



Synthesis and characterization of a new hybrid polymer composite (pollene@polyacrylamide) and its applicability in uranyl ions adsorption

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Abstract

In this study, polyacrylamide-pollen (P@PAA) composite adsorbent was synthesized by in situ polymerization method using polyacrylamide hydrogel and pollen. The adsorptive properties of the P@PAA hybrid polymer composite adsorbent were investigated for the removal of UO_2^{2+} ions. The findings obtained as a result of the structural characterizations showed that the P@PAA composite adsorbent has various functional group variations. The max adsorption capacity of UO_2^{2+} ions was $0.695 \text{ mol kg}^{-1}$. The thermodynamic parameters of the adsorption of UO_2^{2+} ions onto P@PAA hybrid polymer composite were determined and it was clarified that the adsorption was spontaneous.

Keywords Polyacrylamide · Pollen · Composite · Uranyl · Adsorption · Isotherm

Introduction

Uranium, which is a radioactive species, exists in an aqueous solution as hexavalent uranium. It causes pollution in fresh-water due to many sources, especially nuclear power plants, scientific research laboratories and, mines. In addition to being radioactive, it has a toxic effect on many organs when taken into the human body, it can lead to organ failure and even death. It is known to have adverse effects, especially on the liver, kidney, and bone [1]. Uranium, which must be removed from the aqueous environment due to its toxic nature, is very important for the environment and human health.

Adsorption is known as a method of removal or enrichment in the solid phase by transferring an ion or a molecule from the aqueous or gas phase. From this point of view, it is among the most studied areas of recent years, especially

because it is economical and sustainable in the removal of pollutants. On the other hand, it is a very effective method for recovering precious species and for enriching the trace species before their determination. It is used effectively to remove/recovery many species such as metals, radioactive species, dyes, organic pollutants and toxic gases.

One of the important stages of adsorption studies is the appropriate adsorbent design. Carbon [2], clays [3], minerals [4], synthetic and natural polymers [5] composites, and MOFs [6] have been used frequently in recent years in adsorption studies. In the selection of adsorbent, it can be counted among the advantages of being selective to the relevant species, high adsorption rate and capacity, as well as being economic, reusable and natural. Therefore, in recent years, composite adsorbents based on natural materials have come to the fore in the removal of pollutants.

Pollen is the structure in which male seeds are formed in plants and occur naturally. Exine, known as the outer wall, is a complex biopolymer and is highly resistant to external conditions. In general, the pollen content consists of glucose, fructose and sucrose, but also contains flavonoids along with cellulose, hemicellulose, and various proteins. Their interest in different metal species has been demonstrated by various studies. Zhang et al. [7] used modified pollen in the adsorption of cadmium and lead. Lu et al. [8] have proposed pollen as a material for solid phase extraction. Zhao et al. used pollen-based adsorbent for trans-resveratrol separation [9].

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