The Solubility of Noble Gases in Molten Salts

Farahi, Roxanne (School: Oak Ridge High School)

The molten salt reactor (MSR) has garnered renewed interest as an alternative nuclear power technology due to their greater electrical-generation efficiency as compared to conventional Light Water Reactors. Noble gases are produced as a by-product of fission, which need to be removed from the reactor. Because of their abundance and volatility, noble gas isotopes are the main contributors to the radionuclide load in the cover gas system. Knowledge of the solubility of noble gases in molten salts is critical for the radioactive-byproduct removal process. While some information is available on the solubility of noble gases in fluoride and chloride salts, the physical properties of many of these salt mixtures are largely unknown. In the present investigation, the temporal pressure of a chamber is measured as molten MgCl becomes saturated with the contact noble gas. Solubilities of gases in liquids are generally described using Henry's Gas Law, where there is a direct dependence of the concentration of a gas species in the liquid with the saturation pressure. MSSOL software developed in Python performs an exponential regression on the temporal pressure dataset as equilibrium is reached. The MSSOL uses the parameters of the regression to automate the calculation of the solubility. The solubility of Ar in NaCl-MgCl was determined for temperatures ranging from 500–750 Co at pressures between 1.8–0.5 atm. The results are important in the design of the MSR, such as the geometry of the chamber and the operating temperatures, as each fuel cycle is unique.