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Application of chicken eggshell waste to synthesize calcium aluminate via mechanical activation

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A huge amount of chicken eggshell waste is produced annually by the Brazilian food industry and households. This solid waste is highly polluting and its friendly disposal is considered an issue of great economic and environmental relevance. This work aimed to synthesize and characterize a new calcium aluminate material using chicken eggshell waste from the food industry via mechanical activation. For this purpose, the synthesis of calcium aluminate was carried out using a starting formulation in the ratio eggshell waste (CaCO_3): Al_2O_3 (1:1). Six samples were prepared and subjected to a high-energy milling process at times of 0 h, 15 h and 30 h. After milling, three samples were separated and subjected to heat treatment at 1200 °C for 4 h. The calcium aluminate materials resulting after milling and heat treatment were characterized in terms of X-ray diffraction (XRD), thermal analysis (DTA/TG) and morphological analysis (SEM/EDS). The photoluminescent behavior of the samples after heat treatment at 1200 °C was also determined. It was found that the combination of high-energy milling and high-temperature heat treatment resulted in the formation of a composite calcium aluminate material, with a predominance of the CaAl_2O_4 phase. The synthesized calcium aluminate powders showed luminescence spectra with main emission bands between 352 and 418 nm corresponding to the violet color. Therefore, these results suggest a new possibility for the sustainable valorization of chicken eggshell waste as a renewable carbonate material in the synthesis of calcium aluminate with luminescent properties.