

## **Distillation Separation of Hydrofluoric Acid and Nitric Acid from Acid Waste using the Salt Effect on Vapor–Liquid Equilibrium**

Hideki Yamamoto<sup>C, S</sup>

*Department of Chemical, Energy and Environmental Engineering, Faculty of Environmental and Urban Engineering, Kansai University, Osaka, Japan*

Iwao Sumoge

*Densho Engineering CO., Ltd., Saitama, Japan*

This study presents the distillation separation of hydrofluoric acid with use of the salt effect on the vapor-liquid equilibrium for acidic aqueous solutions and acid mixtures. The vapor-liquid equilibrium of hydrofluoric acid + salt systems (fluorite, potassium nitrate, cesium nitrate) were measured using apparatus made of PFE (perfluoroalkyl vinyl ether). Cesium nitrate showed a salting-out effect on the vapor-liquid equilibrium of the hydrofluoric acid-water system. Fluorite and potassium nitrate showed a salting-in effect on the hydrofluoric acid-water system. Separation of hydrofluoric acid from an acid mixture containing nitric acid and hydrofluoric acid was tested by a simple distillation treatment using the salt effect of cesium nitrate (45 weight %). The acid mixture of nitric acid (5.0 mol/dm<sup>3</sup>) and hydrofluoric acid (5.0 mol/dm<sup>3</sup>) was prepared as a sample solution for distillation test. The concentration of nitric acid in the first distillate decreased from 5.0 mol/dm<sup>3</sup> to 1.13 mol/dm<sup>3</sup>, and the concentration of hydrofluoric acid increased to 5.41 mol/dm<sup>3</sup>. The first distillate was further distilled without the addition of salt. The concentrations of hydrofluoric acid and nitric acid in the second distillate were 7.21 mol/dm<sup>3</sup> and 0.46 mol/dm<sup>3</sup>, respectively. It was thus found that the salt effect on vapor-liquid equilibrium of acid mixtures was effective for the recycling of acids from acid mixture wastes.