INFLUENCE OF Co^{2+} IONS ON GYROLITE FORMATION UNDER HYDROTHERMAL CONDITIONS

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As humanity faces various global challenges, such as climate change, biodiversity loss, and pollution, there is an increasing demand for new, environmentally friendly materials capable of reducing environmental harm, including greenhouse gas emissions and other pollutants [1, 2]. Such materials can be calcium silicate hydrates ($xCaO{\cdot}ySiO_2{\cdot}nH_2O$, where x, y, and n are molar coefficients). These materials are characterized by a high surface area and pore volume as well as thermal and chemical stability, making them suitable for use as thermal insulation materials, in the production of low-carbon cements, as adsorbents, and as catalysts supports [3, 4]. Compared to other calcium silicate hydrates, gyrolite [$Ca_8Si_{12}O_{30}(OH)_4{\cdot}7H_2O$] exhibits the largest distances between silicate layers 0.3 nm, i.e., sufficient to intercalate additional ions while maintaining charge neutrality. Thus, gyrolite is a promising material in advanced adsorption processes, for example, for the purification of wastewater from heavy metal ions, anions, and organic compounds; for the adsorption of carbon dioxide [5]. However, there are limited data on the synthesis and application of gyrolite with intercalated transition metal ions. Therefore, this study aimed to determine the effect of Co^{2+} ions on gyrolite formation during hydrothermal synthesis at 200 °C and on its main physical and chemical properties.

To synthesize gyrolite, calcium oxide and amorphous silicon dioxide were mixed to obtain a mixture with a molar ratio of CaO to SiO_2 equal to 0.66. This molar ratio corresponds to that of gyrolite. Then, 20 mL of distilled water or a cobalt nitrate solution (c_{Co}=10 g/L) was added to 2 g of the solid mixture to obtain suspensions (W/S = 10). The resulting suspensions were transferred into PTFE vessels for hydrothermal synthesis. The vessels were placed in a „Parr Instruments“ autoclave and treated at 200 °C, with the duration of isothermal treatment ranging from 0 h to 72 h. The obtained products were characterized by XRD, STA, FT-IR, AAS, and other methods.

It was found that Co^{2+} ions positively affected the formation of calcium silicate hydrates in $0.66CaO{-}SiO_2{-}H_2O$ mixture during hydrothermal synthesis. In the system without cobalt ions, pure gyrolite formed after 48 h and remained stable up to 72 h. Meanwhile, in the presence of Co^{2+} ions, the target product was the dominant phase after 16 h of synthesis and remained stable until 72 h. The analysis of the liquid medium showed that all Co^{2+} ions (100 mg of Co^{2+} per gram of initial mixture) were intercalated into the structure of gyrolite. Cobalt ions changed not only the formation sequence of calcium silicate hydrates but also the thermal stability of gyrolite.

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