

Drying, refining and functionalising in one process step

GUDRUN DING
Head of Business Development
Process Technology

GLATT INGENIEURTECHNIK GMBH
Nordstr. 12, 99427 Weimar, GERMANY
www.glatt.com
gu drun.ding@glatt.com

Fluid bed and spouted bed technologies from Glatt offer multiple benefits for food processing. Particles can be economically refined, functionalized and dried at the same time via spray granulation, spray coating or spray agglomeration (Fig. 1).

Whether it's protein shakes, vitaminized hot drinks or sugar substitutes like xylitol, maltitol and lactitol, instant powders with value-added ingredients need certain core characteristics. They must be easy to dose, quick to dissolve, non-clumping and low in dust; they mustn't separate or leave residues in hot water or cold dairy or plant-based milk drinks, but they should make for a pleasant mouthfeel. These key properties, as well as low bulk density, can be achieved by using spray agglomeration in the fluid bed.

The porous structure of agglomerated particles is what determines the wetting and solubility behavior, ease of use and,

ultimately, the commercial success of an end product. For example, snack vending machines offering Cappuccino or hot soups require instantized products that can be precisely portioned via volumetric dosing and retain their flowability and uniformity.

The structure of agglomerated particles here needs to be more compact and firmer than for normal instant products and adaptable for different brewing systems.

The underlying technology can also be used to dry liquid ingredients such as



Figure 4. Food ingredients.

stabilizers and flavors into granules and pellets, to encapsulate essential oils in microcapsules and to give food supplements a functional coating. In most applications, nothing other than water and air is required to achieve this.

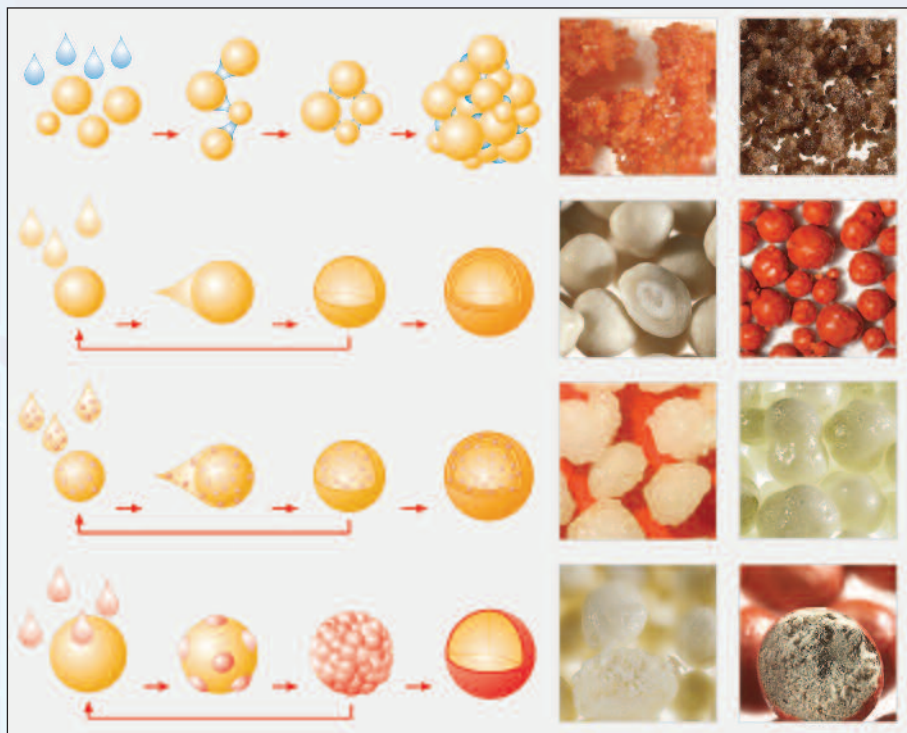


Figure 1. Process-Product-Matrix.

TARGETED, GENTLE PARTICLE TREATMENT

Fluidized bed (Fig. 2) and spouted bed technologies (Fig. 3) have been established for decades as the leading processes for the formulation and optimization of powdered food products. The difference between the two lies in fluid mechanics and process dynamics. In both systems, solid particles behave like liquids after being fluidized with a process gas that flows in from below (in the simplest case air).

This offers the advantage that the entire surface of each particle can be treated at once. The fluidized bed is characterized by efficient heat and mass transfer, which promotes consistent evaporation of water.

As a result, the temperature of the fluidizing air drops and prevents thermal damage to temperature-sensitive ingredients. Moderate process temperatures of 30-50° C mean that proteins, aromas and vitamins retain their nutritional properties.

