Methodology for Design and Analysis of Reactive Distillation Involving Multielement Systems

A new methodology for design and analysis of reactive distillation has been developed. In this work, the element-based approach, coupled with a driving force diagram, has been extended and applied to the design of a reactive distillation column involving multielement (multicomponent) systems. The transformation of ordinary systems to element-based ones and the aggregation of non-key elements allow the important design parameters, such as the number of stages, feed stage and minimum reflux ratio, to be determined by using simple diagrams similar to those regularly employed for non-reactive systems consisting of two components. Based on this methodology, an optimal design configuration is identified using the equivalent binary-element-driving force diagram. Two case studies of methyl acetate (MeOAc) synthesis and methyl-tert-butyl ether (MTBE) synthesis have been considered to demonstrate the successful applications of the methodology. Moreover, energy requirements for various column configurations corresponding to different feed locatio