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## Utilizing the supernatant of waste sulfuric acid after dolomite neutralization to recover nutrients from swine wastewater

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**Abstract:** Cleaner production is an important concept and an urgent need for environmental protection. Toward reducing the consumption of chemicals for swine wastewater treatment by struvite crystallization, we proposed a novel combined treatment process wherein waste sulphuric acid and swine wastewater were treated together, with which the neutralization of the waste sulphuric acid solution by dolomite powder first, followed by the use of the resulting supernatant as the magnesium source of struvite crystallization in swine wastewater. Batch experiments revealed that the waste sulphuric acid solution could be well-neutralized by dolomite powder, such that the  $Mg^{2+}$  and  $Ca^{2+}$  concentrations of the resulting supernatant were approximately 5900 mg/L and 300 mg/L, respectively. Additionally, in the dolomite neutralization process, nearly half of  $Mn^{2+}$  in the waste sulphuric acid solution was removed. The experiments to investigate the effects of  $Mn^{2+}$  and  $Ca^{2+}$  on struvite crystallization revealed that the presence of  $Mn^{2+}$  and  $Ca^{2+}$  had a significant effect on struvite crystallization. The effective ratios of  $Mn^{2+}$  and  $Ca^{2+}$  on struvite crystallization were markedly influenced by the  $Mn^{2+}/Ca^{2+}:Mg^{2+}$  molar ratio, albeit negligibly by the solution pH. When the Mg-containing supernatant was fed to the swine wastewater for the struvite formation at different Mg:N:P molar ratio and at pH 9.5, Approximately 80% of the total ammonia nitrogen (TAN) and 97% of the phosphate ( $PO_4$ -P) can be removed. A pilot-scale operation of the proposed coupling process indicated that an average of 83% of TAN and 95% of  $PO_4$ -P could be stably removed from the swine wastewater, and the remaining  $Mn^{2+}$  concentration was controlled at around 1.2 mg/L. An economic analysis demonstrated that the proposed process could save 0.5\$ of the total cost for treating swine wastewater (per  $m^3$ ) as compared to that of struvite crystallization using pure magnesium salts.

**Keywords:** Swine wastewater; dolomite; combined treatment; struvite crystallization.

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