Powdered raw materials can be

processed economically in a single – batch or continuous – step, and adjusted both in terms of their particle size and residual moisture; they can be dried, granulated or functionalized.

SPRAY AGGLOMERATION

In spray agglomeration, fine powder particles are sprayed with a liquid which forms “bridges” that dry and enable the particles to stick together. By wetting the surface and subsequent drying, the powder particles adhere to each other and form free-flowing, porous agglomerates.

These have a larger grain structure, are dust-free, flowable, can be dosed precisely

and score points for their optimum properties during application, transport and storage.

Glatt offers a wide range of optimization possibilities for spray agglomeration. For instance, various effects can be achieved by altering the choice of spray medium, its composition and concentration.

Instant products gain in internal structure and disperse more easily if spray solutions with high viscosity are used. Raw materials with oil-containing components, such as chocolate powder, require an emulsifier for better dispersion. However, agglomeration improves the sinking behaviour of the particles and helps to avoid lumps. With hydrocolloids (e.g. xanthan gum, pectin, etc) especially, fine powders tend to form lumps that dissolve very slowly due to simultaneous swelling of the outer layer or have to be destroyed with mechanical force.

Irrespective of whether they will be packed in cans, sachets, sticks or other containers, low bulk density and high porosity are among the most desirable properties of many instant products.

Good wettability ensures that the particles dissolve without residue when they are mixed or stirred into water, dairy or plant-based milk drinks. If powdery substances are to be dissolved or dispersed in hot or cold liquids, agglomerates from the fluidized bed offer a significant improvement in quality over those produced by other methods.

In principle, organic substances like vitamin formulations, minerals and trace elements can also be sprayed during agglomeration.

SPRAY GRANULATION

With the help of spray granulation it is possible not only to dry liquid food additives but also to adjust particle size, residual moisture and solid content precisely. Round pellets with outstanding physical properties can be produced as follows: A liquid is sprayed onto the fluidized particles. It spreads over the surface and wets it evenly. While the liquid film dries and hardens in a closed system, almost spherical, abrasion-resistant granules with an onion-like structure are formed.

The granules are free flowing, homogeneous, virtually dust-free and very easy to dose. The aim of spray granulation is to enclose solid, liquid or gaseous core substances in a solid matrix with long-term stability. As is widely known, conventional spray drying can also do this, but its use is limited to fine powders.

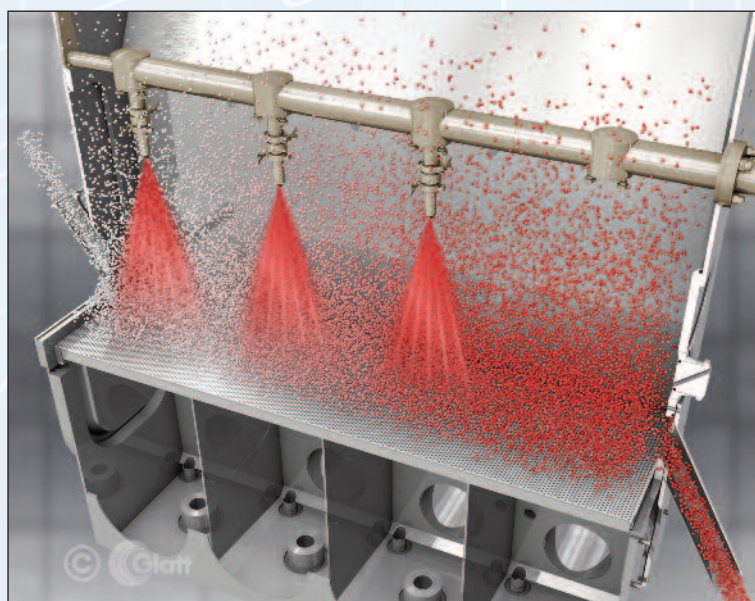


Figure 2. Process fluid bed coating.

However, the fluidized bed and spouted bed offer much greater freedom in adjusting particle and bulk properties, for example by altering the liquids, spray temperature, spray rate and spray pressure, supply air temperature, quantity and humidity, or the residence time in the process. This makes these technologies interesting not only for food ingredients and dry feed additives, but also for encapsulated ingredients.

SPRAY ENCAPSULATION (MICROENCAPSULATION)

Microencapsulation followed by spray granulation brings multiple benefits.

As a rule, sensitive, hazardous, odorous or high-flavor liquid active ingredients are encapsulated to protect them from the environment or to protect the environment from the substances. For this reason, product developers of probiotics, vitamins, volatile flavorings, essential oils and PUFAs rely on compact, free-flowing pellets, which are considerably easier to dose and further process.

Emulsions of microcapsules containing functional ingredients are dried by being coated layer by layer onto particles generated in the process.

