
Al_2O_3	5.69	6.65	18,54
Fe_2O_3	3.28	0.98	12.72
MgO	1.96	3.78	4.21
(NaO_2, K_2O)	1.12	0.018	1.94

2. Materials and methods

2.1. Characterizing materials

Clinker and gypsum were supplied by the Meftah cement plant in Algeria, with the particle size that lies in the range of [1.6mm - 1.12mm].The volcanic natural pozzolan was obtained from the Bouhamidi deposit in the city of Beni Saf (west of Algeria). The chemical composition of the clinker, gypsum, and pozzolane are summerized in Table 1.

3. Results and Discusion

3.1 Analysis of kinetics grindin

The integration of thermal flux thermograms as a function of time for calorimetric experiments carried out in the isothermal heating mode at T= 298 k represents the evolution of released heat is represented in Figure 1. The thermal flux as a function of the time of O.P.C and the pozzolane-based cement is an exothermic mechanism that reflects all cement setting reactions until the surface water is depleted The evolution of the thermal flux and hydration heats corresponding to Portland cement without additives and for cements based on pozzolaneis shown in Figure 2and 3.The results showed a different Blaine fineness and the integration of the thermal flux as a function of time for calorimetric experiments illustrates the evolutions of heats released.

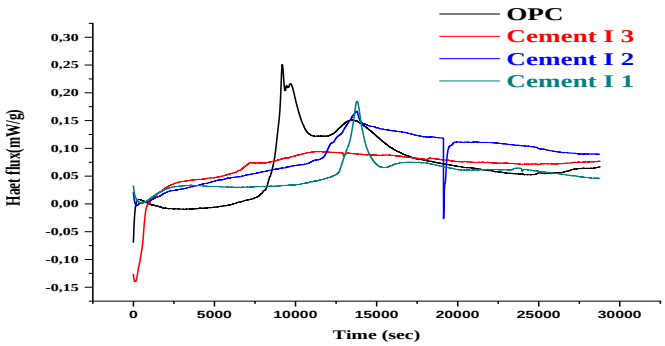

Figure 1: Evolution of O.P.C heat flux and composite Cement based on pozzolan as a function of time

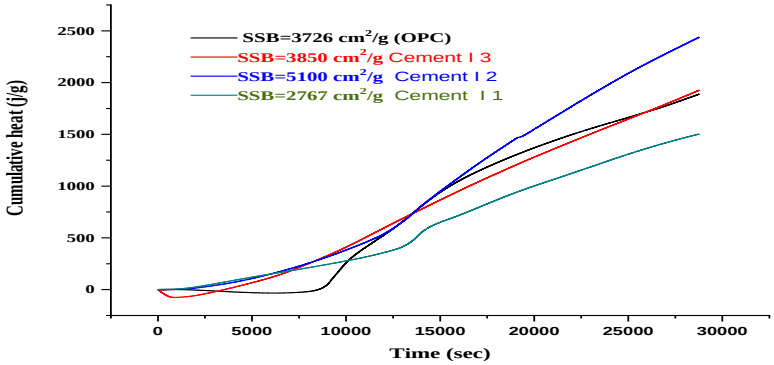

Figure 2: Evolution Cumulative of heat O.P.C and composite cement based on pozzolan as a function of time

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4. Conclusion

In this work, the effects of natural pozzolan on the hydration of blended cements were investigated by measuring the heat evolution and its rate of hydration by isothermal calorimetry. The uses of pozzolan as anditif give us the following advantages:

1. Finer cements result in more rapid hydration and higher amount of early heat evolution than coarser cements.
2. The existence of pozzolan gives C-S-H hydration a larger surface and thus accelerates the early hydration of C3S and this effect is more pronounced in coarser blended cements where the portion of pozzolan is relatively much finer than the portion of portland cement.
3. The study of each cement form shows that the increase in the fineness of Blaine leads to an increase in the heat of hydration that remains essential for Portland cement and, to a lesser extent, for composite cements.
4. Pozzolan additives help to speed up the reaction of cement hydration due to the good reactivity it's chemical composition.
5. The addition of pozzolan increased its activation energy and by consequence the mechanical resistance of cement.

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