SHORT NOTE

Molten Salt Extraction for Removing Iodine from Liquid Sodium

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Since it can be expected that the sodium in the primary coolant system of a sodium-cooled fast reactor is gradually contaminated by passing through the reactor core with corrosion products from constructing materials and with some of the volatile fission products, in the case of the vented fuel design, it is necessary to develop a method for removing these impurities from the coolant sodium and controlling their levels below tolerable limits. The technique based on a cold-trapping concept provides a very effective means of removing some of the corrosion products and non-metallic impurities such as hydrogen and oxygen. But this method will require another technique to avoid the effect of accumulation of deposits in cold trap on flow passages of loop sodium. On the other hand, it was suggested that largely salt-like substances, for example, hydrides, oxides, carbides and nitrides of alkali metals, are more soluble in the molten salt than in liquid metal. In the previous paper, some fundamental studies on the extraction of hydrogen from liquid sodium with molten chlinak were carried out, and it was found that the hydrogen is preferentially extracted into the molten salt phase. Castleman and Clough have reported that from thermodynamic considerations, iodine in liquid sodium is probably present as sodium iodide. Hence, in this work, the further attempt of the extraction with molten chlinak for removing iodine from liquid sodium was carried out. Almost same experimental procedures as that used in the previous paper were employed in this work except using iodine, instead of hydrogen, as a solute. Most of the chlinak solvents used had a composition close to that of the eutectic. In order to make the iodide concentration in liquid sodium below saturation, in accord with the solubility data, less than 10 mg of analytical reagent grade sodium iodide were added under dry argon atmosphere into about 450 g of reactor grade sodium which was kept at 300°C on the 600 g of pre-dehydrated and solidified chlinak solvent in the stainless steel vessel. After agitating liquid sodium for few hours with a mercury sealed stirrer through a lid, the vessel was heated to melt the chlinak. The two liquid phases were mixed mechanically at a desired temperature for several hours and allowed to stand for 3 h without stirring. A small quantity of liquid sodium was pipetted out with a long glass tube to determine the content of iodide in it. The iodide in sodium was determined spectrophotometrically by desolving the sample sodium into distilled water under argon atmosphere. The distribution ratio in solvent extraction techniques is generally defined as the ratio of the equilibrium concentration of soluble species in each phase. But, in this work, the distribution of iodide between the two liquids was estimated only from the change in iodide concentration in sodium before and after mixing the two phases since it is quite difficult to determine iodide in chlinak due to the large interference of chloride ion.

The obtained result are presented in Table 1. The Dm are molar distribution coefficients which give the ratio of the

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iodide content per mole of salt to that per mole of sodium. The $D_m$ in Table 1 is based on the assumption that there is no other way for iodide to escape from liquid sodium than transferring into molten chlinak. Although the accurate values of $D_m$ were not able to be obtained owing to the detection limit of iodide in the analytical method used here, it can be concluded that $D_m$ in Table 1 is relatively large or comparable with that of hydrogen\(^{(4)}\). This means the removal of iodine from liquid sodium by molten salt extraction with chlinak can be feasible. It will be clearly required to do further work in order to make sure of the $D_m$ obtained here, for example, by using radioactive iodine. The simultaneous removal of hydrogen and iodine from liquid sodium by molten chlinak extraction is now under investigations.

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References