Polymers, starch derivatives, lecithin or gelatine protect the sensitive ingredients, and at the same time form a matrix that embeds the actives. This dense structure adds further resistance to external degradation. During the process, the shape, structure and size of the resulting particles can be adjusted via product temperature, spray speed and spray pressure. Even functional coatings can be applied in the same process step.

SPRAY COATING

A coating is more than just a protective shield for sensitive substances: It enhances products with color or gloss, controls release mechanisms, for example via pH stability adapted to the small intestine environment, and modifies the surface structure against temperature influences and oxidation.

Coatings can also be used to control the release of citric or lactic acid during the

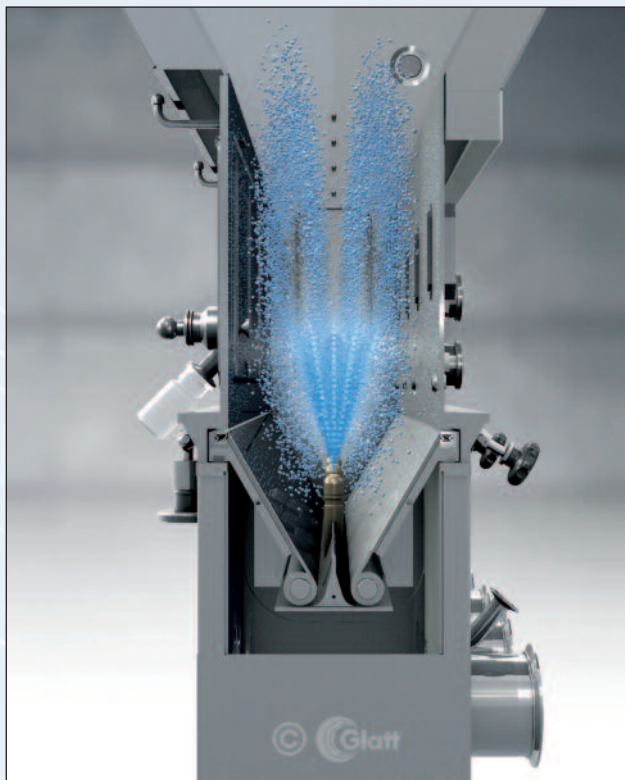


Figure 3. Process spouted-bed spray-granulation.

maturing of sausages and to mask metallic or astringent tastes, for example in vitamin formulations. During the coating process, particles, granules or pellets are sprayed repeatedly with atomized liquid containing a film building polymer. The droplets spread on the particle surface before drying, solidifying and creating, layer by layer, a protective shell or a functional film.

Another very economical option that confers protection or special release properties is hot-melt coating.

Materials with suitable melting temperatures for this technique include lipids such as beeswax, vegetable waxes like carnauba wax, hydrogenated vegetable oils and fats, fatty acids, monoglycerides and diglycerides.

ADDED PERFORMANCE FOR FOOD AND FEED INGREDIENTS AS WELL AS FINAL APPLICATIONS

In processes featuring innovative fluidized-bed and spouted-bed technologies from Glatt, product developers have virtually unlimited options in terms of optimized particle design and functionalization of granules (Fig. 4).

Whether it is spray granulation, spray agglomeration, spray encapsulation, or

coating – the key to the ideal product is choosing the right process parameters, along with the multitude of combination options for these parameters.

Glatt Ingenieurtechnik is one of the world's leading suppliers of integrated plant solutions and has extensive expertise in the development of processes as well as in the planning and construction of production plants.

The German engineering specialists plan, develop and supply fluid bed and spouted bed systems, technology-independent production lines and even turnkey factories for the food, animal feed, pharmaceutical, biotech, chemical and fine chemical industries – worldwide.

The company supports its customers from the initial idea to the final commissioning, with Glatt engineers working alongside clients to develop and optimize processes for a wide range of applications. Optimal process parameters for reliable scale-up

are determined following pilot tests. To facilitate this, Glatt offers a flexible mobile laboratory plant as well as test series at the Weimar Technology Center. Experienced Glatt test teams ensure that feasibility studies can be carried out and product samples produced within one week.

ECONOMICAL SYSTEMS SOLUTIONS

Still new, but based on established technology, Glatt's compact system for classic agglomeration applications in the food industry enables consistently reproducible quality, even for smaller product quantities.

The Glatt GF ModFlex system is available in various sizes to cover the performance spectrum, from one hundred kilos up to three tons per hour. The system has a modular design and, with low operating costs and an installation time of just 12 days, it allows manufacturers to ensure economical and safe continuous agglomeration of powdered components – offering flexible adaptability and expandability at the same time.