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Synthesis and characterization of iron-PVA hydrogel microspheres and their use in the arsenic (V) removal from aqueous solution

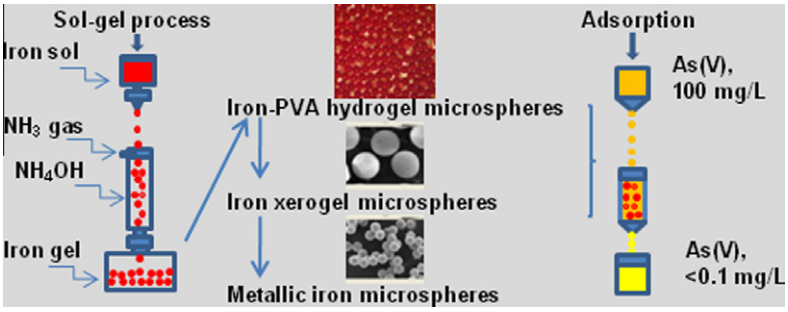
Armindo Santos [a,*], Felipe Wallysson Ferreira de Oliveira [a], Francisco Henrique Araujo Silva [a], Daniel Andrada Maria [a], José Domingos Ardisson [b], Waldemar Augusto de Almeida Macêdo [b], Helena Eugênia Leonhardt Palmieri [c], Milton Batista Franco [d]

[a] Laboratório de Microesferas Gel/Serviço de Nanotecnologia e Materiais Nucleares, Centro de Desenvolvimento da Tecnologia Nuclear, CDTN/CNEN, C.P. 941, 30161-970 Belo Horizonte, Brazil
[b] Laboratório de Física Aplicada/Serviço de Nanotecnologia e Materiais Nucleares, Centro de Desenvolvimento da Tecnologia Nuclear, CDTN/CNEN, C.P. 941, 30161-970 Belo Horizonte, Brazil
[c] Laboratório de Espectrometria de Massas/Serviço de Reator e Técnicas Analíticas, Centro de Desenvolvimento da Tecnologia Nuclear, CDTN/CNEN, C.P. 941, 30161-970 Belo Horizonte, Brazil
[d] Laboratório de Absorção Atômica e Plasma-LAA-ICP-AES/Serviço de Reator e Técnicas Analíticas, Centro de Desenvolvimento da Tecnologia Nuclear, CDTN/CNEN, C.P. 941, 30161-970 Belo Horizonte, Brazil

HIGHLIGHTS

- Monodisperse iron microspheres were produced by the sol–gel process.
- Mössbauer spectroscopy was used to characterize the iron microspheres.
- Metallic iron microspheres could be produced with an average diameter ≥80 μm.
- Iron oxide microspheres with a mesoporous structure (105 m^2/g) were obtained.
- Iron-PVA hydrogel microspheres showed high As(V) uptake (87.18 mg/g).

GRAPHICAL ABSTRACT



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ABSTRACT

We adapt the sol–gel process to synthesize monodisperse metallic iron (80–155 μm), iron oxide (117–200 μm), xerogel (130–224 μm), and -PVA hydrogel (300–600 μm) microspheres. According to the Mössbauer analysis, iron xerogel and -PVA hydrogel microspheres have superparamagnetic nanoparticles of ferrihydrite (65%) and goethite (35%). Maximum arsenic (V) adsorption (87.18 mgAs/g, ≥99.40% at $t \geq 4$ h) on the iron-PVA hydrogel microspheres takes place in the pH range 2–5, in accordance with the Langmuir model. In this adsorption, chemisorption mechanism is predominant, but the intra-particle diffusion model suggests that the adsorption mechanism is more complex. Desorption can be done with 0.011 M NaOH solution, reaching an efficiency of 74.64%. Our sol–gel process is effective in maintaining the iron particles monodisperse and with nanometer dimensions (≤20 nm) inside the iron-PVA hydrogel microspheres.

1. Introduction

Arsenic is found in rocks, soils, groundwater and surface water, sediments, and air. It enters the terrestrial and aquatic ecosystems

* Corresponding author. Tel.: +55 31 3069 3166; fax: +55 31 3069 3390.
E-mail address: santosa@cdtn.br (A. Santos).

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