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CHEMICAL PRODUCTION PLANTS PROCESSES

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Choosing the right mill carefully

Dry fine grinding of plant protectives

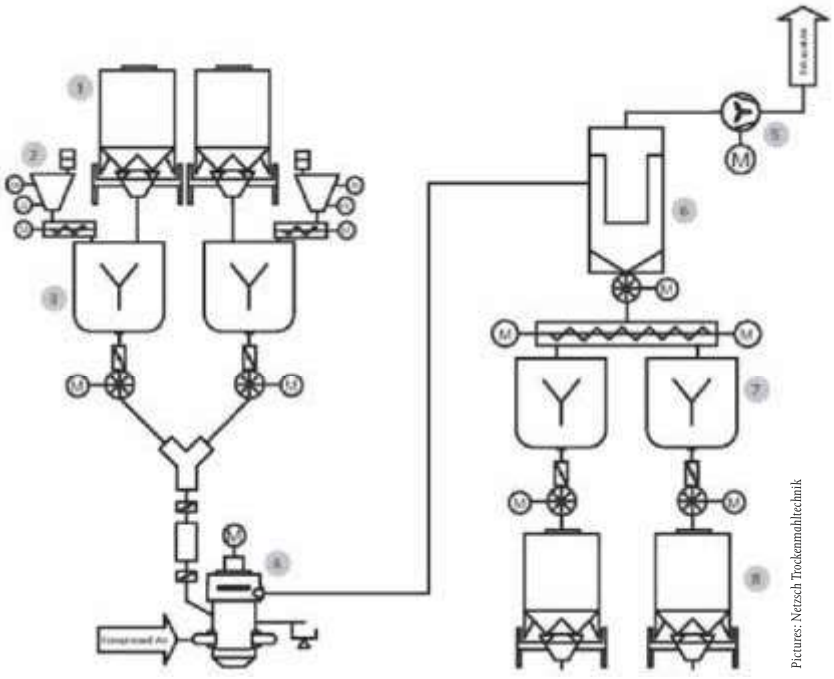
The production of plant protectives is currently gaining in strategic importance. It needs to be re-evaluated to put more emphasis on environmental restrictions, both during the chemical production process and in agriculture when spreading on crops. When optimising the production processes for herbicides, fungicides and pesticides, the selection of the most suitable mill technology plays a vital role.

In crop protection products, it is important that the active molecules act on the right target (insects, weeds or fungi) with the right intensity and at the right time, namely when the crop actually needs protection. Crop protection products therefore contain different components:

- Active ingredients, of which a formulation can contain one or more
- Dry fillers such as clay, talc, kaolin or silica to dilute the active material
- Adjuvants and additives giving certain qualities (stabilising, wetting or anti-foaming agents, repellents, …)

The pesticide production process starts with dosing of the ingredients and intensive mixing. The various mills presented below are required at the next stage. The aim is to obtain homogeneous sizing of all the different particles from the various ingredients as well as end fineness compatible with the final application. After milling and safety sieving to eliminate possible oversized particles, a second mixing step re-homogenises the product and mixes the added ingredients which do not need to be ground.

At the end of the production line are the final products: wettable powders (WP) are produced ready for packing. If a supplementary pelletising or granulation stage is added, the final product is referred to as water-dispersible granules (WG).



Pictures: Netzsch Trockenmahltechnik

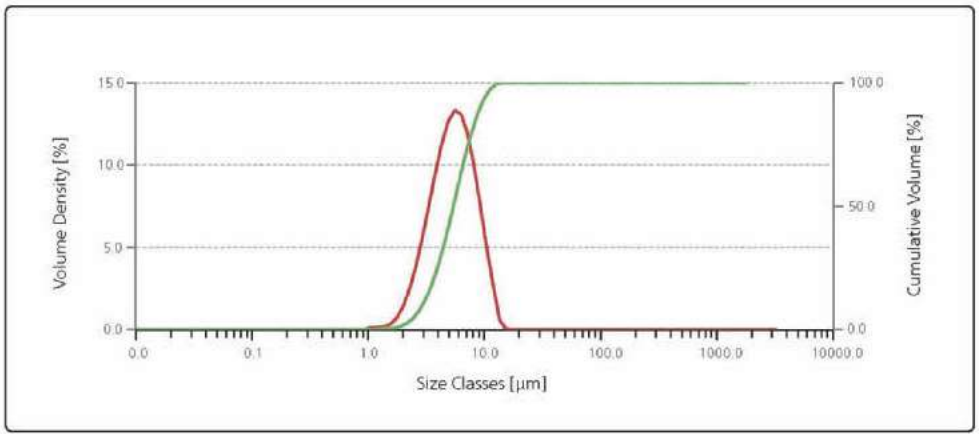
Industrial process for the production of plant protectives: 1 – Container for pre-dosed raw materials, 2 – Dosing screws, 3 – Pre-blenders, 4 – Air jet mill, 5 – Blower, 6 – Filter, 7 – Post-blenders, 8 – Container for final product

