



Contribution ID: 981

Type: Verbal

## Application of ultra/nano filtration membrane on mining Uranium from seawaters

*Wednesday, 18 May 2022 09:00 (20 minutes)*

### Introduction

Nuclear energy is a green and renewable energy. Uranium, as an important resource for nuclear energy, exists in seawater at a concentration of 3.3  $\mu\text{g/L}$ , forming highly stable  $\text{Ca-UO}_2\text{-CO}_3$  and  $\text{Mg-UO}_2\text{-CO}_3$  complex. Though dilute, this amounts to an estimated 4.5 billion tons of uranium, which is approximately 1000 times more than that is available from conventional sources such as terrestrial ores. Uranium in seawater will be a near-limitless resource for nuclear fuel in the future, and its recovery will avoid the deleterious effects of terrestrial mining on the environment. Although there are many difficulties to overcome, mining of U from seawater is the most promising.

### Title

The objective of this work is to test the possibility to separate Uranium from other salts in natural and re-composed water systems by ultra/nano filtration process realized with inorganic membranes, and to understand the rejection mechanism, the interaction of membrane with solution species. For this goal, various physical-chemical parameters, such as MWCO, pH value of solutions, temperature, applied pressure, ionic strength/salinity, solution composition, are evaluated for their influence on metal rejections. Electric repulsion and steric effect are two mechanisms deducing the interaction of solution species and membrane surface thus the rejections. Speciation distribution of each solution is studied with phreeqC software. Mass conservation law is applied to estimate the error. Concentrations of retentate and permeate are measured by ICPOES and ICPMS for determining the rejections.

### Conclusion

Electric repulsion and attraction is the main mechanism of interaction between membranes and solutions species. pH is the principle factor which influences the rejection of every specie. There is a selectively big reject of U(VI) to Na at pH 3 and 8.25 in solutions of U and  $\text{NaHCO}_3$ . MWCO does not influence the rejections of U or Ca except that the IEP of different membranes can be slightly different. The salinity influences a lot the rejection of U in solutions presenting  $\text{NaHCO}_3$  and NaCl (1-35g/L). U rejection decreases with the increase of salinity, but is still considerably rejected until salinity 10 g/L. With the  $\text{CaCl}_2$  solutions of increasing concentration at pH 3 and the same for  $\text{MgCl}_2$  at pH 3, the salt concentration influences a lot the rejection of both Ca and Mg. Both these experiments prove that high salinity shields the electric repulsion, by consequent decreases the rejection. On the other hand, U can be rejected from sodium in solutions contained only U and Na from  $\text{NaHCO}_3$ , NaCl or  $\text{Na}_2\text{SO}_4$  at pH 8. U can be separated from sodium salts and be concentrated in a concentration experiment, so as Ca and Mg in the solutions respectively of  $\text{CaCl}_2$  at pH 3 and of  $\text{MgCl}_2$  at pH 3. Finally, filtration experiments with complicate natural and re-composed solutions including seawaters, Rhone River and theses solutions doped with U are conducted. In all the natural or re-composed seawater solutions, none of the species (U, Na, Mg, Ca, K) is rejected. However, it is proved that with the inorganic membranes, the presence of  $\text{CaCl}_2$  or  $\text{MgCl}_2$  hinders the rejection of every specie in solutions including U.

**Primary authors:** Ms XING, Chen (Marcoule Institute in Separation Chemistry (ICSM), ENSCM, China Scholarship Council); Prof. PELLET-ROSTAING, Stéphane (ICSM, CEA); Dr ARRACHART, Guilhem (ICSM, UM, CEA)

**Presenter:** Ms XING, Chen (Marcoule Institute in Separation Chemistry (ICSM), ENSCM, China Scholarship Council)

**Session Classification:** Separation & Speciation

**Track Classification:** Separation Methods, Speciation