Solvate Crystallization for Separation on Industrial Solvents

N. Lertna, T. Chunanant, T.Rungreungthanapol, Sarita Songsermsawad, A.E. Flood

Vidyasirimedhi Institute of Science and Technology, Rayong/Thailand.

Separation of solvents in the petroleum and petrochemical industries is of great importance, and usually a well-understood and feasible process design. However, some systems, particularly systems with azeotropes or those with small differences in volatility remain a major challenge in industry. Traditional separations based on distillation are extremely energy intensive in these cases, and this becomes more significant due to increasing energy prices, Here, we propose a novel strategy that allows for separation of a variety of solvent pairs (including xylene isomers, dimethylformamide/toluene, 1,2-butanediol/ethylene glycol and others) using low-cost co-formers to create highly selective solvate crystal forms. Unlike crystallization of the pure solvents, crystallization of the solvate compounds occurs at near-ambient conditions. This is advantageous compared to distillation operations which occur at elevated temperatures or direct crystallization of the solvents which require very low temperatures, with the solvate crystallization process being very energy efficient in comparison, at the expense of requiring a co-former as an auxiliary. Subsequent separation of liquid and crystal phases by centrifugation and washing allows for a high purity crystal phase to be produced. Solvent is recovered from the crystal phase either via evaporation of the solvent directly away from the crystal, or else extraction into a second solvent that allows for a more efficient distillation than for the initial solvent mixture. Here, a range of systems are demonstrated, including details of crystal structure, phase diagrams and thermodynamic modeling, separation processes, and yield and purity that have been achieved.