Case Study: Spray Dryers – D.D. Williamson, Inc.
Location: Louisville, KY

Pulse Drying Improves Food Quality, Reduces Energy Cost

View of Dryer From Above

A pulse combustion dryer similar to this one has recorded more than 25,000 hours of continuous operation at a Kentucky caramel coloring manufacturer. Among its benefits are low energy costs and significant improvement in product performance, enabling the powdered food coloring to flow more easily in high-humidity conditions

Many food products are prepared as slurry, and then dried for packaging or further processing. Traditional drying methods, using drums or ovens, can adversely affect qualities such as taste, nutrition and appearance.

Spray dryers solve many of these problems, but can create new ones such as shear damage to feed material, caused by high-pressure pumping. In addition, spray dryers are large, relatively inefficient and are expensive to maintain.

To avoid these problems while improving production efficiency, pulse-drying systems powered by natural gas employ an atomizer, which feeds the slurry at low pressure (1 psi) into a pulsating stream of hot gases. Within milliseconds, the liquid is atomized and dried. The extremely short dwell time prevents the temperature of the liquid product from rising above the local dew point, avoiding oxidation and other degradation of organic components.

D.D. Williamson Inc. has employed a natural gas-driven pulse combustion dryer at its Louisville, Ky. plant since January 1994. The company is one of the world's largest producers of caramel coloring derived from corn syrup. It is used in beverages, baked goods, soups, sauces, pharmaceuticals and even pet foods.

Hosokawa Bepex Corporation, using patented pulse combustion technology provided by J. JIREH CORPORATION, originally installed the Williamson dryer in January 1994. Running more than 500 hours per month, the dryer has accumulated more than 25,000 hours of production time. Shortly after Bepex withdrew from pulse dryers in late 1995 to focus on its core product lines, Jireh introduced an improved model named the Jireh Dryer.

The Jireh Dryer pulls a mixture of air and gas into a tuned combustion chamber (a "Helmholtz Resonator") through a patented unidirectional air valve. When the valve closes, a pilot flame causes the mixture to detonate; hot gases and shock waves exit the chamber through a tailpipe toward an atomizer. The atomizer introduces the liquid mixture into the path of the gases, which are cooled to a desired temperature by blending with quench air.

Occurring about 100 times per second, the pulsing action produces extremely fast evaporative action while avoiding the high shear forces inherent with traditional spray dryers. The suspended powder is collected downstream using standard equipment such as cyclones, bag houses or scrubbers.

At the Williamson facility in Louisville, the pulse dryer produces caramel powder, which absorbs less water than spray-dried product, enabling it to flow more smoothly on hot, humid days. Or, as D.D. Williamson president Ron Ralph explains, "It lets the product run without gumming up the works."

"Pulse-drying efficiency is remarkably high," explains Jim Rehkopf, president, J. Jireh Corporation, San Rafael, Calif., manufacturer of the Jireh Dryer. "Typically, it requires 1250 to 1800 Btu per pound of water removed." Rehkopf says that other factors, such as airflow and maintenance costs, are also lower for pulse dryers when compared to spray-drying systems. "It's a space-saver too," he adds. "The footprint is as little as one-third the size of a spray dryer with similar capacity."

Recent developments in pulse-drying technology have improved the overall performance of pulse dryers. The Jireh Dryer includes a computer-based intelligent control system, which optimizes gas temperature, pulse intensity and atomization for each product. The control system adjusts particle size, product flow, texture, moisture and other characteristics without physically altering the equipment.

Similar installations are operating in Franklin, Pa. (minerals); Garner, Iowa (feed supplements); and at the University of Minnesota in St. Paul (test facility handling a wide variety of feeds). Jireh recently shipped a unit to Degussa AG in Frankfurt, Germany.