

Fluid bed drying and cooling in the food industry



Fluidising is a method of suspending powders and particulates on air jets to produce a bed that behaves like a liquid in terms of flow characteristics. It is a very efficient means of mixing due to intensive particle movement. The solids behave like boiling liquid. Thus, very high rate of heat and mass transfer values are obtained due to intimate contact of gases and individual particles.

Fluid bed provides gentle treatment for the product. The powders or particulates, being suspended in air, suffer very little or no damage. Figure 1 shows the curve for fluidising.

Fluid beds can be used for the following applications:

- Cooling: cooling of powders – powder from spray dryers can be cooled.
- Drying and roasting: in order to reduce the moisture content, dry and hot air is used. For example, breakfast cereals can be roasted, cooked and cooled using fluid beds.
- Agglomeration: a fine dusty powder can be re-wet with steam to produce agglomerated powders. Malt-based instant milk drinks are an example of this application.
- Instantising: this can be achieved by heating the powder to the correct temperature, spraying with instantising liquid (lecithin is used for milk powders) and cooled. This can either be done in one fluid bed with multi-zones or in two fluid beds.

The challenge in design of fluid bed

Each product behaves differently. It is therefore imperative that pilot studies are carried out before the design. The following are the main areas of design:

- Distributor plate: this ensures that the gas is evenly distributed across the area of the fluid bed. Selecting the correct air pressure drop and percentage open area achieves proper fluidising.
- Air velocity: the gas velocity is such that it can fluidise the product effectively without causing excessive carry over.
- Air quality: temperature of air is critical and can effect the quality of the heat sensitive products.

Fluid beds have three main parts:

1. Supply side:

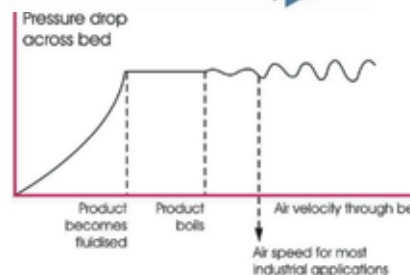
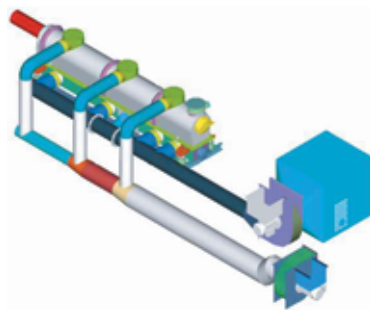
- air filter
- supply fan
- heater (can be direct fired/indirect heated/electric/steam) or chillers
- ductwork
- automated controls

2. Fluid bed:

- product feed
- fluid bed
- vibratory motors
- product discharge

3. Exhaust side:

- duct work
- exhaust fan
- product-air separator (can be cyclone/baghouse/scrubber).




- Dust collection: the exhaust gases carry some product with it and need to be separated before exhausting the air. This can be achieved by using cyclone, baghouse or scrubber.
- Residence time: the height of the product and length of the bed determine the residence time. The centrifugal force of the vibrators used to move the product can be controlled by adjusting the out of balance weights to change the residence time.

Fluid beds can be batch or continuous. Continuous fluid beds rely on moving the product using the principle of vibrating conveyors, which work by developing a pitching motion. The particles flow smoothly while being agitated by the rising air stream, with very little friction against the fluid bed and little impact against other particles. Attrition losses in the fluid bed are negligible. The vibrations are imported to the conveyor by using eccentric drives. The fluid bed is isolated from its support by use of springs or air-cushions.

Fluid beds can also be built with:

- Multi-zone – heating and cooling in one body;
- Multiple stages for drying and conditioning of heat sensitive products;
- Coating of powders with liquids, sprays and subsequent drying.

Saurin has a range of pilot fluid beds in its laboratory for product trials. The data generated can be used for the design of full scale beds. Fluid beds for milk powders, cereals and other food products and also for the chemical and mineral industries can be supplied. The fluid beds are tested using the customer's product before installation. The company was able to increase the fluid bed capacity by 50% for one customer after tests on the pilot fluid bed and subsequent modifications to the fluid bed.

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