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The influence of cation polymerization Na/K in the properties of a geopolymer

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Abstract – The different kinds of ions of polymerization used to prepare the activator solution of geopolymerics pastes influence directly on the properties of the material. To understand the mechanism, this work studies the influence of polymerization cations NA/K on the mechanical properties of geopolymeric pastes, assessing the physical and chemical behavior, thermal and microstructure of hardened pastes. From the results it was concluded that the pastes with sodium showed better mechanical behavior.

Geopolymers is a result of polymers condensation of aluminosilicates and alkali silicates causing three-dimensional polymer structures. They are produced in a distinct way from that of Portland cement, which is a solution that is mixed with the precursor geopolyimeric activator. The works studied enabled to conclude that the pastes prepared with metakaulinite as precursor showed better performance of its properties. The efficiency of the performance of metakaulinite pastes depends on the solution alkaline activator used. Generally, the alkaline activation is a hydration of alumino-silicates reaction with alkaline or alkaline-earth substances, including: hydroxides, salts of weak acids, salts of strong acids or silicate salts of the type $R_2.(n)SiO_2$, where R is an alkaline ion-type Na, K or Li, or alkaline earth such as calcium. In a simple way, the reaction of alkaline activation is reflected, in practical terms, through a process of polycondensation (polymeric synthesis) in which the tetrahedral of SiO4 and AlO4 are alternately connected with each other, sharing all the oxygen. The alkali ions (K+ and Na+) act as formation agent of the structure, compensating the excess of negative charge, and are components that determine the binding properties. Thus, the structure of these bindings is similar to that of natural zeolites, and can even be considered of zeolites synthesis. But there is a substantial difference: on the natural formation of zeolites the liquid phase appears over, which favors crystallization. In the reaction of metakaulinite activation employs the least active agent which is needed to ensure the workability of the paste. Both reactions are made to various speeds, and considerably faster to that found in the segment of the alkaline activation. As a consequence of that, the zeolites are crystalline materials, while geopolymers present amorphous texture. Based on what was exposed, the object of this work is to study the influence of two cations polymerization, potassium (K) and Sodium (NA), the mechanical properties of geopolymerics pastes, assessing the physical and chemical behavior, thermal and microstructure of the hardened pastes. The molar ratio used was Si/Al equal to 3.5, and the ratios for K or Na as a function of Si were 0.25 and 0.27. The materials used were metakaulinite HP White, potassium silicate, potassium hydroxide and sodium hydroxide. The paste were prepared with 7 days of cured in water at 38°C. For characterization of hardened pastes, the material was macerated and sent for analysis of energy dispersive spectrometry (EDX), X-ray Diffraction (XRD), Infra-red spectroscopy and thermogravimetry. The mechanical properties showed higher compressive strength of pastes prepared with sodium as an activator. The analysis of x-ray diffraction, showed the presence of impurities in the form of crystalline peaks, they were easily identified because the geopolymer is an amorphous material. In Infra-red it was possible to identify the bands of Al and Si, Figure 1. In conclusion, the pastes prepared with sodium showed higher reactivity than those prepared with potassium pastes, but the pastes prepared with potassium also showed high mechanical strength.

References

[1] DAVIDOVITS, J., MORRIS, M. “The Pyramids, an Enigma Solved”, Dorset Press, New York, 1988.
[2] VAN JAARSVELD, J.G.S.; VAN DEVENTER, J.S.J.; LUKEY, G.C. The effect of composition and temperature on the properties of fly ash- and kaolinite-based geopolymers. *Chemical Engineering Journal* 89, 63 (2002).