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DORST Spray Drying Technologies: Tailoring Solutions with Innovation and Expertise

Spray drying is a versatile process used widely across various industries. The process is known for its ease of operation, suitability for continuous mass production, straightforward quality control, and ability to handle heat-sensitive materials. It can simply dry a material that has been dissolved in water, or atomize a suspension to obtain atomized spherical granules. In addition, powders with excellent flow properties can be produced, making it a suitable process for the preparation of materials for axial or isostatic pressing. DORST Technologies is a specialist in spray drying. The company started out with ceramic materials for the tableware industry. Over time, the portfolio has expanded to include systems for technical ceramics, tungsten carbide and cermets. In recent years, DORST has developed its expertise in spray drying of metal alloys, materials for industrial batteries and chemical solutions to meet diverse industrial requirements.

Sophisticated solutions and innovative spray drying technologies

DORST Technologies offers solutions for applications in which materials are dissolved or suspended in water. At the main site in Kochel am See, atomization dryers are developed and designed as open systems using heated air as the drying medium instead of inert gases. Such open systems ensure efficient process air distribution and optimum air flow (Fig. 1), which maximizes drying performance and material handling efficiency.
DORST offers various technologies for heating the process air: Gas, electric, steam, and hydrogen heating or hybrid systems that combine several heating technologies to optimise efficiency and performance. This innovative approach enables efficient drying of materials while minimizing the

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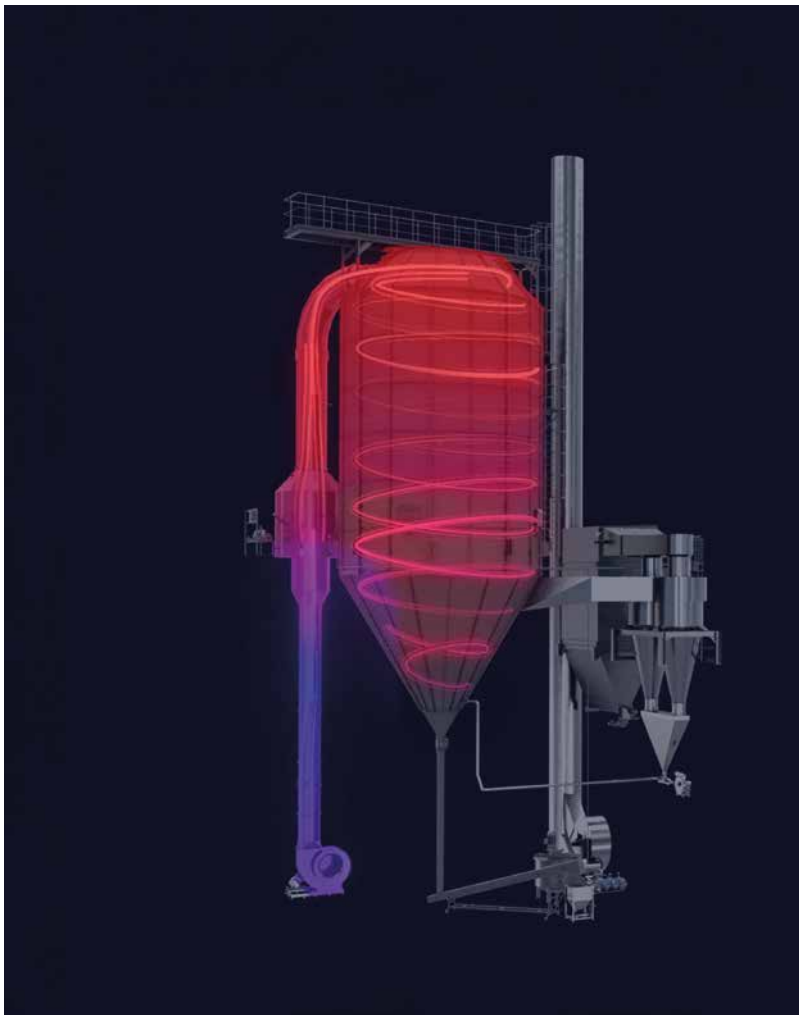

Fig. 1 Process air and heat circulation

Fig. 2 Co-current process – Two-fluid or pressure nozzle

Fig. 3 Counter-current process – Two fluid or pressure nozzle

environmental impact – a fact that makes DORST systems highly attractive for applications which require a high water evaporation capacity.

Additionally, the systems are designed to integrate heat exchanger and heat recovery systems, which further enhance energy efficiency and reduce operational costs.

A decisive factor in process performance is the development of advanced monitoring equipment and process controls. To this end, DORST spray dryer technology excels in control systems, providing customers with the ability to maintain a constant outlet temperature while effectively controlling the inlet temperature and the suspension flow. Additional control loops can monitor either the outlet temperature or the suspension flow in the drying chamber, which makes the process control even more precise. This enables the production of materials with specific particle size distribution and homogenous residual moisture, which in turn ensures a high degree of precision in the end product.

Spray drying process

The most influential factors in the spray drying process are: 1) the atomization technique: nozzle type or rotary atomizer; 2) the

Fig. 4 Co-current process – rotary atomizer

Fig. 5 Customized spray dryer plant – D600

Fig. 6 SMART Compact Series PRO

flow rate of the suspension; and 3) the suspension properties.

