

# **Concentration of Nitric Acid from Waste Acid Solutions Using Salt Effect on Vapor-Liquid Equilibrium**

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When involatile salts are added to an azeotropic mixture, the so-called salt effect changes the vapor-liquid equilibrium, and has a big influence on relative volatility. Aqueous nitric acid is an azeotropic mixture, and cannot be concentrated by ordinary distillation. In this study, we measured the vapor-liquid equilibrium of nitric acid-water-nitrate salt systems with azeotropic composition ( $x = 0\text{--}40$  mol %) for recycling of nitric acid in solutions from semiconductor manufacturing and metal surface treatment processes. Aluminum nitrate, magnesium nitrate, calcium nitrate, lithium nitrate and sodium nitrate were used as nitrate salts. For each salt tested the salting-out effect was confirmed and the azeotropic point was eliminated completely by adding salts at concentration of 30 – 50 wt %. Consequently, nitric acid could be separated by distillation from waste solution with a low concentration (under azeotropic composition) of nitric acid. Separation and concentration of nitric acid from dilute waste aqueous nitric acid was tested by simple distillation using 50 wt % lithium nitrate. As a result, nitric acid aqueous solution was concentrated from  $5.0\text{ mol/dm}^3$  to more than  $14.0\text{ mol/dm}^3$  (yield, 72.2 %).