

Development of a new supplementary cementitious material from the activation of copper tailings: Mechanical performance and analysis of factors

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Abstract

The use of tailings as aggregate and supplementary cementitious materials has been studied previously. Nevertheless, tailings are generally used as collected, without treatment, showing low cementitious capacity allowing low replacement levels of cement (below 15%). This research studies eight copper tailings to determine which tailings are likely to improve their cementitious capacity as supplementary cementitious material by using thermal and mechanical treatments. In the first stage, using TGA and PSD, the capacity of the tailings to undergo chemical transformations through a thermal treatment of up to 1000 °C and physical transformation through low-energy milling for up to 180 min, were explored. Relevant chemical modifications were observed over the range of 500 °C–900 °C, with peaks between 600 °C and 800 °C. It was also observed that due to the nature of rock processing prior to mineral extraction, the particle size was able to be reduced by 50% after 60 min of milling or less. With these results, a central composite design was proposed using thermal treatment temperatures between 600 °C and 800 °C (central point at 700 °C) and milling with a central point at 30 min. The results show that the mechanical performance of the mixtures can be improved by up to 40% at 90 days compared to untreated tailings at a 40% replacement level.

Keywords:

Tailing, Heat treatments, Mechanical treatments.