A one-dimensional transport model of CO_2 in highly saline solutions in a final repository for radioactive waste

T. WEYAND[1], G. BRACKE[2] AND B. REICHERT[1]

[1]University of Bonn, Steinmann-Institut, Nußallee 8, D-53115 Bonn, Germany, torben.weyand@web.de, b.reichert@uni-bonn.de

[2]GRS gGmbH, Schwertnergasse 1, D-50667 Cologne, Germany, guido.bracke@grs.de

Introduction

An understanding of the transport and chemical interactions between the radionuclide ^{14}C and highly saline solutions is necessary to assess the safe containment of radionuclides in a final repository for radioactive waste.

Model

^{14}C can occur as $^{14}CO_2$ and is generated by radioactive waste. The chemical interactions of CO_2 during transport of highly saline solutions are studied with the geochemical code PHREEQC using a one-dimensional transport model. The model is derived from a repository concept of the Gorleben site in Germany [1]. An advective transport is considered in this preliminary safety analysis only due to gas generation and physical equilibria [1]. Various aqueoes species and solid phases containing carbon are considered using a thermodynamic database with Pitzer parameter.

Results

Due to chemical interactions between CO_2 and highly saline solutions, various aqueoes species containing carbon are formed and transported. The pore solutions of the backfill contain $MgCl_2$, and the solid phase $MgCO_3(s)$ is formed. As a consequence, carbon is retained temporarily as carbonate in the solid phase and the transport of carbon slows down. After the pulse injection of CO_2, the carbon is released into the fluid phase and transported again.

Conclusions

This leads to a longer residence time of ^{14}C within a final repository for radioactive waste. It is concluded that this would delay the onset of the peak of potential radiation exposure by ^{14}C in a safety assessement of a repository for radioactive waste. The ongoing decay of ^{14}C would further decrease the potential radiation exposure.

[1] Bracke & Fischer-Appelt (2015) *Progress in Nuclear Energy* **xxx**, 1-10.