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Pb-Zn mine waste based geopolymers: Composition and properties

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Alkali activation is proved to be a promising way for the replacement of conventional materials and waste valorization for a more sustainable habitat. In this study, mine waste MW from an abandoned Pb-Zn site in Northern Tunisia was chosen as an inexpensive additive with high adsorption capacity, replacing metakaolin (0, 5, 10, 20 and 30%) in the synthesis of different geopolymers containing two types of metakaolin (commercial 1200S, AGS Mineraux, France and Portuguese Vicente Pereira VP). During the geopolymerization processes, the SiO_2/Al_2O_3 and Na_2O/Al_2O_3 molar ratios were kept constant at 1 to reduce sodium silicate and sodium hydroxide to a minimum allowing the obtention of geopolymers with low environmental impact. The effects of source materials on the microstructure, mechanical properties and Methylene Blue dye adsorption were studied. Results showed that the MW contain very high values of potentially toxic elements up to 28,040 mg kg^{-1} (Pb) and 94,420 mg kg^{-1} (Zn), hence the need for stabilizing the hazardous elements to avoid leaching problems. Scanning Electron Microscopy observations of the geopolymers showed that each formulation induces different degree of geopolymerization reaction with a predominance of the amorphous phase. In general, compressive strength values of VP based geopolymers were higher compared to MK series. Moreover, at 28 days of curing, VP geopolymers with 10, 20 and 30 wt.% of MW showed the highest strengths ~25 MPa. Methylene Blue absorption was not affected by MW addition, implying that it can be efficient as substitute in geopolymers.