On-line Optimization combined with Nonlinear Repetitive Control of SMB Process

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The simulated moving bed (SMB) process, after more than 50 years of successful use in the petrochemical industry, has emerged as one of the most important separation processes in the fields of pharmaceuticals, fine chemicals, and biotechnology, too. However, the optimal operation and automatic control of the SMB process is still a challenging task because of its complex dynamics caused by periodic port switching and inherent nonlinearity.
In this study, an optimization-based advanced control technique for the SMB process has been proposed. In the proposed technique, target compositions of extract and raffinate streams at the terminal time of a cycle are provided by an on-line optimizer while the composition regulation is performed by a nonlinear repetitive controller which utilizes the past cycle data as well as real-time measurements as feedback information. Both the optimizer and the repetitive controller were designed on the basis of a fundamental model of the SMB process, which is recursively updated using real-time measurements. Through application to a numerical SMB process, it was found that the proposed control and optimization technique performs quite satisfactorily regardless of a series of typical plant disturbances and significant initial model uncertainties.