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Chemical calcium phosphate precipitation using lime hydrates in a fluidized bed reactor

Leila Benmansour[a,*], Riad Eutamene[a], Lakhdar Tifouti[a], Khashayar Saleh[b]

[a]*Laboratory of Environmental Engineering, Department of Process Engineering, Badji Mokhtar-Annaba University, P.O. Box: 12, 23000 Annaba, Algeria, Tel. +213 559 229 551; email: menadjliabenmansourl@yahoo.fr (L. Benmansour), Tel. +213 (0) 661 756 511; email: athameneriad@yahoo.fr (R. Eutamene), Tel. +213 (0) 38 87 10 57; email: ltifouti@yahoo.fr (L. Tifouti)*
[b]*EA TIMR 4297, Université de Technologie de Compiègne, Sorbonne Universités, 60200 Compiègne, France, Tel. +03 44 23 52 74; email: khashayar.saleh@utc.fr*

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ABSTRACT

This study aimed to study the behaviour of the chemical precipitation of calcium phosphate by means of hydrated lime ($Ca(OH)_2$) using solutions with different concentrations of phosphate [PO_4^{3-}] ranging from 5 to 30 mg P/L. A hydrodynamic evaluation of the chemical precipitation of phosphates in a fluidized bed reactor (FBR) was carried out. Under optimal conditions relative to chemical precipitation of phosphates (Ca/P = 3, pH = 9.6, U_f = 0.58 cm s^{-1} and T = 22°C), the phosphate removal efficiency η and the conversion χ were 95% and 99%, respectively. [PO_4^{3-}] concentration in the outlet of FBR was lower than in pure water. A low and uncontrolled instantaneous elimination efficiency of 49%–71% was obtained. This work was also aimed at examining the effect of the porosity of the bed and the fluidization velocity, which are among the least impacting parameters, on the efficiency of the operation. The height of the fluidized bed is exceeded by 10%, with an expansion of H/H_{mf} = 2. There was a quasi-linear increase in expansion as a function of PO_4^{3-} concentration. The effect of PO_4^{3-} concentration on these different hydrodynamic parameters (i.e., expansion, porosity and fluidization velocity) was also investigated.

Keywords: Calcium phosphate; Chemical precipitation; Fluidized-bed reactor; Hydrodynamic behaviour; Phosphate concentration

* Corresponding author.