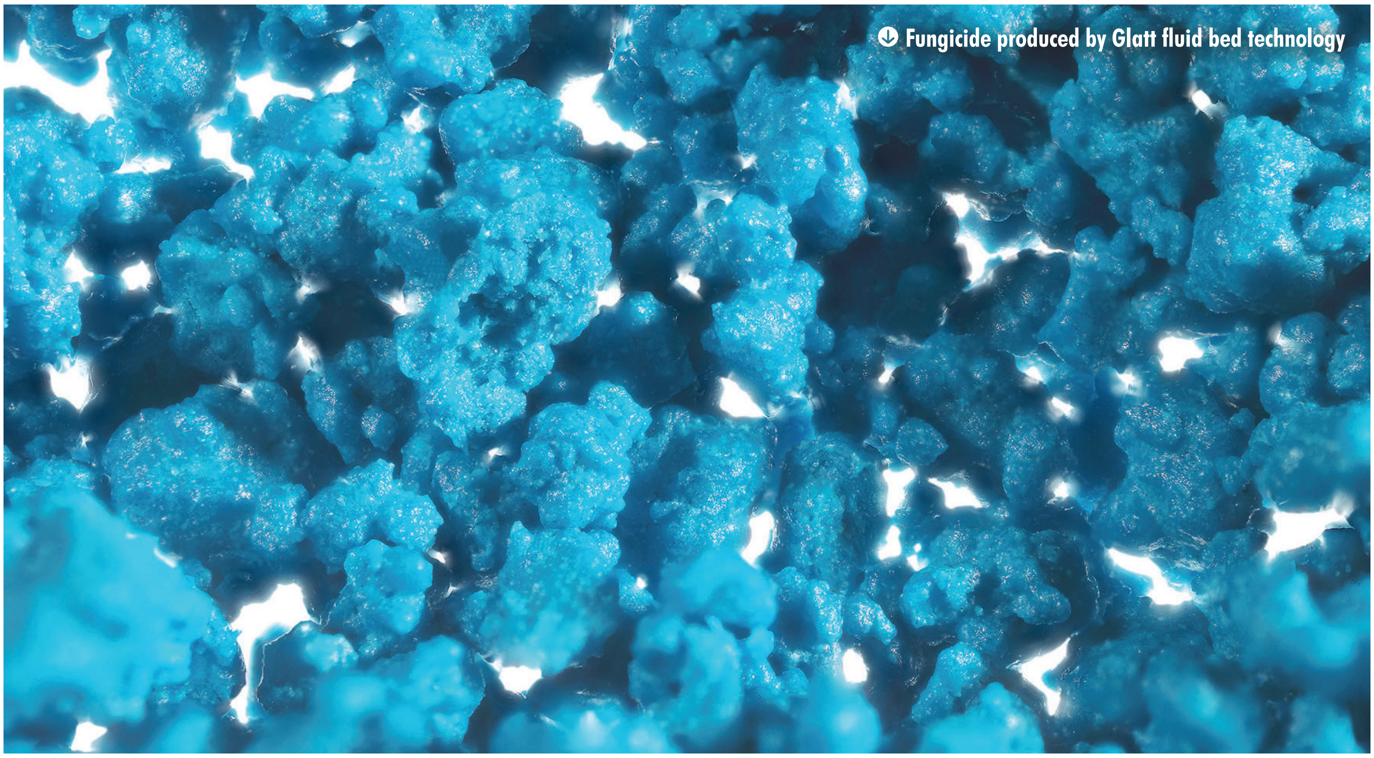

Fungicide produced by Glatt fluid bed technology

Improved performance for crop protection products

Dr Michael Jacob, head of Process Technology – Food, Feed & Fine Chemicals at Glatt Ingenieurtechnik, looks at the use of fluid bed and spouted bed technologies in crop protection

PRODUCT DEVELOPMENT USUALLY focuses on the optimisation of successful products. That means improved effectiveness and storage, safer handling and easier dosing.

