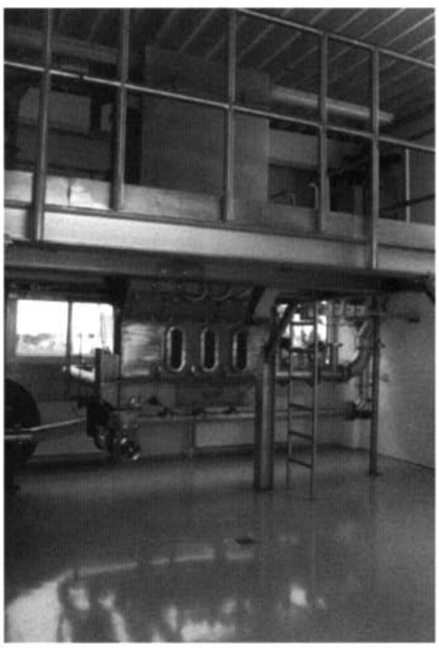
Continuous Coating in Fluidized Bed

by Karlheinz Rümpler, Michael Jacob

Many powder and granular products are coated to improve their properties, and the engineering involved in coating processes is subject to continuous development. In the pharmaceuticals industry, for example, various coatings are used not only to control the release of substances or to adjust the flavor, but also to improve stability or structure. Intermittent fluidized-bed coaters have proved effective in providing this kind of finish. Where large volumes are involved, however - as in the food industry - continuous coating has considerable advantages. A new continuous coating system has been developed for such applications that has the flexibility required for a large material throughput while providing the coating quality demanded in the food industry.

Laboratory testing

The laboratory of one German specialist contains equipment and small-scale facilities for basic trials, scale-ups, product development, and process optimization. Figure 1 shows a continuous fluidized bed for cooling, drying, agglomeration, granulation, and coating. The various processes can also be combined with the aid of peripheral equipment. For example, the air intake can be split up into sections to allow variations in temperature and air speed.



Photos: Glatt Ingenieurtechnik GmbH

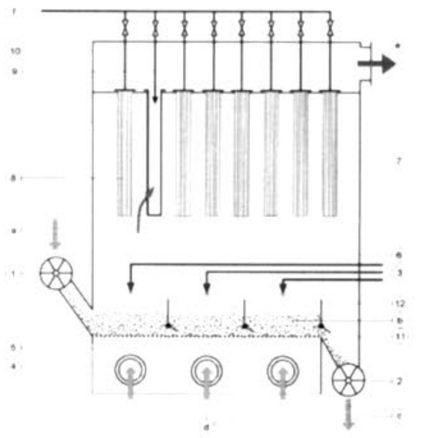


Figure 2 Glatt® - GFC fluid bed coater fundamental sketch

The finished product (c) can be discharged in various ways. In many applications a gate (12), as shown here, which can also be fitted with a regulating flap (11), is used. Specially designed nozzles (3) are employed for spraying, their number and arrangement depending on the particular application. The spray can come from above (top-spray) or below (bottom-spray). The amount of fluid sprayed from the nozzles and the distance between the nozzles can also be adjusted to ensure that the particles are properly covered.

Food industry application

A system as described above was installed to improve storage of a confectionery product in ambient conditions. With this extremely hygroscopic crystalline material it was essential that the finished product should not agglomerate, and that it should flow freely at room temperature over a long period, even with high relative humidity. To achieve this aim, a continuous fat-coating system was installed. The fat was melted and applied using the top-spray process.

The system was tested on a small-scale fluidized bed. The process was broken down into the following steps:

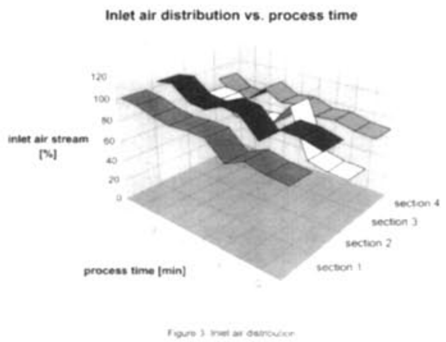
- heating of the crystals
- coating
- drying
- cooling

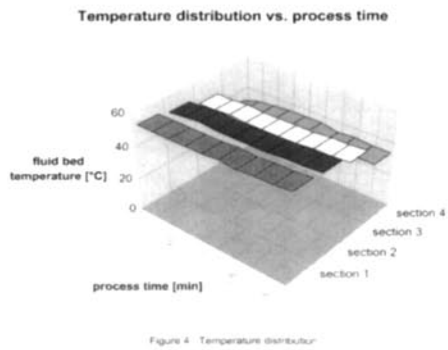
The purpose of the trial was to optimize and scale-up the process. The laboratory equipment could manage a dry throughput rate of 10 to 100 kg/h with inlet air temperatures of 20 to 250°C and particles of 100 µm to 3 mm in size.

