LIGHTWEIGHT INSULATING GEOPOLYMER MATERIAL BASED ON EXPANDED PERLITE

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Expanded perlite, owing to its lightweight and excellent thermal insulating properties, has been extensively used in different industrial sectors to produce self-standing insulating boards bonded with various organic polymers or calcium-silicates. In order to improve the high temperature behavior and mechanical performances of such materials inorganic binders, such as geopolymers, can be regarded as a promising alternative.

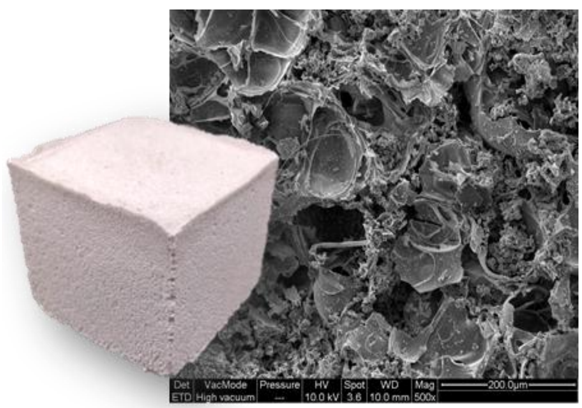

Figure 1 – Alkali-bonded perlite block and its microstructure

In this research work we investigated the possibility to use alkali silicates to bind expanded perlite by promoting the formation of a highly stable and resistant geopolymer interface phase, exploiting the partially reactive aluminosilicate nature of perlite. The material was produced using fine granules of expanded perlite as raw powder and potassium di-silicate aqueous solution as alkaline activator. After consolidation, the thermal and mechanical properties of the obtained material were investigated in correlation with its microstructure and physical properties. Bulk and true density measurements, pore size distribution analysis as well as water stability tests were firstly carried out. Structural characterization of the alkali bonded perlite was then performed through ESEM investigations, FT-IR and XRD analysis, while the evaluation of the thermo-mechanical performances was made by compressive strength tests, dilatometric analysis up to 1200 °C and thermal conductivity measurements by Laser Flash Method up to 550 °C. Our findings confirmed that, besides the action of potassium di-silicate as an alkali binder, expanded perlite granules reacted on the surface forming geopolymer nano-precipitates. The obtained material had a density of 467 $kg \cdot m^{-3}$ and a total porosity of 80 vol. % with a corresponding compressive strength of 1.6 MPa, while the measured thermal conductivity was between 0.084 and 0.121 $W \cdot m^{-1}K^{-1}$ in the range 25-550 °C. Results showed that the use of potassium disilicate as an inorganic binder promoted the partial activation of the expanded perlite granules, creating a mechanically strong bond within the particles, ensuring at the same time satisfactory thermal insulating properties and stability at high temperatures