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A pilot-scale investigation on the recovery of zinc and phosphate from phosphating wastewater by step precipitation and crystallization

Haiming Huang ^{a*}, Peng Zhang ^a, Liping Yang ^b, Dingding Zhang ^a, Guojun Guo ^a, Jiahui Liu ^a

^a *Hebei Key Laboratory of Applied Chemistry, School of Environmental and Chemical Engineering, Yanshan University, Qinhuangdao 066004, PR China*

^b *Shenzhen Academy of Environmental Sciences, Shenzhen 518001, PR China*

Abstract: A sustainable process to recover zinc and phosphate separately from phosphating wastewater was proposed, which involved a preliminary recovery of zinc by the adjustment of pH, followed by phosphate recovery through the formation of magnesium ammonium phosphate (MAP). Lab-scale batch experiments were first performed to investigate the effects of suspended solid (SS), linear alkylbenzene sulfonate (LAS), and Zn^{2+} on the crystallization of MAP. The results indicated that the presence of LAS and Zn^{2+} , except SS, had a markedly inhibitory effect on the MAP crystallization. The inhibition ratio of Zn^{2+} on MAP crystallization markedly increased with an increase in the Zn^{2+} concentration; whereas, it progressively decreased at a pH range of 8.5–9.5, reached the minimum value at pH 9.5, and then increased gradually at a pH range of 9.5 to 10.5. Nevertheless, the presence of Zn^{2+} was conducive to the removal of phosphate. The results of the experiments for overdosing magnesium and ammonium salts demonstrated that excessive addition of magnesium was more conducive to the enhancement of phosphate recovery efficiency from phosphating wastewater compared to that of excess of ammonium. The investigation on separate recovery of zinc from phosphating wastewater showed that the zinc recovery efficiency reached 99% by adjusting pH to 7, accompanied by the removal of a small quantity of phosphate. The pilot-scale study revealed that 99% of the Zn^{2+} and 98% of the $\text{PO}_4\text{-P}$ could be recovered from phosphating wastewater by the proposed stepwise precipitation process. An economic analysis revealed that the treatment cost and the benefit of the recovered product by the proposed process could be basically offset.

Keywords: Zinc, phosphate, phosphating wastewater, precipitation.

*Corresponding Author: Phone: +86 335 8387 741; Fax: +86 335 8061 569;

E-mail: huanghaiming52hu@163.com

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