

Uranium/vanadium separation using SepTor technology

Introduction

Uranium is the mainly used for nuclear power generation. The world production of Uranium (as U308) is estimated at 50 ktpa, with Canada and Australia as main producers. The market price of Uranium has

been fluctuating in the range of \$ 26 – 35 per kg over the last decade but has recently climbed to over \$ 80 per kg. Since then, the price has more than doubled. This is mainly attributed to an increased demand from emerging countries such as China and India.

The leach solution from uranium ores contains a variety of other metals, such as vanadium. The separation of uranium from the leach can be done by means of ion exchange. In this application note, a continuous chromatographic recovery process for Uranium will be presented, based on the continuous SepTor Ion Exchange Technology.

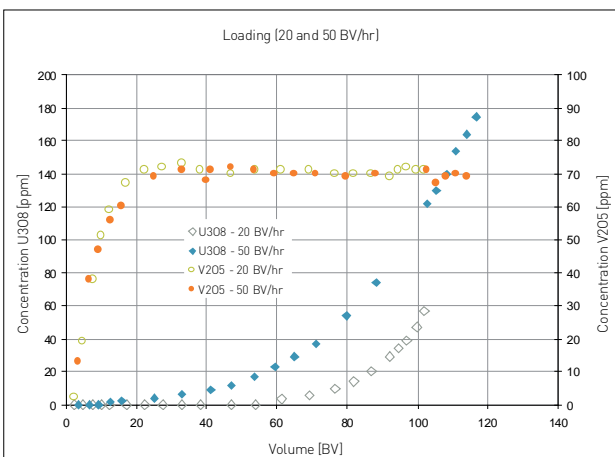


Figure 1: Uranium and vanadium adsorption curves.

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More out of ore

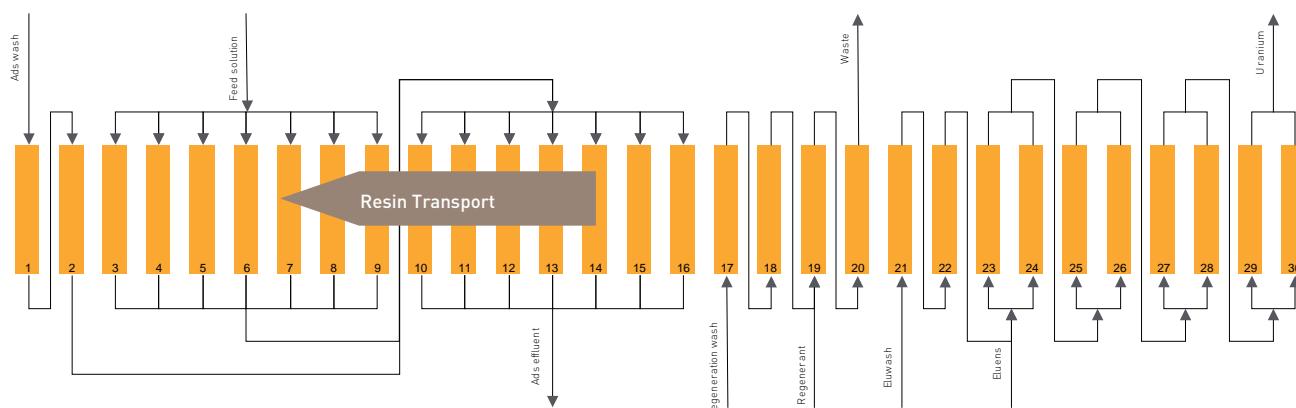


Figure 2: Process Flow Diagram for the recovery of uranium

Design considerations

The recovery of Uranium is done on strong basic anion exchange (SBA) resins. By choosing the adequate ionic form for the resin it is possible to selectively adsorb Uranium and hence separate it from Vanadium (commonly present in Uranium streams) as shown in figure 1. Column tests performed at two feed solutions using representative feed material.

In adsorption/elution system the eluents consumption is not only an important factor to the OPEX but also to product dilution. For this process, to minimise the chemical consumption and product dilution during elution, it is necessary to use a different buffer than the one used at regeneration.

Process flow diagram

A typical Process Flow Diagram for the purification of Uranium is shown in figure 2. The process design includes the following features:

Adsorption is done in two stages, undiluted adsorption and diluted adsorption. Fresh feed solution is applied undiluted on the first stage where columns are partly saturated. This situation exploits the concentration difference between the resin and the liquid to achieve maximum adsorption efficiency. The effluent from the first stage is diluted with the adsorption wash effluent and passed to the second stage adsorption where the liquid sees fresh (regenerated) resin. This section is to adsorb the Uranium leaving the undiluted adsorption. The effluent from the adsorption section is enriched in Vanadium and can be further treated for Vanadium recovery.

The regeneration step receives the effluent from the regeneration wash section thereby lowering the water and chemical / consumption. The regenerant changes the resin back into the appropri-

ate ionic form and leaves it ready for a new adsorption step.

The elution step has an analogous chemistry to the one from regeneration, thus it follows the same design principles. The elution effluent is the Uranium product stream.

Washing steps are included between adsorption regeneration and elution to minimise product losses, product contamination and loss of chemicals.

For a production capacity of 1100 tpa uranium, this operation typically requires a SepTor 30-75, carrying 30 columns with a total resin volume of approximately 20 m³. Depending on the feed composition, one might expect the uranium product to be typically 20-fold concentrated relative to the feed solution.

Process economy

The use of ion exchange on Uranium recovery will yield around 50% savings over the resin in pulp method. Furthermore there are some added advantages to ion exchange done on a continuous mode over a batch process (fixed or fluidized beds). Exploiting the benefits of the counter-current mode, the effective loading of Uranium on the resin can be increased over a 30%. This is subsequently translated in a reduction in resin inventory and consumption of chemicals of over a 30%.

Conclusions

The process design here presented can be further improved by means of pilot tests. In this way the process parameters are fine tuned for the specific process conditions and so are the resin inventory and chemicals consumption.

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