

Request for a three to six-months internship at the Nuclear Energy Agency (NEA), Paris

Development of a database of extractants for actinides separation processes

Background

The implementation of advanced nuclear systems requires new technologies associated with the back-end of the nuclear fuel cycle. The separation of minor actinides (MA: Np, Am, Cm) from other fuel components is one of the advanced concepts required to close the nuclear fuel cycle and improve long-term effects on performance of geological repositories. Many processes for partitioning MA have been developed worldwide using different extractants and solvent extraction techniques. A comprehensive review of separation processes developed in NEA member countries was recently performed by members of the Expert on Fuel Recycling Chemistry (EGFRC) (under the auspices of the Nuclear Science Committee (NSC) and the Working Party on Scientific Issues of the Fuel Cycle (WPFC)) along with an assessment of the technological maturity (TRL)¹ and a state-of-the-art-report was published in 2018. Many countries have developed hydrometallurgical partitioning processes to recover TRU elements in order to decrease the radiotoxic inventories of nuclear waste. Although their development studies have sometimes reached demonstration tests at the laboratory scale, none of these processes has yet been implemented at the industrial scale. Following the preparation of the report, members of the Expert Group have discussed the possibility of extracting information from the document to create a database that covers the different existing processes and the chemical extractant used for each process.

In addition, within the EURATOM Framework Programme 7 collaborative projects ACSEPT (2008-2012) and SACSESS (2013-2016), several separation processes were developed to scientific feasibility with the identification of new organic extracting or complexing molecules and diluents. The behaviour of extractants, complexants, and diluents was studied in order to ensure the optimisation of each process. Participating countries have published reports on the matter.

A great deal of knowledge and data have been generated worldwide during past and current research projects on separation processes and although they have been reviewed in various reports, no tool yet exists to facilitate the wider use of this knowledge. A database was developed within the SACSESS project for the purpose of compiling known data on extractants but was not populated or released outside the project. Access to the database was limited to participants in the SACSESS project and the current platform expired in 2018.

With the permission of the SACSESS project, the database has now been transferred to the Nuclear Energy Agency (NEA) in order to preserve the database on a sustainable platform as well as extending access to the database to the wider international community.

The NEA has a long experience in developing database and the Data Bank stores information about experimental data used in validating different types of computer programs. Databases are currently held for radiation shielding experiments (SINBAD), criticality safety benchmark experiments (ICSBEP), fuel performance experiments, and atmospheric dispersion tracer experiments.

The database

The database is a knowledge management tool. The objective is to create a chemoinformatics and a document database and build a comprehensive, internationally recognised database of extractants for actinide separation processes. The database should contain:

- a complete list of existing actinide separation processes
- a short description of the processes (elements separated, etc.)
- a list of the chemical species used to recover the actinides

Through the mandate of the EGFRC, the NEA has offered to help gathering data and start entering them into the database. The first stage was completed in 2018 by an intern to the NEA and consisted in the population of an Excel datasheet containing the name of the extractant, its structure, molecular formula, the name of the

associated separation process, and a list of references for each ligand. In addition, we initiated thoughts on the user interface design.

At this stage of development, although a considerable amount of data was entered, no ligands are complete in term of data entry. Work should therefore continue to complete data input prior further developing the actual database interface.

Internship

The objective of the internship would be to further develop the database by continuing the work started in completing data entry for each ligands. .

The intern will work for a period of 3 to 6 months (TBD with home institution) at the Nuclear Energy Agency under the supervision of Dr S. Cornet and in close collaboration with members of the Expert Group on Fuel Recycling Chemistry.

The intern will perform the following tasks:

- Review existing separation processes described in the literature
- Implement recommendations from the first stage of database development
- Further populate the existing database
- Develop contacts with key players in the project (SACSESS members, expert group members, etc.),
- Actively participate to NEA EGFRC meetings and present progress of work
- Initiate discussions with the database developers and identify improvements to be made to the current database
- Identify additional requirements needed for hosting a database at NEA

The candidate should

- Have a degree in chemistry (at least 4 years) with knowledge in nuclear science and radiochemistry
- Knowledge on the chemistry of the actinides and actinide separation processes.
- Be able to work in English. Knowledge of French would be an asset.
- Strong communication skills; detail-oriented with an ability to work independently and prioritise tasks

Interested candidates should send a CV and a cover letter to stephanie.cornet@oecd-nea.org by 15 February 2019.