The process starts with the preparation of a suspension or solution. While some customers have extensive experience and know-how in the development of a suspension, others can work with DORST, in collaboration with its partners, for this step.

The suspension or solution is pumped through a nozzle or a rotary atomizer into the drying chamber, creating fine droplets. When these droplets come into contact with the heated air inside the drying chamber, the water evaporates, and the binding agent helps to shape the droplets into spherical granules. In a co-current process (Fig. 2), both the hot air and the droplets are fed into the drying chamber from the same direction, typically from the top. As the hot air pushes the droplets downwards, they experience a rapid increase in temperature, which leads to quick surface drying. This method offers a fast drying process. The droplets are exposed to the highest temperatures when they still contain a considerable amount of moisture at the start of the process, which creates a cooling effect. The cooling effect can be advantageous for heat-sensitive materials.

In a counter-current process (Fig. 3), where the nozzle is located at the bottom of the drying chamber, the hot air and the droplets flow in opposite directions. This configuration results in a slower and gentler drying process compared to the co-current method.

Atomization techniques

During atomization, the suspension or solution is subject to different forces, which depend on the type of nozzle and pump used. The droplet size and their interaction are the key parameters governing the particle size distribution and bulk density of the spray dried material [1].

The DORST pressure-nozzle system operates with quite high pressures, whereas the suspension is only conveyed in a two-fluid nozzle system and atomization is supported by compressed air. By adjusting the air pressure, the droplet size and thus the particle size distribution can be specifically influenced. Additionally, the vario-nozzle system combines the principles of both, pressure atomization and compressed air atomization, producing particles that are finer than those from a pressure nozzle but coarser than those from a two-fluid nozzle.

To complete the range of spraying methods, the rotary atomizer (Fig. 4) was added to the portfolio. The rotary atomizer uses a high-speed rotating disk to spread the suspension. Centrifugal forces push the liquid, which is applied to the rotating disk, outwards and break it up into fine droplets.

Customized solutions

DORST's customized spray dryer plants can achieve evaporation capacities of up to 8000 kg/h (Fig. 5). Tower size and evaporation capacity can be adapted to the respective requirements – also in terms of an energy-optimised solution.

DORST offers various options for its spray towers to recycle fine particles during the process, such as diverting the material from the cyclone to the tower, either back into the atomized slurry to agglomerate by providing the fine particles back into the cone of the spray drier. This results in an increase in the granulate yield. For the second separation stage, DORST spray dryers are equipped with a dry filter, which ensures that the residual dust in the chimney complies with the applicable emission regulations. Over the years, DORST's spray dryer technology has consistently demonstrated its ability to serve a wide range of industrial needs with precision and efficiency.

All-in-one solution

Constantly striving to meet diverse customer needs, DORST Technologies has recently launched its SMART-Compact Series PRO of spray dryers. This innovative series can be adapted to different needs for spraying suspensions without the need for major modifications.

The innovative SMART-Compact Series PRO, was specially designed to meet the needs of smaller-scale production, and it offers enormous flexibility in terms of diverse requirements:

- Can be operated with or without a cyclone;
- Customers can choose between co- and counter-current configurations;
- Use of either a two-fluid nozzle or a rotary atomizing unit.

Factors such as inlet air temperature, hot air flow rate and droplet size all influence the behaviour of the water as it evaporates, which in turn influences the outlet temperature and residual moisture content of the spray-dried powder. To address these varying needs, DORST offers the SMART-Compact Series PRO in three different sizes: Small, Medium, and Large. In the Large model, it is possible to reach a maximum water evaporation rate of 60 kg/h at an inlet air temperature of 450 °C, while maintaining an outlet temperature of approximately 100 °C.

The drying process does not only depend on heat and mass transfer determined by process conditions, but also on the diffusion of the substances involved [1]. DORST works closely with its customers to evaluate their specific processes and materials. In this way, DORST tailors the design precisely to individual requirements and determines the appropriate size of a spray dryer for each project. The SMART-Compact Series PRO is supplied largely pre-assembled, which significantly reduces installation time to just a few days.

This series is completed by an R&D spray dryer, the SMART-Lab Atomizer. With an evaporation capacity of 5 kg/h, this atomizer is designed for spraying small-batch sizes and is therefore ideal for material development and testing. In addition this equipment is also ideally suitable for pilot-scale applications.

Conclusion

DORST Technologies is at the forefront of innovation in the field of spray drying and offers customised solutions for the individual requirements of a wide range of industries in the range of 5–8000 kg/h water evaporation capacity. Long-standing expertise in the most diverse areas enables DORST to provide highly efficient and versatile spray drying systems. Systems with a water evaporation capacity of up to 60 kg/h are installed according to the plug & spray principle, without the need for time-consuming on-site assembly.

By partnering with DORST Technologies, customers benefit from cutting-edge solutions that drive efficiency, minimize environmental impact and support innovative manufacturing processes.

DORST strives to continuously develop its technology to meet the ever-increasing quality standards and energy efficiency requirements of today's industrial landscape.

References

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