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Enhancing the Uranium Recovery Performance in Gattar Pilot Plant Using Pulsed Column Technique

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ABSTRACT

Comparison of various technologies for uranium recovery from sulphuric acid leach solutions shows that the moving bed systems are more effective processing routes than fixed bed. Developed system using air pulsation for resin moving was tested and examined for uranium recovery from Gattar pilot plant project (North Eastern Desert, Egypt) sulphuric acid leach liqour using Chinese resin D263B. Recovery equilibrium and kinetic isotherms are established. The obtained results showed high performance and the validity of derived pulsed resin column for uranium extraction. Elution behavior was improved by using intense fractional eluent which gives efficient results.

1. Introduction

In the earliest uranium plants, concentration and purification of solutions was achieved by selective adsorption of uranium by an ion exchange resin in fixed-bed columns. The development of the continuous ion exchange system has been a big breakthrough in uranium extraction technology. The fluidized bed technique has been studied and applied in uranium industry from 1970 and now research and application of the densely packed-moving bed techniques in uranium industry are in progress [1]. Problems due to a decrease in particles mean radius during adsorption prompted us to use a fluidized bed. It is also possible with this reactor to treat solutions containing suspended solids which would clog fixed beds [2]. In the same time during elution, the addition of the less dense eluant caused the resin bed to sink slowly as the dense feed solution was displaced eluant flowed down through the column, which was operated as a fixed bed. The elution characteristics, after the bed settled as a plug to the bottom of the column, were the same as observed for a fixed bed [3,5]. The decrease in particle radius (or increase in apparent density of the resin) produces a contraction of the fluidized bed: unloaded particles remain at the top of the bed and a density gradient appears throughout the column, leading to a stabilization of the fluidized bed [3,4].

An application in a fluidized bed reactor requires a good understanding of equilibrium and kinetics properties of the adsorption. In the perspective, equilibrium relationships, generally known as adsorption isotherms, describe how pollutants interact with theadsorbent materials, and thus are critical for optimization of the adsorption mechanism pathways. Namely; the surface properties, capacities of adsorbents, and effective design of the adsorption systems [4,5]. In general, an adsorption isotherm is an invaluable curve describing the phenomenon governing the retention (or release) or mobility of a substance from the aqueous porous media or aquatic environments toa solid-phase at a constant temperature and pH [6,7]. Adsorption equilibrium (the ratio between the adsorbed amount with the remaining in the solution) is established when anadsorbate containing phase has been contacted with the adsorbent for sufficient time,with itsadsorbate concentration in the bulk solution is in a dynamic balance with the interface concentration [8,9].

Developed system theory depends on acceleration of resin adsorption and elution rate through the expansion of the ion exchange bed area (EBA), using pulsed air. In EBA, adsorbent particles with defined size and density distribution are fluidized by a mobile phase directed

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