TECHNICAL SPOTLIGHT

FEATURES AND BENEFITS OF HORIZONTAL CONTACT DRYING

The dynamic, high-temperature process of horizontal contact drying makes it possible to treat bulk materials more efficiently and evenly than traditional drying ovens and rotary kilns.

As new materials are developed and introduced across the industrial landscape, the number of related high-temperature processes is experiencing parallel growth. Traditionally, drying ovens and rotary kilns are often used for high temperatures. However, the dynamic processes found in horizontal contact dryers can offer significant advantages in terms of product quality, energy efficiency, and emissions. Two examples include the production of high-performance silicon carbide and recycling of rare earth materials. When it comes to the processing of minerals, the recycling of lamps, batteries, or photovoltaic cells, or the pyrolysis of biomass, the right high-temperature processes are critical to ensuring reliable results. In addition, these processes must meet stringent quality standards in terms of product and throughput, produce minimal emissions, and maximize energy and resource use.

Thermophysical and thermochemical processes such as combustion, calcination, thermal cracking, gasification, and even smelting are typically carried out in industrial plants featuring kilns, rotary kilns, or drying ovens. However, these processes require significant energy use and product quality can sometimes be compromised due to the uneven nature of the treatment regimen. The dynamic process of contact drying, on the other hand, makes it possible to treat bulk materials, filter cakes, or sludge more efficiently and evenly. In addition, contact drying equipment can easily be integrated into various production setups and plant floor layouts.

Horizontal dryer used to calcinate minerals. All images courtesy of BHS-Sonthofen.

CONTACT DRYING DETAILS

During contact drying, the relevant raw material is separated into a solid and a liquid condensate. In one example of this type of equipment, temperatures up to 1200°F can be achieved by the reactors and high-temperature dryers from BHS-Sonthofen, Germany. The machines are manufactured based on careful calculations using the finite element method and made of high-temperature steel to withstand consistently high loads.

In conventional high-temperature ovens, the product is not agitated, leading to uneven drying. As a result, the process cannot be precisely controlled. In high-temperature processes, however, the temperature of each particle plays a key role. If the temperature deviates at all, the product must be discarded. By contrast, the continuous homogenization that takes place in a contact dryer means that the time and required product temperature are always precisely controlled, resulting in higher product quality and lower scrap.

The special feature of the dynamic process in contact dryers is the continuous mixing that occurs for the full duration of the process. In other words, by combining the steps of heating and mixing, a fully homogeneous product

is achieved throughout the entire process. New particles are continuously being conveyed over the heating element so that the heating surface remains optimally utilized at all times. In addition, the design of the heating surface ensures optimum heat transfer to the product. By mixing the material in this way, temperatures do not get too high or too low. All parameters can be precisely controlled throughout the process, which is a critical factor for product quality. In addition, homogeneous mixing leads to significant gains in efficiency.

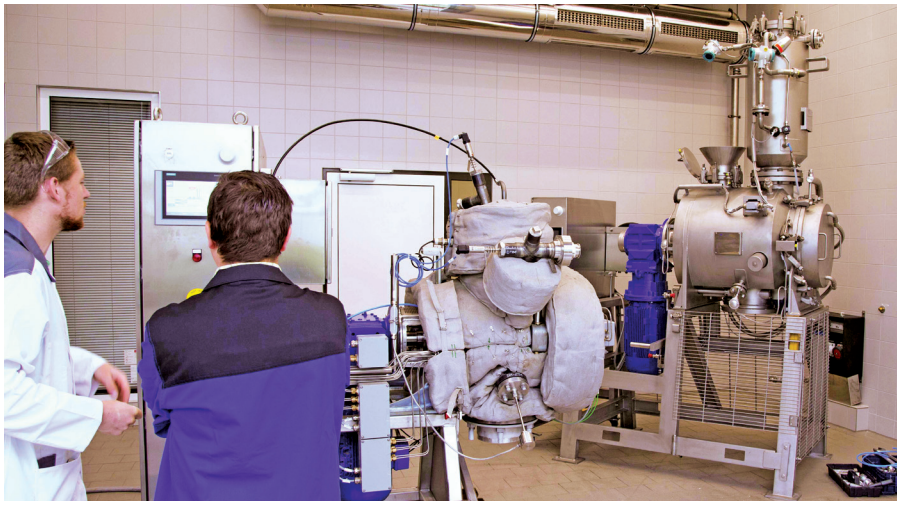
The core components of these systems are horizontal contact dryers that can be run either in batch or continuous operation. In many cases, multiple steps such as mixing, evaporation, and reaction can be performed by a single machine. A few examples of where contact dryers are used in calcination and pyrolysis are discussed below.

