Circular fluid-bed dryer improves pelletizing process

Many bulk solid materials are pelletized to reduce or eliminate dust and improve handling, flow characteristics, or processing performance. Often, pelletizing can turn a waste material into a valued product. Many different materials can be pelletized, including fertilizers, limestone, bulk chemicals, food products, pharmaceuticals, carbon black, fly ash, ores, pigments, and pesticides. Pelletizing a product such as limestone dust (used as a soil amendment in gardens, lawns, and crop fields), for example, adds value to the product, allowing for a higher selling price.

Mars Mineral, Mars, PA, designs and builds turnkey systems to convert a wide range of bulk powder materials into spherical pellets. To develop a pelletizing process that’s optimized for a customer’s material, Mars Mineral offers research and testing services, including a pilot pelletizing line at the company’s 45,000-square-foot production facility.

Pelletizing at pilot scale

Drying the pellets without altering their size, shape, or other properties is a critical part of the pelletizing process. To provide effective drying with maximum design flexibility for process development, Mars Mineral uses a circular fluid-bed dryer in its pilot-scale pelletizing line. The dryer is gentle enough to handle the most friable pellets and offers advantages over a horizontal...
fluid-bed dryer, including footprint and cost. The company specifies circular fluid-bed dryers for many of its customers, depending on material throughput requirements.

“We provide the enabling technology to convert waste powders into value-added products,” says Craig Vaughan, general manager at Mars Mineral. “As part of that process, we supply customers with the entire suite of processing equipment needed to complete that conversion. Depending on capacity, we include circular fluid-bed dryers as an integral part of that process because of the advantages of space and cost.”

Mars Mineral uses dryers from Kason, a screening and processing equipment supplier based in Millburn, NJ. On the pilot line, a pin mixer combines the feed material with the binder to form the pellets. The pellets are then dried in a Kason 30-inch Vibro-Bed, two-stage circular fluid-bed dryer. From there, the pellets are conveyed to a circular screener, where they are separated by size and then sent to be packaged.

Using a circular fluid-bed dryer

A two-stage circular fluid-bed dryer has a circular housing fitted with two horizontal screens, one above the other. Two gyratory motors vibrate the vessel to keep the pellets in motion, and a centrifugal fan takes in ambient air and blows it through a heater section. The dryer in the Mars Mineral pilot line uses electric heating, as do most circular fluid-bed dryers, but dryers may also use oil, natural gas, or steam as a heat source. The pilot line’s dryer is equipped with a 500,000 BTU-per-hour heater.

The heated air enters the housing bottom, passes up through the screens, and exhausts through a duct connected to the top of the unit. Meanwhile, the green pellets are fed onto the dryer’s top screen. The upward-flowing hot air surrounds and dries the pellets as the vibration agitates them. The combination of heat, upward flowing air, and vibration speed up the drying process by maximizing the pellet’s surface area that can be dried.

The pellets are partially dried on the top screen and, as vibration...
moves them to the screen’s periphery, the pellets pass to the lower screen where drying is completed. The pellets exit the dryer through a discharge chute on the outside. During drying, the pellets follow a path determined by the unit’s geometry and vibratory motion so that processing is first-in, first-out and continuous.

According to Vaughan, the circular fluid-bed dryer cleans much more easily and quickly than a large rectangular dryer.

Pellets of some materials can withstand rough handling. “Cement or metals or coal make pellets like bullets,” Vaughan says, which can withstand rough treatment. But some pellets, such as cat litter, organic fertilizer, or carbon black, need to be handled gently to prevent them from falling apart during drying. Some dryer types, such as drum dryers, may damage fragile pellets. The circular fluid-bed dryer, however, is more suitable for handling fragile pellets, as it agitates, moves, and dries the pellets with only vibration and air flow. The pilot line dryer must be gentle enough to handle the most delicate pellets.

A fluid-bed dryer can also provide cost savings for a customer. Take, for example, a company that makes organic pelletized fertilizer from fresh chicken manure. Because the manure is fresh and not composted, it needs to be pasteurized to destroy harmful microbes to make it safe for consumers to handle. Mars Mineral developed a drying process with a circular fluid-bed dryer that keeps the manure pellets in the dryer long enough and at a high enough temperature to pasteurize them, eliminating the additional costs, energy use, and space requirements of a separate pasteurization process.

So, part of the drying-rate equation is theoretical and part needs to be determined through testing. Removing a pound of free water requires 1,850 BTUs, and removing bound water takes even more energy. Through testing, in the company’s lab and on the pilot pelletizing line, Mars Mineral can fine tune the overall drying requirement and process for each customer’s application.

For any pelletizing system, the dryer is specified to the desired throughput and amount of water that needs to be removed from the green pellets. The pilot line processes about 1 to 2.5 tons per day, depending on the amount of moisture to be removed. For example, green pellets of a special chemical product enter the dryer at 40 percent water and exit at 15 percent and run on the pilot line at the rate of about 600 pounds per hour. Mars Mineral pelletizing systems at customer sites can produce between 1 ton per day to 10 tons per hour of pellets — capacities that would otherwise require a larger dryer.

Green pellets are up to 40 percent water. Pellets of different materials have different requirements for final moisture content, ranging from less than 1 percent to as high as 15 percent. “To inhibit mold growth in chicken manure fertilizer, for example, the pellets must contain no more than 10 percent water,” Vaughan says.

**Dryer selection**

Mars Mineral selects circular fluid-bed dryers primarily based on space, energy requirements, ease of cleaning, and pellet toughness. The dryer’s circular design saves as much as 50 percent of floor space over rectangular units with similar capacity. To gain additional capacity, the pilot line’s dryer has two screens — two stages — permitting higher capacity in the same footprint.

“It’s like building a two-story house instead of a one story,” says Vaughan. “If you go vertical, the cost for incremental capacity is lower.”

As mentioned earlier, the pilot line’s fluid-bed dryer is powered using electricity, but for customer systems the power supply is determined by the material being processed and the plant environment. Ease of cleaning also is a factor in selecting a fluid-bed dryer. For a dedicated pelletizing line, space is less important, but since the pilot line runs many different materials, thorough cleaning between runs is critical to prevent cross-contamination.

Some or all of the water contained in green pellets may be present as free water and some water may be chemically bound to the material.

Note: Find more information on this topic in articles listed under “Drying” and “Agglomeration” in Powder and Bulk Engineering’s article index in the December 2016 issue or the Article Archive on PBE’s website, www.powderbulk.com. (All articles listed in the archive are available for free download to registered users.)