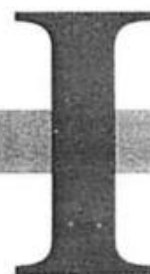


Process Examples of Parallel Systems

APPENDIX



Parallel process systems were introduced in Section 5.4, where a wide range of potential process behaviors were demonstrated. An important factor in determining the behavior for a specific system was shown to be the numerator, that is not a constant but contains the Laplace variable " s ." Setting the numerator term (alone) to zero and solving for s provides a method for evaluating the numerator "zero." The possible step response behaviors are summarized below (for a stable system with real roots of the characteristic polynomial).

1. When the zero is negative and larger in magnitude than at least one pole, the dynamic step response of the output is an overdamped, S-shaped response.
2. When the zero is positive, the output experiences an inverse response.
3. When the zero is negative and smaller in magnitude than all poles, the output experiences an overshoot of its final value.

Importantly, overshoot requires unique controller design and tuning, and inverse response can be difficult to control for any feedback controller. Therefore, the engineer should understand how the process design and operation causes these unique dynamic behaviors. Two process examples are presented in detail in this appendix to provide a link between process technology and parallel systems.

EXAMPLE I.1. Heat exchanger with bypass.

Often a process stream must be heated or cooled a variable amount using a heat exchanger. A common method for variable heating is a heat exchanger with bypass, as shown in Figure I.1 for a cooler; the bypass provides the parallel struc-