

The Right Extruder: Process, Sizing and Options

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Common problems associated with the selection and use of food product extruders include lower than desirable throughput, high scrap rates, long post-extrusion cooking or drying times, excessive energy consumption, and high equipment costs. Frequently, these stem from choosing an extruder design that is ill suited for the application. A basic review and understanding of extruder design and operation can help prevent these frustrations.

Extrusion Process

When pelletizing or specialty forming a product, extrusion offers advantages over other alternatives. By definition, extrusion is “the act or process of shaping by forcing through a die.” Advantages include operating simplicity, diverse product shapes and, when the appropriate extruder is selected, moderately priced equipment that allows high throughput.

Cold feed methods of extrusion typically involve a pellet mill or screw type extruder, in which force is applied to the food material by rolls or a screw (auger) respectively. A pellet mill typically employs two rolls inside a cylinder. The rolls are attached to an arm that rotates on the axis of the cylinder (or vice versa) which causes the rolls to rotate against the cylinder’s inner diameter where the die plates are mounted. Product is introduced to the cylinder and forced through the dies with this rolling action. Pellet mills deliver continuously, but equipment size becomes an issue when significant throughput is required, profile complexity is limited and cleaning and maintenance can be excruciatingly difficult

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Screw-type extrusion incorporates an auger inside a feed hopper, which continues into a barrel. When material is introduced to the hopper, it is conveyed by the screw into the barrel and compressed against the die, creating pressure. It differs from a pellet mill in that the screw rotates to create a constant flow of material. The continuous nature of screw-type extrusion offers maximum productivity through positive displacement inherent in the design, and allows for profiles of almost any shape to be extruded to any length. Because the single screw is the only moving part, cleaning and maintenance is simplified.

There are two types of extruders typically supplied to the food industry: cooking and cooling. A single screw cooker is fairly simple in that the screw is the most sophisticated feature, designed to induce shear for various degrees of cook and expansion. Temperature modulation is also a factor in achieving proper cook and is typically obtained through the use of steam or multi-zone temperature control unit (TCU).

A cooling extruder is simply designed to produce the least amount of shear and the maximum amount of surface area such that a given amount of heat can be pulled from the product in a limited amount of residence time. They are typically used to produce pellets for further processing; on occasion they are also used for profile extrusion.

Extruder Sizing and Options

When selecting equipment, it is important to first establish your throughput requirements, space constraints, input power requirement, and product profile specifications. The extruder manufacturer will also need information about your product material and may request a sample for laboratory testing. This information is crucial in order to determine the appropriate equipment size, feed requirements and screw and die design.

Once the extruder is sized, drive options should be taken into consideration. An overall compact design will afford more flexibility, whether designing a new facility or fitting a new line into an old facility. Various drive options can add to this flexibility. Using a gear motor results in the most compact design and requires less maintenance. Space constraints and other factors frequently dictate the drive design. Where DC power used to be the standard in drive designs, AC motors and inverter controllers are now more common. These supply constant torque ratios ranging from 3:1 to 10:1 at a fairly low cost.

Ancillary equipment also needs to be considered, which can facilitate the desired characteristics in the end product. In some pelletizing applications, it is sufficient to simply extrude onto a conveyor belt. In others it may be necessary to incorporate a vibrating or oscillating conveyor, or to extrude into an airlock or onto another type of transport system.

Pelletizing will require a die face cutter, whereas profile applications may require downstream cutting and sometimes wrapping. A multiple hole plate is commonly used in pelletizing, while a forming die can range from a very simple, solid

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cylindrical shape, to a more complex shape such as one used for topping bits, pretzels, and various types of pasta.

Jeff Schweizer is President of Diamond America Corp., a position he has held for the past 5 years. He has nearly 30 years of experience in the design and manufacturing of extruders used in food processing and other industries. More information on food extrusion is available at http://www.diamondamericacorp.com/food_products.asp [1].

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