



## Characterization and modification of porous ceramic sorbent for arsenate removal

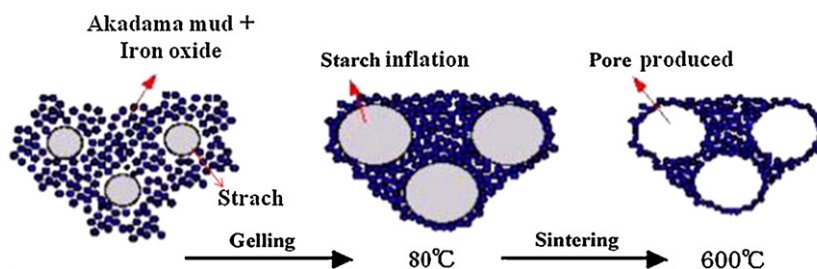
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### HIGHLIGHTS

- ▶ Porous ceramic adsorbent was synthesized and modified for As removal.
- ▶ The  $\text{FeCl}_3$  modified ceramic sorbent showed best As removal performance.
- ▶  $\text{Fe}^{3+}$  impregnation has a combination force of the acidification and iron precipitation.
- ▶ Such two effects result in a large surface area and Fe–As surface exchanger.
- ▶ Ceramic sorbents can be separated from water simply, and no toxic sludge or leached iron was observed.

### GRAPHICAL ABSTRACT



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### ABSTRACT

Porous ceramic sorbent, synthesized with a mixture of akadama mud, wheat starch, and  $\text{Fe}_2\text{O}_3$ , has been used for the removal of arsenic, which is an extremely toxic contaminant even at very low concentrations. Acid washing process using dilute HCl solvent and iron impregnation using ferric and ferrous solutions were applied to modify the ceramic for enhancing arsenic removal performance. The batch results indicated that ferric impregnated ceramic (ceramic/ $\text{FeCl}_3$ ) exhibited the best arsenic adsorption efficiency at room temperature (25 °C) under neutral conditions (pH 6.9). And its maximum adsorption capacity for arsenic removal was 7.12 mg/g, estimated by the Langmuir–Freundlich equation with correlation coefficient of 0.984. The equilibrium data also well fitted to Dubinin–Radushkevich adsorption isotherms with a sorption energy  $E = 8.11$  kJ/mol, indicating that the mechanism for As(V) adsorption on ceramic/ $\text{FeCl}_3$  was a combination of chemical ion exchange and physical electrostatic attraction, in which chemisorption seemed to be a little stronger. No secondary pollution (toxic sludge and leached iron) caused by the ceramic/ $\text{FeCl}_3$  was observed.

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### 1. Introduction

The occurrence of arsenic compounds in natural waters derives from anthropogenic sources as well as from natural ones, mainly due to the natural erosion of arsenic containing rocks. The

ubiquitous presence of arsenic in groundwater has become a worldwide environmental issue because of its detrimental effects to human health that range from acute lethality to chronic and carcinogenic effects [1]. The detrimental health effects of As prompted the World Health Organization (WHO), European Commission (EC), and United States Environmental Protection Agency (USEPA) to reduce the maximum contaminant level (MCL) of arsenic in drinking water from 50 to 10  $\mu\text{g/L}$  [2–4].

The lowering of this MCL makes it urgent to find cost-effective and easily operated techniques to meet the regulation. Among

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