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The Development of Mathematical Model for Electrorefining Process
전해제련 공정의 수학적 모형 개발

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Electrorefining is a major technology of pyrochemical processing that has a potential benefits for solving the proliferation issue and spent nuclear fuel wastes problem because it has a capability of group separation without producing the pure elements. In nuclear industry, electrorefining process has a very much elements induced by nuclear fission and is a very complicated electrochemical reactions. Hence it is difficult to predict the efficiency and throughput of electrorefiner. The development of simulation code for predicting the behavior of the electrorefiner has been carried out.

Electrorefining process is mathematically modeled using diffusion layer theory including coupled transport of diffusion and migration and interface kinetics of Butler-Volmer type. The resulting set of nonlinear partial differential equations is converted to the set of ordinary differential equations using finite difference method. This is known as the method of line. The set of ordinary differential equations is numerically solved by LSODA package, an ordinary differential equation solver.

The code is verified by calculations with experimental data, which can be obtained. The experiment of Argon National Laboratory in USA is simulated with the same operation history of electrorefining process and compared with the experimental results and other simulation code, TRAIL developed at Central Research Institute of Electrical Power Industry in JAPAN. The similar results are obtained. The calculation results are also predicted the concentration changes of each elements at the equilibration period.

The developed model has a unique advantage. That is, the model can simulate the transient phenomena. Hence this model can be applied to study on various effects on the electrorefining such as the effect of periodic current.