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Evaluation of Thorium Adsorbent Prepared by Radiation Grafting and Functionalization with Glucamine

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Adsorption is considered as the most effective and simplest approaches to separate metal and others chemicals from aqueous systems. Activated carbon is one of the most widely used adsorbents and it can be used to remove almost all pollutants and metals. However, activated carbon adsorption is suffered from costly regeneration, high attrition rate and low selectivity of pollutants. The low cost adsorbents with good mechanical strength, high adsorption capacities and selectivity have attracted increasing interest from researchers to develop a practical economically adsorbent for separation/extraction of metals. In the past decades, polymeric adsorbents having ion exchanger property have been identified as potential candidate as compared to other adsorbents. This is because it has large surface area, excellent mechanical stability, adjustable surface modification and chemistry, high selectivity and stable after multiple regeneration cycles. Polymeric adsorbents having fibrous structure have been found to perform better in term of its adsorption kinetic and capacity. Radiation induced graft copolymerization is an effective method to prepare adsorbent precursor in fibre form by grafting of monomer onto the fibre and subsequent functionalization to produce fibrous polymeric adsorbents.

Thorium adsorbent was prepared by grafting of glycidyl methacrylate (GMA) onto nylon fibres in methanol mediated grafting system. The degree of grafting was calculated from the weight gained of fibers before and after grafting. The grafting was carried out by electron beam irradiation using the pre-irradiation grafting method. The GMA grafted nylon fibres were further modified by reaction glucamine. Then, batch adsorption tests were conducted by adding adsorbent to Erlenmeyer flasks containing thorium solution. The remaining thorium in the solution was tested using inductively coupled plasma mass spectrometry (ICP-MS, Agilent 7900) and standard solutions of thorium at 1 ppb, 10 ppb, 100 ppb and 1000 ppb were used to prepare a calibration curve.

Grafting yield of 220% were obtained at 100 kGy absorbed dose, 2 hours reaction time, 40 oC reaction temperature and 10% monomer concentration. The parameters to obtain glucamine density of 2.2 mmol/g adsorbent were 10% glucamine concentration, 80 oC reaction temperature and 1 hour reaction time. The new graft copolymers of GMA and incorporation of glucamine onto grafted fibres were confirmed by scanning electron microscope (SEM) and Fourier transform infrared spectroscopy (FT-IR). A thorium adsorbent containing glucamine functionalized onto GMA grafted nylon-6 was prepared and the maximum adsorption of thorium was achieved at pH 2. The fibrous adsorbent showed > 98% separation of thorium from aqueous solution using adsorbent dose of 0.5 g at 50 mg/L thorium concentration, 3 h reaction time, 30 oC reaction temperature, 200 rpm stirring speed and pH 4.

It can be concluded that the thorium adsorbent having fibrous structure was successfully prepared and can be applied for thorium separation from aqueous solutions.

Country/Organization invited to participate

Malaysia

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