Farmers and manufacturers of crop protection products are facing an increasingly fragmented market, with regionally specific requirements. Due to globalisation and imbalances in the ecosystem, it is becoming increasingly necessary to control pests in a targeted manner and protect plants from previously unknown threats.

At the same time, a growing market for organic farming means an increase in demand for biological or biodegradable crop protection agents that are obtained, for example, via fermentation processes. These intermediate products are not temperature-stable during industrial processing; they require gentle treatment at low temperatures.

A further challenge is climate change. Cultivated areas in normally temperate climate regions are now exposed to more frequent extreme weather events, such as heavy rainfall or prolonged periods of drought with very high temperatures. Prolonged wet, hot or cold spells make it increasingly difficult to control soil conditions, plant growth and harvest times. These extremes can also lead to plants being threatened by other influences, so while there is a need for action to ensure crops thrive, preventive plant protection and pest control are also necessary.

Gentle processes

Glatt, a German specialist in particle design, process development and plant engineering, is among the companies that offer fluid bed and spouted bed technologies to address these challenges.

By means of spray granulation, spray agglomeration, spray coating and (micro) spray encapsulation, the properties and functionality of different raw materials and multi-component systems for new formulations can be optimised. This improves solubility and also ensures that ingredients are homogeneously distributed in particles, with a broad, specifically adjustable size spectrum.

Compared to classic spray drying, it is possible to use these techniques at very low temperatures and with short processing times. Thermal damage can be avoided at product temperatures under 70°C. This can be achieved, for example, with a maximum inflow temperature of up to 150°C, which is economical and still safe.

Planning the facilities requires extensive engineering competence, including risk assessment, specific plant design and the initiation of concepts that make for safe process control.

In addition, functionalised substances can be dosed more effectively and safely. They are more stable in storage and can be colour-matched to the product design. A functionalised surface ensures tailored application properties.

Redispersibility, release behaviour and homogeneity are some of the parameters for ensuring optimum effectiveness with minimum use of raw materials. What is usually important with crop protection products is the formulation of the liquid suspension, which contains insoluble components, such as salts, ashes or metal complexes, or carrier materials. These must be mixed carefully with each other under strict safety precautions.

Technology: Fluid & spouted bed

The almost unlimited possibilities of process design are provided by flow-mechanical and thermodynamic properties that facilitate processes for optimising powders and liquids, and refining them almost without restriction (Figure 1). Both concepts make it possible to thermally dry and functionalise raw materials economically in a single process step – batchwise or continuously, in single- or multi-stage processes, under protective gas as well as nitrogen. Drying and product design are thus possible in one process step using the same apparatus.

A fluidised bed is created when upwardly flowing process air raises a layer of solid particles, thus fluidising them. The process air is used to generate the fluidised bed state. At the same time, it supplies the thermal energy required for the particle technology processes.

In addition to the thermal treatment of solids, fluidised bed processes are used for drying tasks, the construction of granulates from powders (spray agglomeration) or from liquids (spray granulation) and the coating of particles (spray coating).

