multivariable, non-minimum phase and unstable processes. Due to these reasons, MPC has been widely implemented for advanced process control within various industry sectors.[11] Furthermore, over the past few decades, it has also been the subject of extensive academic research to improve robustness whilst reducing computational load and conservatism.[12,13] MPC technology is well suited to continuous crystallization processes as it involves multivariable interactions, long time delays and possible disturbances in the feed conditions. In this section, two approaches for advanced control of crystallization process are presented, namely: data driven MPC and a digital design approach. Additional details on control and MPC development can be found in Chapter 4.

16.5.2 Data Driven Approach to Advanced Control for Crystallization

This section presents the design and implementation of a transferrable, data driven MPC scheme for the control of two different continuous crystallization units. This work was carried out as part of the MOPPS project (Innovate UK, grant number: 101334) with the results published in ref. 14. The first continuous oscillatory baffled reactor (COBR) unit considered in this work is the Rattlesnake produced by Cambridge Reactor Design. As shown in Figure 16.13 (left), it consists of four cylindrical modules with a volume of 2760 mL. The temperature of each module is controlled through a water-filled jacket and the residence time within the unit can vary from 60 minutes upwards depending on the throughput.

The second considered COBR unit is the DN15 developed by Nitech. As shown in Figure 16.13 (right), it comprises of 31 tubes each consisting of baffled zones. The tubes were jacketed for temperature control and gave a total volume of 2500 mL. Peristaltic pumps were used for the seed and feed flows. Furthermore, an FBRM (focused beam reflectance measurement) was used for measurement of chord length distribution (CLD) and FTIR spectrometer provides inline spectra measurement.

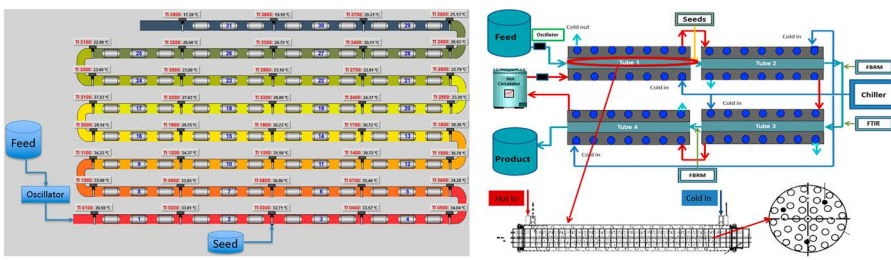

Figure 16.13 Rattlesnake (left) and DN15 continuous crystallization reactors.[14] Reproduced from ref. 14 with permission from Elsevier, Copyright 2017.