Reducing active ingredients

A finer powder helps make the action of the pesticides on targets more efficient. The same result after treatment can then be achieved using a smaller number of active ingredients in the formula. This is beneficial for safety, environmental and economic reasons. Furthermore, pesticide powders without oversized particles simplify the end application on the crop by the farmer:

- Before application, the powder is dispersed in water. The suspension is more stable if the particles are finer and no sedimentation occurs during operation.
- Spreading on crops is carried out by a spraying system with a series of nozzles. Clogged nozzles due to oversized particles prevent regular spraying and can even make it impossible.

Based on the fineness and specifications requested by the producers of plant protectives, Netzsch has developed various technologies for dry grinding. Condux mechanical impact mills are well adapted for pre-grinding and relatively coarse milling. The CSM type classifier mill is recommended for a perfect top cut without oversized particles. The CGS fluidised bed jet mill offers key advantages for the production of high-quality pesticides, namely higher fineness, a final product free from oversized particles and optimal preservation of the active ingredients.



Typical particle size distribution with a sharp top cut from a CGS type fluidised bed jet mill

Mechanical impact mills

Rotary impact mills are used for fine grinding of soft and medium-hard materials. The typical fineness range for the mean particle size is between 20 and 500 µm. Circumferential speeds of between 25 and 150 m/s are achieved. A version is also available for counter-rotating operation at up to 250 m/s. The air flow, which depends on the type of rotor, ensures temperature-stable grinding. The rotor is mounted on a horizontal fly shaft arrangement. The high circumferential speeds at the shaft enable sealing with contact-free labyrinths.

Mechanical impact mills can be equipped with a variety of grinding tools. This allows them to carry out two different tasks on plant protectives. The Condux mill version featuring a blast rotor in combination with a stator (screen or grinding track) is often used for pre-grinding. These grinding tools produce a blowing effect with a high air flow and only a very small temperature increase. The efficiency of the thermo-sensitive active ingredient is thus maintained. The fineness which can be achieved with this combination is typically <100 µm.

Condux mills with a grinding disc and integrated dynamic air classifier provide the standard fineness required for pesticides, which is generally <30 µm. In this case, the design of the machine has been kept simple with only one drive for the grinding disc and the classifier wheel. The top cut is defined by adjusting the height of the wheel and accessibility to the grinding chamber is very easy, for quicker cleaning between two different products.

