THERMAL PROCESSING OF PARTICLES FOR INNOVATIVE POWDER MATERIALS

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Introduction

Established technologies for the particle design and functionalization, such as fluidized bed processes, are typically run at temperatures between room temperature and 250°C. This is sufficient for many materials.

On the other hand, certain materials processed that way, will need a subsequent thermal treatment to achieve the desired chemical composition or crystalline structure. As every additional process will produce supplementary costs and handling efforts, thermal processes that combine particle formation and thermal treatment have proven to be very beneficial for these applications.

State-of-the-art thermal powder processing technologies

Thermal treatment of powdery materials it traditionally done in spray towers, furnaces, stationary or rotary kilns. These thermal treatments have two mayor disadvantages: There is only limited gas exchange inside the powder bed. Residues of the solvent or thermal conversion will accumulate in the voids and hinder diffusion out of the product.

This will result in long and expensive processing times. In addition, these compact powder beds tend to agglomerate. To achieve the desired particle size, in most cases a subsequent milling step is necessary, ending up in irregular shaped powder, which is often disadvantageous for later use.

New technologies for thermal powder processing

Based on these disadvantages and the general need to decrease energy consumption, new technologies for thermal treatment of powdery materials are required.

Fluidized bed systems are well known for highly efficient drying and processing of powders, granules and pellets. These systems are traditionally run at temperatures well below 250°C. One step towards better heat treatment technology is the design of process equipment that allows operation at higher process temperatures.

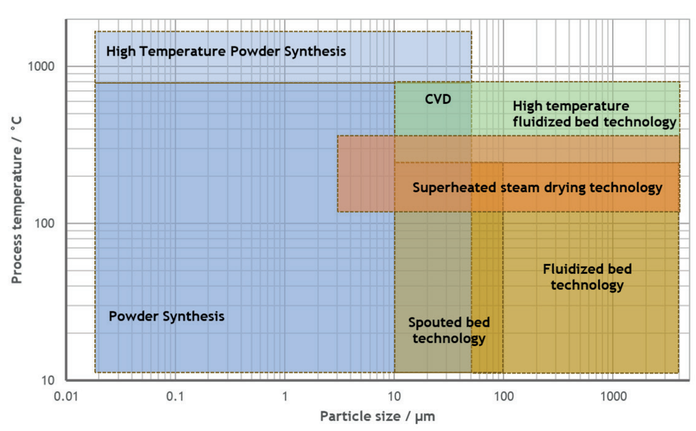


Fig 1: Different powder processing technologies based on particle sizes and process temperatures

For the preparation, functionalization and refinement of powdered materials using fluid bed technology, the particle size is limited to approx. 50 µm.

However, smaller particle sizes are desired for many applications. This requires additional technologies. Functional materials with a particle size range < 50 µm can be generated and processed using Glatt powder synthesis. This technology was developed specifically for the production and processing of micron to submicron particles.

High Temperature Fluidized Bed

A high temperature fluidized bed system is extremely versatile as it can be used from room temperature up to 800°C.