APPLICATION EXAMPLES

Calcination: High mineral content and efficient vacuum operation. Calcination describes a wide range of processes in which input materials such as minerals or metals are modified under thermal treatment. Minerals that contain different amounts of hydrate are often heated with the goal of splitting off physically bound water. Gases and water vapor are also released during the process. For one calcination process at a customer's facility, BHS adapted a continuous horizontal dryer for intense heat transfer and precise material conveyance. Special high-temperature sluices for input and output streams ensure efficient, high-temperature operation, while vapors are cleared of dust using hot gas filters. Since the dryer went into service, it has been operating at a throughput rate of more than one metric ton per hour.

Pyrolysis and gasification. Pyrolysis refers to the thermal cracking of materials in an oxygen-free environment. It is used in many industrial processes with the aim of recovering and recycling gases or oils. As a thermochemical conversion process, gasification goes beyond pyrolysis. Two examples of this include the conversion of biomass into gases or ash and the conversion of plastics to a gaseous state. Further examples involving pyrolysis are discussed below.

The horizontal dryer makes it possible to work with sticky, viscous materials in pyrolysis applications.



In-house testing center for new applications at BHS-Sonthofen.

Silicon carbide production. The horizontal dryer has proved particularly advantageous in a newly patented process that enables production of high-purity cubic silicon carbide in large quantities. This silicon carbide can be used in a variety of specialty applications involving semiconductor circuits, sensors, and hydrogen generation. Several process steps can be combined in one high-temperature machine that serves as a mixer, vacuum dryer, and pyrolysis reactor.

The horizontal reactor is first charged with different aqueous input solutions. These solutions contain the silicon content and various additives. After preparation of a homogeneous mixture, the aqueous input solution is evaporated. This is carried out under vacuum at temperatures well below 200°F. The product is then heated. Starting at roughly 350°F degrees, several chemical processes take place including oxidation, caramelization, and partial pyrolysis. The product undergoes strong toughening phases,

which can be overcome by the special mixing unit. If the temperature is increased further to the target temperature of approximately 850°F, pyrolysis is complete. The end product is a powder.

Recycling of rare earths. High-temperature processes are also used to return rare earths to the circular economy. When old lamps are recycled, approximately 1% to 3% mercury-containing lamp powder remains, which is typically disposed of as hazardous waste. These lamps also contain rare earth minerals. However, due to its high toxicity, mercury must first be separated from the other metals before further recycling can proceed. This can be achieved in batch-operated, horizontal high-temperature dryers. In the first stage, the product is heated to approximately 400°F to remove any liquids, such as water or solvents. The dry product is then heated further until the mercury has completely evaporated. Values below 10 ppm are possible. The system is designed to be completely closed with neither the operator nor the environment exposed to mercury.

TESTING NEW APPLICATIONS

Potential new applications include thermal cleaning of metals and production of cathode and anode material, among others. Some companies such as BHS-Sonthofen offer an extensive range of testing options on flexible, mobile pilot machines. Depending on project requirements, BHS adjusts the system and selects additional modules for exhaust gas aftertreatment, for example.

The dynamic process of contact drying offers an energy-efficient and high quality alternative to existing technologies found in the chemical and process industries, as well as in research and development. **~AM&P**

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