Extruder Principles and Operation

Extruder Principles and Operation, Vol. 27 #2, November 2000

by M. J. Stevens & J. A. Covas

Second Edition, Chapman and Hall, 1995, 475 pages

In general, this comprehensive book on extrusion and dies is primarily descriptive with a minimum of mathematics. The basic format is similar to most extrusion books starting with a discussion on polymer rheology and other important thermal properties.

A chapter on dies includes profile, blow molding, wire, sheet and coextrusion dies. The information is mostly descriptive. Any theoretical aspect of die design discussed is primarily the strategy of the design process rather than details of flow equations, etc. These strategic details are given in flow chart form, which makes the process easy to follow or modify to fit one's own needs. The flow charts would be very useful when complimented with the readily abundant software that is now available to handle flow equations and mathematical details.

For the extrusion process, the approach is typical to that found in other texts, starting with the classic isothermal melt flow equation. The section on solids conveying follows that of Darnel and Mol with the addition of the energy balance for calculating temperature. The melting model discussed is primarily that of Tadmor, and again the use of flow charts indicates how the model would be used to calculate the melting. The charts again make it easy to follow the strategy of the melting model as compared to the algebraic development found in most books.

Particular attention is given to the overall energy balance of an extruder. Perhaps, this section would have been more suited to being presented earlier in the book, as it is fundamental to the overall functioning of the machine. One item not found in most texts is the discussion of heat conduction in the extruder screw as part of the energy balance. Mathematical details of an energy balance are left to an appendix, where an elaborate example is used to demonstrate the phenomena.

A short chapter describing twin screw extruders is included next. This is followed by some operational methods for actual operations. Topics of residence time, control, stability, startup and shutdown, cleaning and other most practical issues are discussed. A short mathematical treatment of flow stability for a single screw is presented in an appendix.

Lacking in the book is a significant discussion of melt temperature development in extrusion, and the book tries to cover too many large topics, such as dies and twin screw extruders. It would have been better to eliminate twin screws and die, title the book, Single Screw Extrusion Principles and Operation, and add some details of melt temperature development.

The strong point of the book is the discussion and example of the overall energy balance in a single screw extruder, which includes heat conduction in the screw. Consideration of heat conduction in the screw is rarely found in any text (if it exists at all) or in the literature.

- Stephen J. Derezinski Eastman Kodak