FLUIDIZED BED PROCESSES IN COMPARISON

Continuously or in batches?

↑ Continuous fluidized bed plant with vibration system

↑ Fluidized bed batch agglomerator with vertical product flow

Continuously or as a batch process? In principle, both methods, continuous and batch operation of a fluidized bed plant, are very effective processes. In the fluidized bed, drying, granulation, agglomeration, coating and micro-encapsulation are carried out in a time and cost-saving manner with reliable results.

Continuous plant operation is frequently used for mass production whenever price-sensitive markets require highly automated production processes. Batch operation, on the other hand, is rather linked to manually controlled processes and campaign production. In the pharmaceutical industry, batch processes are still the standard and widely used, although continuous technologies are increasingly being used with great success.

In order to determine the optimum process for the individual application, a variety of aspects should be considered in more detail.

What happens in the fluidized bed?

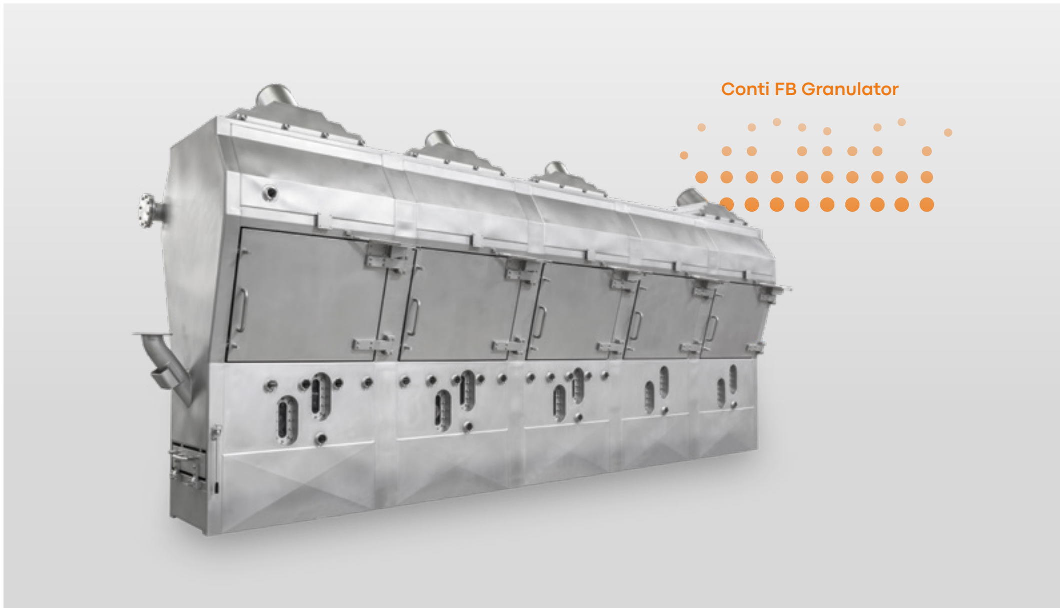
A fluidized bed forms when a stream of air or gas (for example, inert gas such as nitrogen) flows through powders or granules at a certain air velocity. The product layer gets into intense motion and behaves like a liquid. The entire particle surface is accessible all around for drying air as well as for sprayed liquids, emulsions or suspensions. Thus, the fluidized bed offers ideal conditions for extremely effective drying processes as well as advanced methods in which the particles are to be simultaneously formed into granules or agglomerates.

Improvement of product properties

With the fluidized bed processes agglomeration/granulation, particles are sprayed with a liquid binder and transformed to uniform solid particles having a specific size and desired properties. Defined residual moisture content, dosability, flowability and solubility improve the product properties and simplify handling in subsequent processes. Fluidized bed spray granulation is a process for drying solutions, suspensions or emulsions in the fluidized bed with the aim of building up compact granulates of defined properties.

How do the processes work?

Fluidized bed processes can be carried out in continuous or batch mode. Both modes of operation have individual advantages, depending on production volume, space conditions, installation options, targets such as production time or costs and the required process steps. In any case, it is worth taking a closer look at which method is the more suitable.



← Continuous fluidized bed granulator in pharmaceutical design

Do you have questions regarding the AMANDUS KAHL technology?

