The introduction of twin-screw extrusion to the world of ready-to-eat (RTE) cereal production in the 1980s, followed by the development of co-extrusion by Baker Perkins for high-value, center-filled product applications, has created significant benefits for the RTE cereal industry.

As well as the ability to develop an array of products that would be impossible using any other method, extrusion has brought both short- and long-term flexibility to the manufacture of RTE cereals. With regard to short-term flexibility, modest product runs are now profitable thanks to rapid, simple changeover and the ability to develop new products quickly and economically.

A production schedule can combine short runs of staple and innovative products. This enables manufacturers to be more agile and to react faster to developing trends—particularly important in a mature market that is relatively static in size and in which growth can be generated only by new ideas.

Extrusion also enables long-term flexibility. Cereal extrusion lines can be designed to be expanded or adapted on a modular basis at any time to increase output or widen a product range. For example, a basic line that manufactures direct expanded products can be extended with co-extrusion equipment, flaking rolls, cookers, and dryers to make a wide range of high-specification products. A coating system is also an option for adding value through frosting or glazing.

With texture, filling, and shape all controlled, there is extensive potential for product innovation. Chocolate, cream, and low-moisture fruits are typical fillings—virtually any color or flavor is possible. The outer shell texture can be made to appear plain, stringy, or shredded, and extra value can be added by glazing or frosting. The shell tubes can be formed into a variety of different sized products, including bite-size pieces and handheld bars.

**Flexibility and Economy**

Twin-screw extrusion also provides an alternative to the time-honored rotary steam cooking production process traditionally used for flaked breakfast cereals. Extrusion brings flexibility and lower production costs to this sector because extruded flakes are made from flours and other powdered ingredients that require no preparation or preconditioning on-site.

Process options for the production of corn, wheat, and bran flakes include a twin-screw extruder with an extended barrel. This technique combines cooking, cooling, and pellet formation.
in a single twin-screw extruder to provide a compact system suitable for the majority of extruded RTE cereal flakes. Pellets from the extruder are fed into a flaking roll unit. The feed rate is carefully controlled and matched to the roll speed to ensure the pellets are well spaced as they are flaked to avoid formation of doubles.

Major cereal projects have been undertaken in the United States, Russia, Germany, Eastern Europe, and Australasia by Baker Perkins. The majority of these projects have involved extrusion of flakes, which offers more flexibility than a traditional flake production system.

**Innovation**

**Product.** As lifestyles become more hectic and spare time is compressed, the development and launch of convenience products that can be eaten “on the go,” straight from the packet, is affecting the breakfast cereal industry. The lunch market has already been transformed by the development of portable foods eaten as meal substitutes. To a lesser, but growing, extent the same is true of breakfast foods. Cereal manufacturers are reformatting conventional loose products designed to be consumed with milk at home, into bars that can be eaten in any situation.

Cereal bars are designed to appeal to people who need to combine the benefits of a healthy breakfast with the convenience of portability. Co-extrusion technology offers the ability to produce a bar with a nutrient-dense filling that is easy to carry and eat, while the contrasting tastes and textures add interest and variety.

Another use of extrusion in cereal processing is the manufacture of ingredients for other cereal products, such as granola, muesli, or oatmeal. Crispy pieces, flakes, small balls, and clusters can be extruded to add texture and interest to these types of products.

**Technology.** As manufacturers take advantage of the potential applications of the extrusion process, new technology is keeping pace with the need to continue to develop innovative, cost-effective products. For example, Baker Perkins has developed a new color-change system for packs of assorted extruded cereals that enables changeover between color variations to be made “on the run” with minimal waste. One typical application is mixed fruit colors in a single packet.

This type of skid-based system avoids the inconvenience and cost of cumbersome mixing and storage processes for different colored snack and cereal products, with their adverse impact on product waste, hygiene, and shelf life.

Twin-screw extruder technology also has kept pace with the competitive needs of the cereal industry. Today’s sophisticated machines are designed to produce consistent, high-quality products at efficiency levels that minimize downtime and waste. They are automatically controlled using parameters stored in preconfigured formulas. The ability to change the formulas is usually restricted to production managers or process technologists, eliminating product inconsistency caused by operator intervention in the process.

Automatic start-up and shut-down is crucial to smooth and efficient system operation. Machines are automatically sequenced from warm-up to production and optimized to minimize time and material waste. There is no operator involvement and, therefore, no opportunity for error. The shut-down sequence is similarly automated to reduce waste and cleaning time.

In addition, an open frame design provides the highest hygiene standards. There are no covers, so access is easy for all routine cleaning and maintenance tasks. Powder and liquid feeding systems are easily accessible to reduce cleaning and changeover time as well. The AC motor requires no routine maintenance.

**Testing Facilities.** Cereal manufacturers seeking to maximize the product flexibility extrusion can offer need facilities to experiment and develop new products without tying up their own busy production lines. To aid testing, Baker Perkins recently installed a twin-screw extruder in its Innovation Center in Grand Rapids, MI. The center provides cereal companies with the tools to create new products and processes, produce samples for evaluation, perform feasibility studies, and train staff.