

Solid phase ion-exchanger in recycling processes

A. Main topics

- Ion-exchange resins as crucial scaffolds in energy efficient recycling processes in aqueous media.
- Volume reduction of aqueous solutions using solid phase cation exchangers
- Enrichment of copper-containing solutions prior to electrolytic purification.

B. Targeted audience

Beginning with 16 years old students

C. Key concepts

1. Some materials show functional groups that allow the exchange of cations (e.g. sulfonic acid groups). This ability can be utilized in recycling processes.
2. In the design of economically and ecologically reasonable recycling processes, the concentration of aqueous media often has to be adjusted. The volume reduction via distillation is connected to a high energy demand. Therefore other enrichment-processes are used – for example ion exchange resin.
3. During the recycling of copper, electrolysis is the most expensive step in the process chain. Therefore the concentration of the solution to be electrolysed has to be as high as possible to decrease the energy demand per mass unit of copper recovered. This is carried out as shown in this experiment.

D. Experimental activity:

The students will load a prepared cation exchange column with a copper(II)-sulphate solution. This can be observed by the colour changing from pale yellow to deep blue. The eluate is colourless during this process, indicating that the copper cations “stick” to the resin. Once the resin is loaded with copper, it is flushed with diluted sulfuric acid, shifting the equilibrium of the reaction towards the protonated species of the ion exchange resin. Therefore the loaded resin releases the copper ions again. The presence of copper in the eluate is indicated by blue colour. As a result, it can be observed, that the copper solution is half as bulky as before.

E. Toolkit material

- Samples of copper sulphate and a packed column with the cation exchange resin.
- Protocol with the description of the experiments.
- Slideshow with graphics and additional information.
- Video material?

F. For information on the toolkit

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