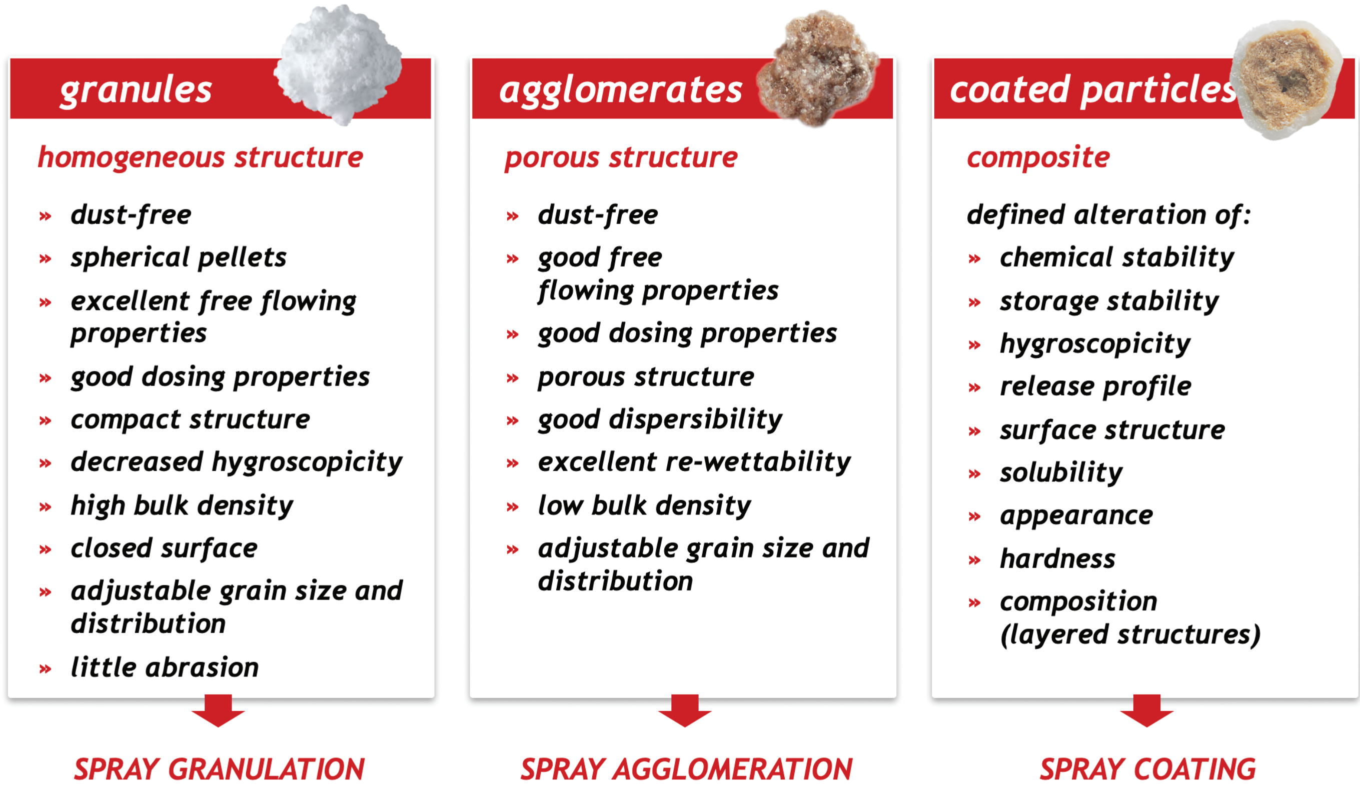


Figure 1 – Advantages of granules & pellets over powder & liquid

In the fluidised bed, the particles behave in principle like a liquid. All particles are mixed so intensively that a uniform treatment temperature is guaranteed. The spouted bed technology is also based on the basic principle of fluidising particles by upwardly flowing process air. The difference between the concepts lies in the fluid mechanics and process dynamics. This results in significantly higher heat and mass transfer rates for the processing of sensitive products with short residence times.

Granulates

Spray granulation is an optimal process for the production of granules from liquids and powders. The round pellets provide a dense surface and high abrasion resistance. The granules are built up, then dried in a single process step: liquids are sprayed onto fluidised particles and then dry on the surface (Figure 2). This results in layered particle growth.

The small particles required for further granulate build-up are generated in the process itself. Only the liquid raw material – classically a suspension – has to be provided. In addition, it is possible to feed powdery or fine-particle solids into the process in a targeted way, in order either to integrate them homogeneously into the granulate structure, or use them as external starting cores for granulate growth.

Other practical advantages include improved shelf life due to reduced hygroscopicity, and better transport and dosing properties. At the same time, the water-solubility of the granules can be specifically adjusted for liquefying it again before spreading. Another interesting application is fine agglomerates, which are applied directly to plants and dissolve immediately, becoming active on contact with water.

