



Figure 16.17 Step tests on the circulator temperatures.¹⁴ Reproduced from ref. 14 with permission from Elsevier, Copyright 2017.

Similar to above, step tests were applied to the circulator temperature setpoints as shown in Figure 16.17 below. Then, the thermocouple temperature response was regressed with the circulator temperature to develop a data driven reactor temperature control model.

The results for the developed cascade MPC control strategy are shown in Figure 16.18. Note that the (master) particle size MPC controller is able to drive the D50 to the desired setpoint by manipulating the concentration setpoint. This concentration setpoint is then successfully tracked by the slave MPC through real-time manipulation of the feed/seed pump speeds. The proposed data driven control scheme is not only flexible enough to be applied to different continuous crystallization reactors but can also be extended to accommodate different APIs.¹⁴

16.5.3 Digital Design Approach to Advanced Control for Crystallization

In the previous section, a data driven approach was presented for advanced control of crystallization units. Whilst this approach is highly effective, its main drawback is the time and materials requirements associated with the experimental work for developing the control and calibration models. Therefore, a digital design approach has also been investigated for the development of hybrid control models for crystallization. The work presented in this section is based on.¹⁵

As part of the digital design approach, a mechanistic flowsheeting model was developed.¹⁶ The flowsheet consisted of an MSMR tank with a temperature