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Assessment of Physical and Mechanical Properties of Perlite Mortars with Recycled Cement

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Abstract : In order to achieve the European Union's sustainable and circular economy goals, strategies for reducing raw material consumption, reusing waste, and lowering CO_2 emissions have been developed. In this study, expanded perlite mortars with recycled cement (RC) were obtained and characterized. The recycled cement was obtained from demolition concrete waste. The concrete waste was crushed in a jaw and grinded in a horizontal ball mill to reduce the material's average grain size. Finally, the fine particles were sieved through a 125 µm sieve. The recycled cement was prepared by heating demolition concrete waste at 550°C for 3 hours. At this temperature, the decarbonization does not occur. The utilization of recycled cement can minimize the negative environmental effects of demolished concrete landfills as well as the demand for natural resources used in cement manufacturing. Commercial cement CEM II/A-LL 42.5R was substituted by 10%, 20%, and 30% recycled cement. By substituting reference cement (CEM II/A-LL 42.5R) by RC, a decrease in cement aqueous suspension pH, electrical conductivity, and Ca^{2+} concentration was observed for all measurements (2 hours, 6 hours, 24 hours, 4 days, and 7 days). After 2 hours, pH value was 12.42 for reference and conductivity of 2220 µS/cm and decreased to 12.27, respectively 1570 µS/cm for 30% RC. The concentration of Ca^{2+} estimated by complexometric titration was 20% lower in suspension with 30% RC in comparison to reference for 2 hours. The difference significantly diminishes over time. The mortars have cement: expanded perlite volume ratio of 1:3 and consistency between 140 mm and 200 mm. The density of fresh mortar was about 1400 kg/m3. The density, flexural and compressive strengths, water absorption, and thermal conductivity of hardened mortars were tested. Due to its properties, expanded perlite mortar is a good thermal insulation material.

Keywords : concrete waste, expanded perlite, mortar, recycled cement, thermal conductivity, mechanical strength
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