STUDY OF GEOPOLYMERIZATION MECHANISMS BY ^{27}AL-NMR AND CALORIMETRY CORRELATION

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Geopolymers are alumino-silicate binders prepared by reacting a powdered alumino-silicate source (metakaolin) with an alkali silicate "activating" solution. The geopolymerization reaction is a complex process but it is consensual that geopolymers are formed by dissolution of the metakaolin and condensation reactions between silicates and aluminates initially in solution or as dissolution products. However, those two processes occur concomitantly during the geopolymerization. It makes it difficult to study geopolymerization mechanisms in detail for kinetics or thermodynamics purposes. This could explain why detailed mechanistic descriptions are scarce in the literature and why this topic is still a matter of debate.

In this study, an experimental method highlighting the different mechanisms involved in the geopolymerization is proposed, allowing the determination of a thermodynamic parameter of the system. The different processes constituting the geopolymerization were dissociated by varying the metakaolin content in geopolymers, for a given activating solution. Reactivity of such mixes was investigated by isothermal conduction microcalorimetry (ICC). Time resolved ^{27}Al static Nuclear Magnetic Resonance (NMR) was used to monitor the concentration of aluminate centers in solution during the reaction.

The correlation as function of time of the total heat release measured by ICC with the aluminate centers concentration in solution exhibited the existence of a master curve allowing the determination of a reaction enthalpy. The influence of alkali cations, silicate species and aluminate ions on this reaction enthalpy was then investigated. For the first time, the dependence of the geopolymer thermodynamics over the initial composition of the system was highlighted