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Phosphate adsorption from natural waters and evaluation of sediment capping using modified clays

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ABSTRACT

The aim of this study was to investigate the efficiency of Fe-modified bentonite as adsorbent for phosphate removal from natural waters with an additional estimation of sediment capping effectiveness preventing phosphorus release from eutrophic lake sediments. A modified inorganic bentonite (Zenith/Fe) based on natural Zenith-N, was prepared by embedding Fe in its interlayer space. Its morphology and structure was thoroughly characterized and adsorption isotherms were evaluated in a wide range of pH. The initial phosphate concentration was 0.1 mg/L, and represents a eutrophic natural ecosystem. The results showed that Zenith/Fe was effective at removing phosphate from aqueous solution at pH values from 5 to 9. The maximum adsorption capacities (q_m) calculated from the Langmuir model were 11.60, 14.45, 14.14, 11.20, and 9.98 mg/g for pH range from 5 to 9, respectively. Adsorption kinetics showed that most phosphates (more than 80% at pH 6) are adsorbed during the first 1 h. The adsorption rate of phosphates fits pseudo-second-order kinetic models for all pH values considered. Moreover, Zenith/Fe is likely to be effective in the adsorption of phosphates in natural environments in the presence of strong reducing conditions. In addition, the application of Zenith/Fe as a P-inactivation agent resulted in about 68% reduction of the phosphate flux from the sediments under anoxic conditions. Thus, Zenith/Fe is a very good adsorbent for phosphorus removal and potential lake restoration.

Keywords: Bentonite; Eutrophication; P-inactivation agents; Phosphorus; Restoration

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