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Kinetic factors affecting jarosite formation at room and high temperatures

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The energy transition, in order to reduce the effects of climate change, has increased the demand for critical metals. Hydrometallurgical processes, as leaching and bioleaching, are often used to recover critical metals from low-grade ores. Enhancing these processes is definitely important to overcome the challenges of the energy and mineral sectors. During the bioleaching of chalcopyrite and cobaltiferous pyrite, for the recovery of copper and cobalt respectively, favorable conditions such as acidity, the presence of ferric iron, and sulfate lead to the formation of jarosite. Unfortunately, the formation of this secondary mineral is disadvantageous since its precipitation, either on the surface of the ore or by decreasing the concentration of Fe^{3+} in bulk solution, reduce the rate of extraction of the desired metals. Kinetic data on jarosite formation and the knowledge of the effects of process conditions are essential for a better control of industrial processes. However, such data, despite being very important, remain scarce in the literature, particularly under ambient conditions, due to the slow rate of jarosite formation. This study investigates the impact of parameters such as initial ionic concentration (K^+, Fe^{3+}, SO_4^{2-}, H^+), agitation (200 and 600 rpm), seeding (2 and 5 g/Kg) to understand their effect on jarosite precipitation at room temperature. The temperature effect (23, 35, 50, 70°C) on precipitation control was also studied, and the activation energy of the reaction was determined. This work shows that increasing the concentration ratio of K^+ / Fe^{3+}, under the studied conditions, increases the reaction rate and the percentage of precipitated jarosite. Agitation and temperature increase favored the precipitation rate of jarosite. As the temperature increases, it is possible that a change in the mechanism of jarosite formation could occur. This work emphasizes that pH and temperature are the most important parameters on jarosite precipitation. The findings offer valuable insights into assessing the conditions of the recovery processes in order to exercise greater control over, or even prevent, the formation of jarosite, and consequently, improve the processes.