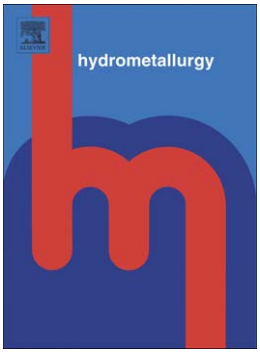

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Fractional Order Fuzzy PID Optimal Control in Copper Removal Process of Zinc Hydrometallurgy

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Abstract

The copper removal process is the first stage of purification in zinc hydrometallurgy. Due to its dynamic characteristics and complex reaction mechanism, a robust and effective controller to maintain high quality and stability of the outlet-ion-concentration is in great need. In this paper, a fractional order fuzzy proportional integral derivative (FOFPID) controller based on fuzzy logic is proposed to meet this challenge. The proposed work is conducted through a combination of three novel interdependent efforts. First, controller design problem is transformed into a nonconvex optimization problem. Second, a novel method named state transition algorithm (STA) is employed to solve the aforementioned optimization problem. Furthermore, in order to evaluate the performance of the proposed control strategy, the response performance of the system is analyzed. Finally, further tests are carried out to evaluate the performance of FOFPID controller, where disturbances caused by the measurement, flow rate, and inlet-ion-concentration are all taken into account. The simulation results demonstrate the superiority of the FOFPID controller in copper removal process over the competing FOPID and manual control in the same application environment.

Keywords: Copper removal process, disturbance rejection, fractional order calculus, fuzzy logic control, PID control, state transition algorithm

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