Grinding and classifying in one

Fluidised-bed jet mill for organic pigments

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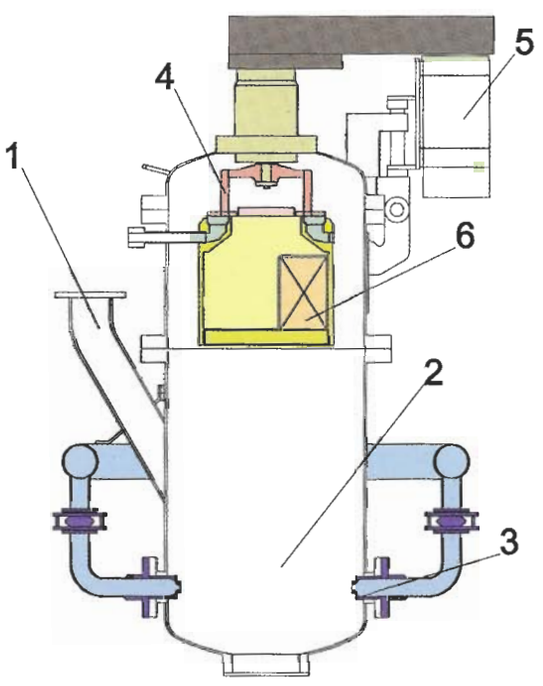
Mechanical treatment of raw, consumable or prefabricated materials is an important part of many methods of production in the chemical industry. Numerous steps of a wide variety of production methods are necessary to obtain the desired finished material. The fluidised-bed jet mill enables organic pigments to be processed to a high fineness with a maximum particle size.

There is a clear trend in mechanical manufacturing technology towards ever finer products. Materials that used to be ground in conventional impact mills and separated in external classifiers can today be milled in a single step to even higher finenesses with exact maximum particle sizes. Fine grinding of organic pigments places tough demands on the machine technology. The most common minimum requirements include a very fine "clean" particle size distribution, minimal product build-up and fast, thorough cleaning for product changeover. In addition, specific product qualities will determine the optimum operating conditions. The CGS fluidised-bed jet mill, a combination jet mill and dynamic air classifier in one housing, is a machine suited to these tasks without the disadvantages of an external classifying system.

Figure 1 shows the layout of the CGS fluidised-bed jet mill. Powder pigment enters the mill above the milling nozzles via a rotary airlock valve (1). Gas jets (3) form a fluidised bed of material in the milling chamber (2). Particles from the fluidised bed are accelerated to high velocities. Milling occurs through the impact of the particles with each other in the gas streams and in the centre of the milling chamber. The particle-laden gas rises to the centre of the classifier wheel (4), which is driven by a variable speed motor (5). The particles with the desired size enter the fines outlet (6), while larger particles are rejected by the classifier wheel and fall back into the fluidised bed to be milled further.

Stable milling process

The principle of milling in a fluidised bed and the self-regulating internal circulation of coarse product lead to an energy-efficient, stable milling process. Losses in the milling gas supply are avoided by the optimised geometry of all parts containing pressurised gas. A throughput of 400 kg/h with a final particle size of approximately 3.2 µm (d_{99}) can be achieved in a CGS 50 fluidised-bed jet mill. The fluidised-bed jet mill enables organic pigments to be processed to a high fineness and with a defined maximum particle size limit. The desired particle size distribution of the product is very narrow because the product is used as the milling medium. There is no wear on the milling chamber. Hard or very abrasive products can be processed without difficulty. The fluidised-bed jet mills in the CGS series are available in nine sizes, depending on the desired throughput. These include laboratory mills for small quantities of product up to production machines with a gas throughput of 14,000 m^3/h. The CGS 10, conceived for laboratory use, uses an air flow of 50 m^3/h.



Automatic product conveyance

The mill is part of a complete plant. A screw feeder conveys pigment into the mill. Simultaneously, a load cell weighs the entire jet mill to determine the amount of pigment in the milling chamber. The screw feeder is controlled by the load cell to maintain an optimal fluidised bed level. This is an additional factor in obtaining a consistent pigment quality. The milled product is collected in a bag-house filter. The filtered gas passes through a second filter to obtain a residual dust content of < 1 mg/NmΔ. This value exceeds the requirements of TA-Luft, the German regulation for dust emissions. In conjunction with this, for explosion protection due to the fine powder, the mill is pressure shock-resistant up to 10 bar(g). The filter is equipped with an explosion extinguishing system.

Easy cleaning

To enable a smooth and expeditious changeover of pigment types, intermediate cleaning of the milling plant is necessary. Smooth, flawless interior walls of the machine almost completely prevent clinging of the product and allow thorough cleaning. The electro-polished surfaces of the stainless steel have a mean surface peak-to-valley depth of Ra < 0.8 µm. Quick-release clamping screws used to fasten the machine body together, as well as easy-to-dismantle and remove nozzles, simplify servicing and cleaning of the machine. Additional CIP cleaning mechanisms on various parts automate the cleaning process. The classifying area, fines outlet and milling chamber are thoroughly cleaned by a slowly rotating, fanned stream from several spraying nozzles and lances. The rotation of the spraying head is determined by the required amount of cleaning medium and the resulting flow velocity. An additional drain opening on the underside of the milling chamber allows residual product and cleaning liquid to be discharged. The dust filter is cleansed in the same manner. Extra spraying heads are necessary in the filter, due to the significantly larger chamber volume.