Adsorption of phosphates onto Granular Ferric Hydroxide as a robust end-of-pipe purification strategy

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In this paper, a technology based on phosphate adsorption is proposed as a technically simple technology for phosphate removal from wastewater. This method has some benefits over the typical metal salt precipitation, including its robustness and lower postprocessing requirements. It concerns a chemisorption process, using granular iron with a sand core, also called Granular Ferric Hydroxide (GFH). The GFH used in this study is generated as a waste material in fast sand filters used for the deferrization of drinking water from groundwater, and can be used for the adsorption of a variety of pollutants (e.g., arsenic and phosphate) from wastewater (Sperlich, 2010). The primary research objective of this paper is to translate lab scale experience to good practices and optimal working conditions for industrial scale applications. First, the Langmuir and Freundlich adsorption kinetics were determined by batch tests. The kinetic evaluation of the results of these batch tests resulted in the estimation of the maximum P sorption capacity of the granules (18 - 27 mg PO₄-P/g sorbent). Based on the results of the performed kinetic study a PO₄-P adsorption capacity of 2 to 6 mg PO₄-P/g DS can be expected in full scale phosphate filter applications, when it is assumed that these filters are fed with wastewater containing an average P concentration of 25 mg PO₄-P/l. Also, bench-scale column adsorption experiments were carried out to verify the adsorption capacity and to investigate whether the PO₄-P adsorption capacity could be augmented by changing the operational conditions of the filter, i.e., attempting to achieve an increased adsorption by the use of intermediate rest periods. It was observed that these rest periods indeed cause a significant improvement in the adsorption capacity. The underlying cause was explained by the interparticle diffusion of PO₄-P towards the core of the grain during the rest periods. This will result in fresh and free adsorption sites, leading to a slower saturation of the grains.

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1 Sperlich A. (2010). Phosphate adsorption onto granular ferric hydroxide (GFH) for wastewater reuse.