be estimated as a function of material throughput and volumetric waste output.[24,27] Labour costs can be estimated if rates local to the plant location are known, but are typically lower than batch processes due to the automated nature of continuous manufacturing with respect to batch mode. Quality control for continuous processes is typically higher due to the lower state of development of online analytical methods (Process Analytical Technology, PAT) than those for batch that are well developed.

15.2.3 Prices and Costing Factor Databases

Various sources are available for equipment prices for scaling *via* eqn (15.1). Commonly implemented plant equipment typical of processes across a variety of manufacturing sectors can be estimated based on historical data and general rules of thumb implemented in the literature.[24,25] Specialised equipment (*e.g.* specific types of microreactor, pumping systems) can be found from specific vendors; comparison of prices across as wide a range of sources as possible is recommended to establish reliable averages for different types of equipment. The CEPCI values for calculation of inflation-adjusted equipment costs (eqn (15.1)) are published monthly.[28]

Material prices can be found from a variety of sources. Independent Chemical Information Services (ICIS) provide a range of prices from different countries for different quantities of bulk chemicals;[29] fine and speciality chemicals can be sourced from specific vendors. As described previously, consideration of a range of prices from a variety of vendors is recommended to allow a more reliable average for material cost calculations.

15.2.4 Costing of Continuous Processes

Here, we describe a methodology implemented by our group in various case studies[30–36] to estimate total cost components of different continuous manufacturing processes. The FOB costs are calculated as described previously (sum of all equipment purchase costs as calculated in eqn (15.1)). The Chilton method is used to calculate BLIC as follows.[24] The installed equipment cost (IEC), process piping and instrumentation (PPI) and total physical plant cost (TPPC) are calculated from eqn (15.2)–(15.4). A construction factor of 30% is added to TPPC to calculate the BLIC (eqn (15.5)).[27]

$$\text{IEC} = 1.43\,\text{FOB} \tag{15.2}$$

$$\text{PPI} = 0.42\,\text{IEC} \tag{15.3}$$

$$\text{TPPC} = \text{IEC} + \text{PPI} \tag{15.4}$$

$$\text{BLIC} = 1.3\,\text{TPPC} \tag{15.5}$$