A NEW METHOD FOR STABILIZATION/SOLIDIFICATION OF RADIOACTIVE WASTE SALT (LiCl, LiCl-KCl) FROM PYROCHEMICAL PROCESS

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Abstract

A pyrochemical process to recover uranium and TRUs consists of a series of electrolytic processes using metal salts such as alkali metal chlorides. During the process, uranium and TRU elements are recovered as metallic form and a series of fission products are left in the electrolyte. This radioactive waste is one of problematic waste not to directly apply to the conventional vitrification process due to high volatility and low compatibility with silicate glass. At present, there are two approaches to the immobilization of these radioactive wastes, Cl-containing material as a host matrix and non Cl-containing matrix by dechlorination. Among many Cl-containing minerals, sodalite ($Na_8Al_6Si_6O_{24}Cl_2$) is a practical example to treat a metal chloride waste, which was suggested by Argonne National Laboratory (ANL). Also, the immobilization of metal chloride waste by using phosphate-based glass has been reported by Research Institute of Atomic Reactor (RIAR). Different from these direct immobilization, our research group adapted a dechlorination approach for waste salt by using a inorganic stabilizer, **SAP**, that composes of five kinds of oxides, SiO_2, Al_2O_3, P_2O_5, Fe_2O_3 and B_2O_3. This inorganic composite can be prepared by a conventional sol-gel process. It has a sequential bond (-Si-O-Al-O-P-) which can be broken to react with metal chloride when contacting with molten salts (LiCl or LiCl-KCl). By this reaction, a series of products (metal aluminosilicates, metal aluminophosphates and metal orthophosphates) manageable at high temperature can be obtained. A monolithic wasteform can be prepared by a heat-treatment of product at 1150°C. The wasteform composes of silicate and phosphate glassy phase uniformly distributed in tens of nm scale. Gaseous chlorine (or other halogen gas) generated during this process can captured by alkali metal oxide (Li_2O or K_2O) to produce alkali metal chloride that can be reused as an electrolyte. In conclusion, the new method suggested in this study, the dechlorination of metal chloride by using SAP and the recycle of gaseous chlorine by alkali metal oxide, can provide a chance to reduce the final volume for disposal and to maintain the total amount of Cl used in pyrochemical process.