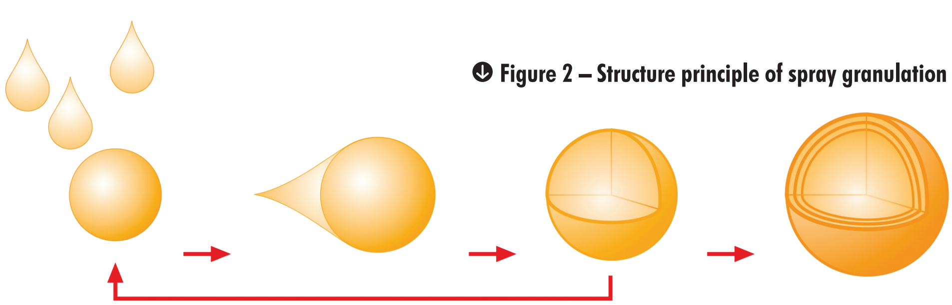
Microencapsulation is based on the spray granulation process and therefore supplies granules of solid or liquid substances that are particularly sensitive or volatile. They can be distributed homogeneously and embedded in a protective matrix. This is an ideal way to stabilise active substances and allow porous granulates to be loaded with solid auxiliary materials.

Flexibility

Structure granulation – so-called 'layering' – facilitates a high degree of flexibility, as particles are formed from different solid layers, and cores can be loaded and coated. This enables manufacturers to functionalise their products in a targeted manner and provide them with a higher added value, which ultimately determines market success.

In addition, the same apparatus can be used to coat the previously spray-granulated particles, for example to achieve a retarding

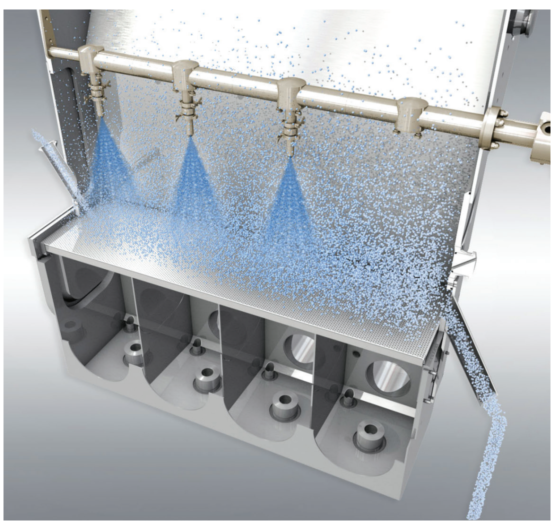
Figure 2 – Structure principle of spray granulation



effect, to protect the active component from external influences or to mask an unpleasant taste or odour. This might be interesting when producing feed and also pesticides that must suit the pest.

Spray granulation v. spray drying

Continuously operated spray granulation processes offer impressive flexibility due to the process chamber design – for example, subsequent cooling can be combined in the same apparatus. In addition, fluidised bed spray granulation systems for handling organic solvents or oxidation-sensitive products can be implemented easily in a closed-loop operation.



Spray granulation in the fluid bed

An essential difference between the two techniques lies in the particle size and morphology. In spray drying, the individual particles are dried from the outside in, whereas in spray granulation, they are built up in layers and dried from the inside out.

As soon as the liquid contains a dissolved component, spray drying produces a wide variety of hollow spheres. The hot air stream in which the spray droplets are dried creates a hard outer shell of the single particle with a high concentration of the dissolved component, while the inner core of the particle still contains moisture. As the temperature increases, the moisture suddenly escapes and, depending on the drying speed and solids concentration of the liquid, creates hollow spheres or dents in the particles.

Only when spraying melts and pure suspensions are solid spheres formed during spray drying. In certain fields of application, such as the microencapsulation of active ingredients, these particle properties are unsuitable. However, the aim of microencapsulation is to enclose liquids in the core of the particles and protect them from environmental conditions. ●

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