

COMPUTER AIDED TESTING OF DIFFERENT CONTROL STRATEGIES FOR AN EXOTHERMIC BATCH PROCESSES

ABSTRACT

A tenth order differential equation model of an exothermic jacketed batch reactor with external heat exchangers was used as a test bed for the application of different control strategies to control the temperature of the batch reactor.

Three types of conventional control were applied first. Single strategy uses PD and PID controllers. The PID control system shows a better result according to overshoot values. Cascade strategy then presented with (PI/P) loops, the backward calculation algorithm was introduced as an anti-reset method to avoid wind-up problem, satisfactory results were obtained. Dual-mode scheme was then applied with two combined controllers, on-off/cascade, this strategy performed better than the previous strategies through the exothermic reaction cycle. Furthermore, changes in the heat of reaction, heat transfer coefficient and cooling inlet temperature, were used to test the different control schemes.

Due to changes in the parameters of the batch exothermic reactor, there was need to test more advanced control strategies, an adaptive strategy was tested using GPC algorithm. The controller replaced the primary controller in the outer loop of a cascade control system. Off line identification method was performed and fixed parameters were fed to the controller. Better results were obtained using feedforward derivative action along with the GPC algorithm.

Fuzzy algorithm was represented as a rule based control strategy. Error and its derivative signals were used to construct the fuzzy rules. In addition, a simple algorithm was used to modify the overshoot region. The controller gives better results in the steady-state region. Then a combined on-off and fuzzy schemes together were applied to the system to improve the temperature response.

Finally, the neural network strategy was introduced as the primary controller in the cascade loop scheme. A modification was made to the error function which was important to have successful application of the strategy, a derivative term replaced the error signal of the network's output. The results show that the learning of the network was sufficient to follow the reactor temperature profile through different conditions.