Effect of zeolite size as stabilizer on phosphate removal by nanoscale iron

(P Removal by Fe(OH)/Zeolite)

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Abstract— In many parts of Iran, surface and groundwaters are polluted with phosphate ion (PO₄³⁻). Phosphate is released to water resources mainly by agricultural and industrial activities and intensive animal husbandry. High concentration of phosphorus, like nitrate in water is harmful to humans, animals and plants. As an effective method for phosphate decontamination, ion exchange and surface adsorption of phosphate has been done by iron hydroxide nanoparticles stabilized on zeolite. Intending to best results, the natural zeolite with grain size of 1 and 0.1 mm and nano size, was used. Chemical method was applied to stabilize iron nanoparticles on zeolite. Characterization of nanoparticles was done using various techniques (SEM, XRD). In order to measure phosphate, ultraviolet–visible spectroscopy was applied at 820 nm. The results indicate the maximum efficiency of nanoscale iron hydroxide nanoparticles with larger size of zeolite. The method causes the zeolite particles to stabilize iron hydroxide nanoparticles by providing the right zeolite size, preventing their aggregation and thereby increase the reactivity of iron nanoparticles on zeolite.

Keywords: Pollution, phosphate, Nano iron hydroxide, zeolite, stabilization

I. INTRODUCTION

Agricultural activities such as excessive use of phosphate fertilizers, industrial wastewaters and aerial exposure of minerals are the most common ways of phosphorus’ entry into soil and water resources [5]. However, agricultural activities are the main sources of pollution [6]. Not only does excessive consumption of phosphate fertilizers reduce yields but also, because of making disorder in nutrients absorption, causes a reduction in absorption of some nutrients and in long time it negatively affects the efficiency of yields [7]. In 2013, global demand for phosphorus element was 48/9 million tons [8]. So far, several methods for removing phosphorus from wastewaters and polluted waters have been used. Chemical and biological methods are the most important of those. Among the disadvantages of chemical methods, expensive chemicals and low efficiency could be noted. The difficulty of biological process and possible restoration of phosphorus into water resource are the deficiencies of biological methods [9, 10]. The application of nanotechnology is an effective method to remove environmental pollutants. These methods are fast, easy and affordable [11]. Among the nanoparticles, zero-valent iron nanoparticles with their unique characteristics such as small size, distinctive surface area and significantly high reactivity have high capacity to remove environmental pollutants such as nitrate and phosphate [12]. Despite of benefits of zero-valent iron nanoparticles, they have a little persistence during the reaction [13]. They rapidly oxidizes when exposed to air [14] and during a chemical reaction these nanoparticles accumulate and their proper operating level reduces [15]. In some studies, some iron oxides and hydroxides of amorphous with low-grade crystalline [16], or combinations of two or more metal oxides such as iron and aluminum oxides and hydroxides [17], binary Fe-Mn

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