We will be happy to answer them and can be reached here:

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The batch process is flexible

In general, batch systems are used to process limited production quantities with a variety of different recipes. All process steps take place one after the other in a bin with a predefined volume. The quantity of the product to be processed determines the size of the bin and thus the entire plant. Laboratory plants start with batch sizes as small as 50 g. Production plants can have a capacity of over 2000 litres.

Set-up and operation of batch systems are less complex than continuous systems. Batch devices are often used in R&D applications and therefore it is only logical to use the same concept for subsequent production. In the pharmaceutical industry, the use of batch processes has developed over the years due to the validation requirements that are customary in this sector. It seems to be easier to transfer parameters and process requirements from the pilot phase to commercial production in a batch.

An advantage of batch operation is the reduced effort for product changes as well as the flexibility in process control when very demanding recipes with a large number of process steps are required. The batch process is a good choice if neither short processing times nor large product quantities play a role or frequent product changes are planned.

The continuous process is efficient

The concept of continuous systems consists of a plant with several individual supply and exhaust air chambers, so that the process parameters can be set individually for each zone. All process steps run fully automatically and without manual intervention. As the product quantity is unlimited, the continuous process is particularly suitable for mass production. Depending on the input product and the required processes, the throughput of a continuous plant varies from a few kilograms to several tons per hour. The longer a continuous plant is operated without interruption, the better its economic efficiency.

Continuous plants can be designed as closed systems. Without product changes, long production times are possible without the need for intermediate cleaning. If the plant does need to be cleaned, the hygiene concepts and the WIP system from AMANDUS KAHL offer optimum conditions for simple and effective cleaning.

Starting and shutting down a continuous plant must be precisely defined. These are the most sensitive phases, as the product should ideally meet all specifications without restriction from the first to the last minute of operation. Optimised start-up and shut-down routines maximise yield and reduce product losses to < 1 %. Continuous fluidized bed processes offer very consistent product quality with maximum economic efficiency.

Decision criteria for choosing the most appropriate process

Production capacities are growing, multinational companies are bundling their production sites: Increasing price pressure is forcing the companies to look for alternatives to increase productivity and reduce costs. Before deciding on a continuous or batch system, various aspects and their significance for the respective production conditions must be examined.

- → Product quality
- → Production quantity / campaign size
- → Number of product changes
- → Process conditions
- → Complexity of the requested process
- → Process interruptions
- → GMP aspects
- → Qualification / validation
- → Batch size
- → Plant concepts / flexibility
- → Cleaning
- → Safety / explosion protection concepts
- → Space requirement
- → Investment volume / operating costs

Batch and continuous systems offer different advantages

Planning and executing a batch or continuous plant in a hygienic or GMP-compliant manner is now standard practice. Qualification and validation of a continuous system is also possible, similar to the batch system. However, slight differences in product quality are to be expected in both operating modes despite the basically identical processes, since, for example, the product layer level in the fluidized bed, the retention time or the spray intensity varies. This can lead to deviations in terms of particle size distribution, bulk density, product homogeneity or lumping. Often, the product homogeneity of a continuous plant is better, as lower bed heights are normally used than in batch operation.

All process parameters must be adapted to the required product quality in both operating modes.

A batch process cannot be easily transferred to the continuous process; this requires a lot of experience. For example, there are differences in temperature, flow velocity, position of the nozzles or height of the product bed. The continuous process is often more stable and less prone to failure, so that the product quality is more homogeneous. In batch plants, product changes can be carried out more easily because these systems were developed precisely for this purpose.

Due to its compact design, a continuous plant usually requires less space – in particular less height. However, the installation of a continuous plant is more costly due to the high degree of automation and the required upstream and downstream aggregates.

Selecting the appropriate system with AMANDUS KAHL

Both operating modes are excellently suited for the economical production of homogeneous products with improved product properties. The choice of the appropriate system depends on the individual situation and the intended objectives. Fully automatic continuous systems that do not require any manual interruptions best solve productivity problems through reduced production times and manpower requirements, provided that the continuous process is strictly tailored to the respective requirements and framework conditions of the individual application. Standard processes rarely exist, so AMANDUS KAHL is an experienced partner when it comes to individual solutions and consulting.

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