Comparative study of As(V) removal by ferric coagulation and oxy-hydroxides adsorption: laboratory and full-scale case studies

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ABSTRACT

This research attempts to evaluate the efficiency of the two main arsenic removal processes, i.e. Fe(III) coagulation and iron oxy-hydroxides adsorption, by combining laboratory-scale experiments and results from operating full-scale water treatment units, located in several places of Greece. The proposed experimental procedure showed that the removal ability of Fe(III) coagulation is proportional to the added iron salt dose and appears to be much more efficient than the adsorption process applied in columns filled with iron oxy-hydroxide solid media. Furthermore, the comparison with the results obtained from large-scale water treatment plants indicated the possibility to predict the required quantities of chemicals’ addition, or adsorbents in scaling-up the laboratory or pilot-scale systems, respectively. However, apart from the effectiveness of each method, the variation in water flow rates, the residual arsenic concentrations, and the specific requirements for operation and maintenance should be also considered as important criteria for the selection of the optimum arsenic removal process.

Keywords: Arsenic removal; Ferric oxy-hydroxides; Coagulation; Adsorption; Case studies

1. Introduction

Arsenic pollution of water sources, arising by geochemical or anthropogenic origins, is considered as a serious health problem affecting the consumption of drinking water from large populations worldwide [1,2]. Among the proposed techniques for the removal of this toxic element, arsenic sorption by ferric oxy-hydroxides is the most extensively applied, especially for the removal of As(V), due to a number of reasons including high effectiveness, low cost, and simplicity of application [3]. The capacity of sorption is mainly determined by the surface charge and the specific surface area of the used oxy-hydroxides, thus amorphous structures of this material are preferable. In practice, there are two competitive technologies taking advantage of the affinity of As(V) oxy-anions with the Fe(III) cations, i.e. adsorption onto granular ferric oxy-hydroxides, or on-site precipitation of...