557f Evaluation of a Two-Temperature Control Structure for a Two-Reactant/Two-Product Type of Reactive Distillation Column

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Several different control structures have been studied for reactive distillation columns. The appropriate control structure depends on the flowsheet and on the type of reactions occurring in the column. If two reactants are involved and if it is desirable to operate the process without any excess of reactant, it is necessary to manage the fresh feed streams so that the stoichiometry is exactly balanced. A composition analyzer that measures an internal composition in the column is often required. However, if two products are produced, it is possible to avoid the use of an analyzer by using two temperatures in the column to adjust the two feed streams. This type of structure was proposed by Roat et al (1986) for the ideal reaction A+B□C+D in one of the earliest papers dealing with reactive distillation control. The purpose of this paper is to explore the effectiveness of this two-temperature control structure for various column designs (number of reactive stages) to quantify the impact of design on controllability. We also discuss the issues of the selection of the trays whose temperatures are to be controlled and the tuning of the two interacting temperature controllers. Disturbances in production rate and fresh feed compositions are made to examine the rangeability of this control structure. One of the main conclusions is that the locations of the temperature control trays should be made such that the two temperature controllers both have direct action (an increase in temperature increases feed), which requires negative openloop process gains for both loops.