Dissertation abstract:

Synthesis of inorganic salts by electrodialysis metathesis using the example of potassium nitrate

Author: mgr inż. Hanna Jaroszek

Dissertation advisor: dr hab. inż. Piotr Dydo, prof. Pol. Śl.

The aim of the study was to examine the applicability of electrodialysis-metathesis (ED-M) for synthesis of inorganic salts, on the example of potassium nitrate. The research was carried out in a wide range of parameters.

Using the various configurations of the membrane module, the fluxes of ions and water through various ion-exchange membranes (IEMs) were studied. It was found that migration of counter-ions, diffusion of co-ions and electroosmotic water transport dominate the mass transport in ED-M. The electroosmotic water flux can be further limited by choosing IEMs with low electroosmotic permeability and maintaining high salt concentration in the feeds.

The ED-M synthesis tests were carried out on a laboratory scale according to the general equation:

$$ANO_3 + KX \rightleftarrows KNO_3 + AX \ (X = Cl^-, SO_4^{2-}, A = NH_4^+, Na^+, Ca^{2+}, Mg^{2+}).$$

Based on the obtained results, factors limiting the reaction rate, purity of the product, energy efficiency and concentration of products were determined. The criteria for the selection of IEMs, process conditions and raw materials have been formulated. A system for obtaining KNO_3 solution by ED-M was proposed and verified.

The obtained results indicate that ED-M is suitable for the synthesis of highly soluble inorganic salts. Among the salts tested, the synthesis of KNO_3 and NaCl, NH_4Cl or Na_2SO_4 was most efficient in terms of energy consumption.