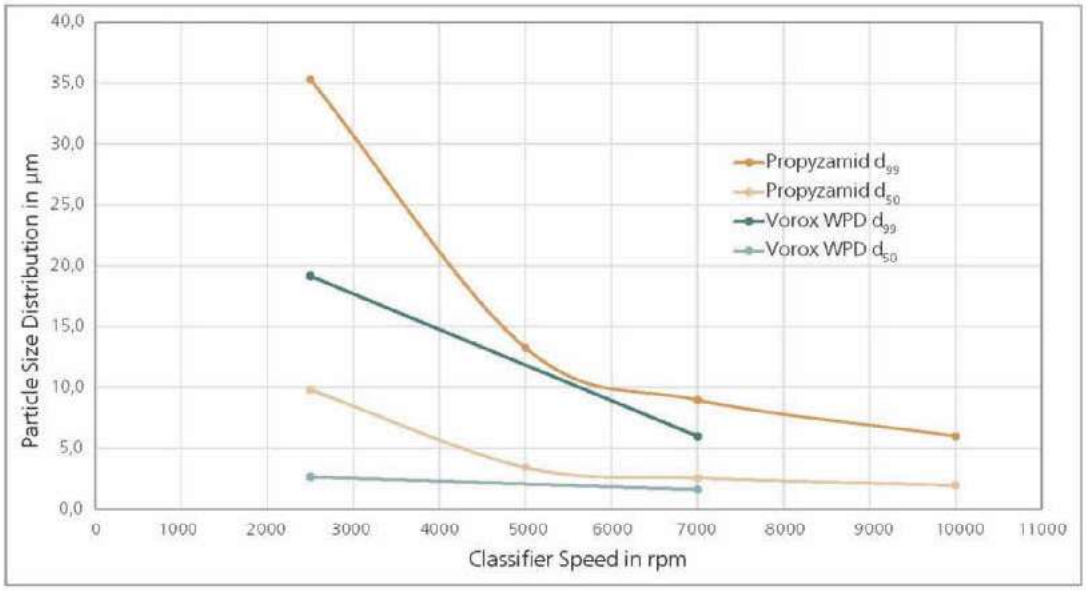
CSM 560 classifier mill

Milling and classifying in one system

The CSM classifier mill unites milling and classifying effects in one system and is a combination of a fine impact mill and a deflector wheel classifier. With two independent drives – one for the grinding disc and another for the classifying wheel – the CSM can be exactly adjusted and offers a wide final product fineness range from d97 = 9 to 200 µm. The geometry of the classifier wheel, together with the air purge gap between the rotating wheel and the stationary mill cover, results in a highly precise top cut and a milled product free from oversized particles. For fungicides and pesticides, the CSM 360 version achieves finenesses of d99 = 45 µm at a throughput of approximately 400 kg/h, while for sulphur the CSM 165 the fineness is d99.9 = 63 µm at a throughput of 200 kg/h.

When finer products are called for

The CGS air jet mill is used for ultra-fine grinding of soft to extremely hard materials in a fluidised bed. Grinding takes place



Milling of two herbicides with a CGS 16 fluidised bed jet mill: the particle size distribution varies depending on the classifier speed

CGS 50 fluidised bed jet mill

without tools in the air jet and a dynamic classifier limits the maximum particle size. The particles are finely ground due to the high 500 to 600 m/s velocity of the air jets at the nozzle outlets inside the grinding chamber. The high level of available energy and the speed of the impact between particles in the fluidised bed enable a d50 fineness of 1 to 5 µm.

One very interesting point for plant protection applications is that the energy received by the product for breaking the particles does not generate any heat. The expansion of the air physically induces a reduction in its temperature. Therefore, despite the heat which is produced when the particles impact each other and break, the two phenomena are balanced and the temperature remains constant, so that the active molecules are not damaged.

Classifying takes place in the top part of the CGS mill, in a quiet zone well separated from the milling zone. The specific design of the Convor wheel makes it possible to achieve a sharp top cut even if the particles are only a few microns in size. The easy control of the rotating speed by a frequency converter means the CGS mill has a wide range of possible finenesses.

Safe and easy to clean

Regardless of the milling technology, attention should also be paid to the design of the complete grinding plant. Two aspects in particular must be considered: safety in relation to the dust explosion risk and cleaning to limit contamination.

In most cases, pesticides include organic components which present a risk of dust explosion. The characterisation of the complete formula by a certified laboratory defines the relevant dust explosion values. These mainly concern the minimum ignition energy, the ignition temperature and the K_{St} value. Depending on this data and when the limits are exceeded, the milling system must be adequately protected. A pressure shock-resistant plant design, including specific elements such as explosion valves and rupture discs, has the advantage that it brings down production costs and keeps operation simple. A second solution is to grind under inert gas while monitoring the oxygen content in the plant. An explosion suppression system using fire extinguishing powder sprayed into the installation is the third option.

Very often, the same plant is used for several products with completely different formulas and possibly antagonistic active ingredients. In such cases, pesticide manufacturers clean their milling equipment especially carefully between two campaigns.

As a market leader for processing technology, Netzsch has worked intensively on the design of its grinding plants. Internal parts are readily accessible thanks to a cover which opens completely as well as optimally positioned doors. The stainless-steel mill structures, fine polishing and bottom discharge valve enable simple washing with water.

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