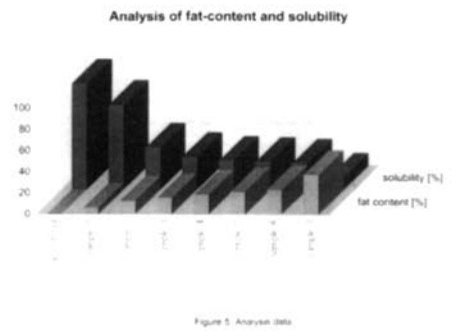
Process and mechanical engineering

The company's fluidized bed has an elongated bed with mainly rectangular surface for continuous operation (figure 2). The air fed in from the bottom (5) turns the product (a) to be coated (powder, agglomerate, or granulate) into a fluid bed (b). Above the processing chamber (6) the air flow slows down through expansion with the result that smaller particles that have been carried through by the air can be sorted and returned to the fluid bed. The waste air is cleaned by means of an integrated internal filter (8), while the filter elements themselves are cleaned regularly by blasts of compressed air (9).

Different conditions and means of transporting the solid material in the fluid bed can be obtained by dividing







the air-intake chamber (4) into several sections. The air flow (d) in each section can be regulated separately, and the fluid bed itself can also be adapted by means of various add-ons (e.g. intermediate gates) to the process requirements.

The solid material (a) is transported continuously to the machine through a dosing unit. It is conveyed within the machine by the fluidizing air alone.

The process parameters were optimized during preliminary laboratory trials on an intermittent machine and used as starting parameters for the small-scale trial. The different processes were carried out in a single processing chamber. The material flowed successively through the four fluid-bed sections, which had been set to the required conditions.

This small-scale trial was designed to establish the ideal parameters for continuous operation. Variables that were investigated included nozzle arrangement, spray pattern, air temperature and pressure, and temperature profile in the fluid bed. The system also had to be adapted to downstream stations.

Figure 3 shows the different air volumes in the successive fluid-bed sections and the times involved. A number of fluctuations occur in the course of the process, attributable to control variables. The temperature for each stage of the process was therefore stabilized to ensure uniform and reproducible results. Figure 4 shows the temperature settings for the four sections.

The product quality was checked regularly. A solubility test comparing the sample with the raw material was performed to measure changes in hygroscopicity. Figure 5 shows some of the results, illustrating the influence of fat content on solubility. As can be seen, even relatively small amounts of coating brought about a marked reduction in solubility. It was noted on microscopic examination of the particles that for this material the surface did not need to be completely enclosed for the desired quality parameters to be achieved. It was therefore possible to reduce the amount of coating material used and hence to increase the throughput rate.

Conclusion

With this continuous fluid-bed coating process customers can adapt the system to their own specific requirements while maintaining the flexibility needed for large product ranges. Our company uses continuous fluid beds mainly for drying, cooling, agglomeration, granulation, and coating. With relatively little technical alteration, this system can be adapted for other products and processes. Specific customer requirements can be taken into account in the design and planning. The principle of fluid-bed coating is shown in Figure 6.

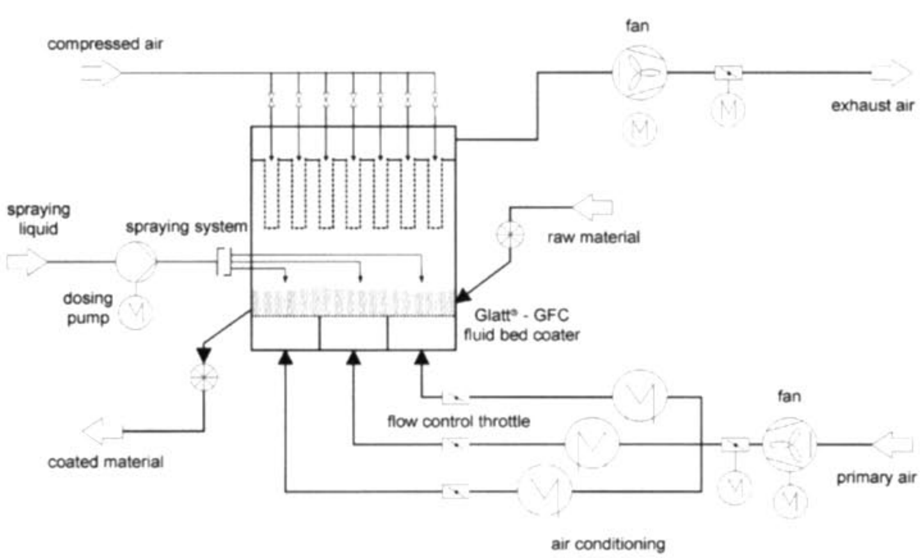


Figure 6 : Glatt® - GFC continuous fluid bed coater

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