

## A comparative study of phosphate removal technologies using adsorption and fluidized bed crystallization process

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### ABSTRACT

This study compared the two novel technologies “calcium phosphate fluidized-bed crystallization (FBC) process” and “adsorption” which used an amorphous iron oxide BT-1 as the adsorbent for treating an industrial wastewater with high concentration of phosphate (1,000 mg P L<sup>-1</sup>). In the adsorption process, most of phosphorus was adsorbed rapidly initially and then reached the thermodynamics equilibrium in 24 h. The phosphate adsorptive capacity of BT-1 was 2.03 mmole/g when the PO<sub>4</sub><sup>3-</sup> equilibrium concentration was conditioned at 8.23 mM. The adsorption process followed the Langmuir and Temkin adsorption isotherm. In the FBC process, the optimum pH range was wider (pH > 5.3) for the total removal of phosphate than that for crystallization (optimum pH = 5.3–5.9). The total removal efficiency and crystallization ratio of phosphate were about 90% and 60%, respectively, in the optimum pH range. The EDS analysis showed that the Ca–P crystal products had an approximate 1:1:6 molar ratio of Ca:P:O. The XRD diagrams confirmed the crystal type of FBC product in a highly phosphate concentrated system was diacalcium phosphate dehydrate (CaHPO<sub>4</sub> · 2H<sub>2</sub>O, DCPD), which was different from the general calcium phosphate crystal content, hydroxyapatite (Ca<sub>5</sub>(PO<sub>4</sub>)<sub>3</sub>OH, HAP), produced by FBC process.

**Keywords:** Fluidized bed crystallization; Adsorption; Phosphate removal; Hydroxylapatite; Dicalcium phosphate dehydrate

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