Treatment of Chelated-Metals Containing Wastewaters by Fenton-like Process

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ABSTRACT

The purpose of this study is to use Column Fenton-like Process and Cementation Process to treat wastewater of single heavy metal (Cu²⁺) and various chelating agents (EDTA, NTA) to study various operating factors in reaction system (initial pH of solution, zero-valent iron addition level, initial concentration of pollutant, inflow rate and H₂O₂ addition level), in order to understand reactant reaction behavior and removal efficiency. Through pollutant-oxidizer mass balance calculation, this study evaluated consuming efficiency of sacrificed metal and oxidizer, and analyzed through BDST column kinetic simulation, so as to select treatment performance of Advanced Oxidation Process plus Cementation Process and its optimum operating condition. When the solution containing CuEDTA or CuNTA (treated by means of Cementation Process) ran column reaction, total copper removal rate would fall with increasing initial pH of solution, decreasing zero-valent iron level, increasing initial concentration of pollutant, and higher inflow rate. In addition, the experiment on copper topography distribution during reaction in mass balance perspective showed that, after reaction, solid-state copper growth rate tended to rise with decreasing nitial pH of solution, increasing zero-valent iron level, higher initial concentration of pollutant, and lower inflow rate. In Fe₀/CuEDTA system, the optimum operation condition is: initial pH of solution is 3.0, zero-valent iron level is 0.25g/L, initial concentration of CuEDTA is 5.0mM and inflow rate is 6ml/min. Total copper removal rate reached 98% after reacting 60min. After 4h, the total copper removal rate amounted to 64%. In Fe₀/CuNTA system, the optimum operation condition is: initial pH of solution is 3.0, zero-valent iron level is 0.2g/L, initial concentration of CuNTA is 5.0mM and inflow rate is 6ml/min. Total copper removal rate reached 73% after reacting 2.5min; and after 4h, the total copper removal rate amounted to 28%. When the solution containing CuEDTA or CuNTA (treated by means of Fenton-like Process) ran column reaction, total copper removal rate would fall with increasing initial pH of solution, decreasing zero-valent iron level, increasing initial concentration of pollutant, higher inflow rate, and increasing H₂O₂ level. In addition, the experiment on copper topography distribution during reaction in mass balance perspective found that, after reaction, solid-state copper growth rate tended to increase with decreasing initial pH of solution, increasing zero-valent iron level, higher initial concentration of pollutant, lower inflow rate, and decreasing H₂O₂ level. In Fe₀/H₂O₂/CuEDTA system, the optimum operation condition is: initial pH of solution is 3.0, zero-valent iron level is 0.25g/L, initial concentration of CuEDTA is 5.0mM, H₂O₂ level is 2.5mM and inflow rate is 6ml/min. The total copper removal rate reached 70% after reacting 2.5min; and after 4h, the total copper removal rate amounted to 15 %.

Compared to other treatment processes, such as Sulfide treatment method, Chelating Ion Exchange Resin method, Bio-treatment method, Electrocoagulation-Flotation Method, Electrochemical Method and Membrane Filter Method. This study only added an appropriate amount of zero-valent iron and H₂O₂, and excellent total copper removing efficiency could be achieved. Therefore, it not only shortens treatment time, but is also more cost efficient.

Keywords : Fenton-like process、Cementation Process、heavy metal、chelating agent
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