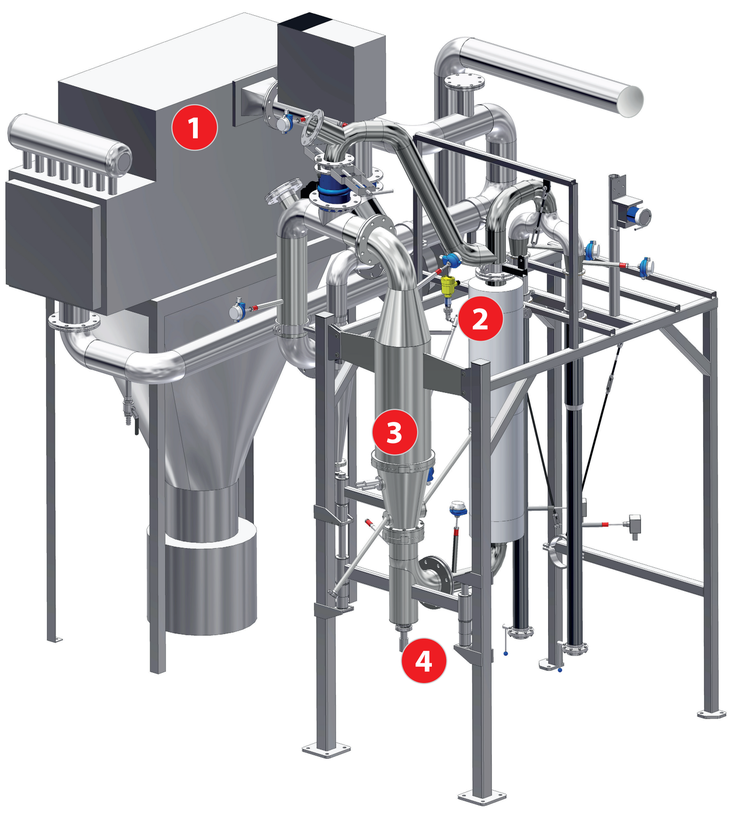


Fig 2: Laboratory scale high temperature fluidized bed system (1) Exhaust filter, (2) Heating unit, (3) Fluidized bed chamber, (4) Water-cooled spray nozzle

The advantage of the system is the combination of traditional fluidized bed processes like agglomeration, granulation and coating and an additional thermal treatment that can be run also in parallel. Due to the use of electrical heating the processes can be done in oxidising, inert or reducing conditions.

As an example of a porous catalyst carrier, the penetration depth of a coating material can be defined: The higher the temperature, the faster the solvent will evaporate not giving a chance to penetrate the carrier material. On the other hand, running at too high temperatures, porosity of the coating might be increase because of very fast drying.

Glatt Powder Synthesis

Glatt Powder Synthesis is developed to produce powders, coat, thermally treat, functionalize and refine powdered materials that are too fine to fluidize (< 50 µm) in classical fluid bed systems.

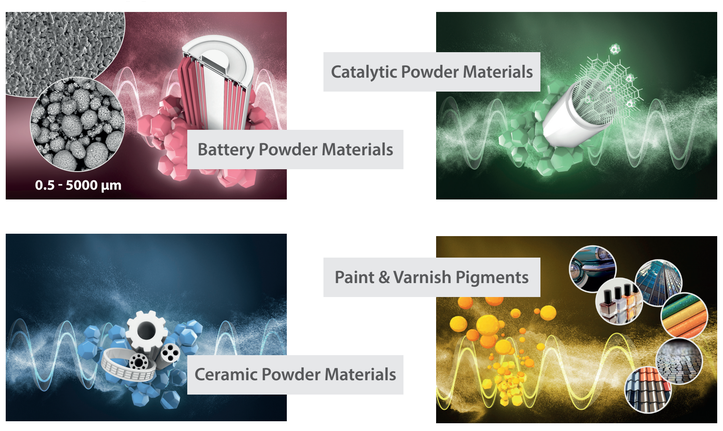
Key element of that technology is a pulsating gas stream with a temperature up to 1300°C in which the raw materials (solutions, suspensions, powders) are injected. Being hit by the gas pulses, the primary droplets of the feedstock will be further atomized ending up in super-fine droplets, which can be dryed and heat treated extremely fast.

In addition, the pulsating gas will create a high degree of turbulence within the reactor, homogenizing its gas temperature and velocity profile.

Fig. 3: Glatt Powder Synthesis with additional secondary heater that provides thermal processes up to 1300°C.

As a result, very homogeneous powdery materials in the micron and submicron range can be either synthesized or coated and based on the high process temperatures, a heat treatment process can be combined in the same process run.

Fields of application



Conclusion

There are well-established heat treatment processes for powdered materials, but they have significant drawbacks in efficiency. With Glatt high-temperature fluidized bed and Glatt powder synthesis, new technologies are available to open up new particle potential and to help powder manufacturers improve their products.

For more information, please visit our website:

fff.glatt.com