NETZSCH
Proven Excellence.

Sustainable Increase in the Effectiveness and Environmental Compatibility of Plant Protection Products and Fertilizers through the use of Nanomaterials

Abstract

In order to meet the world's ever-increasing demand for food, there has been a dramatic increase in the use of pesticides, fungicides, herbicides and fertilizers in recent decades. This excessive use of plant protection products and fertilizers not only drives up the prices of agricultural products, but also damages the soil and the environment or has a negative impact on other non-target organisms such as livestock, birds, bees and other pollinators and insects, as well as the rest of the plant world.

The primary reason for this is that, according to scientific studies, only about 1-25% of the nearly 4 million tons of conventional pesticides applied annually reaches the actual "target organisms" directly, while the bulk of the toxic components enter the environment through spray drift, volatilization, dust drift, or leaching [[i]].

Numerous scientific studies have shown that the application of so-called encapsulated nanopesticides can increase efficacy by more than 30% compared to conventionally applied crop protection products. This was due, in part, to the controllable release of the active substances and to the lower drift and leaching effects.

Other studies focus on the use of carbon-based nanomaterials such as graphenes, CNTs or fullerenes, which can be used as substrates, fertilizer components or fungicides [[ii], [iii]].

Use of materials with particle sizes in the submicron range

If we look at other application areas, the pharmaceuticals industry for example, active ingredients are specifically crushed down to the nanometer range in order to significantly improve the solubility, the bioavailability, and thus the efficacy in the human body through reduction of the particle size and the related increase in the surface area of the particle. This reduces the amount of active ingredient required for a treatment unit, with a demonstrable reduction in possible side effects. If we also consider the economic aspect of the production of sub-micron/nano-scale active ingredients, it is possible to produce quantitatively more high-quality active ingredient, thus ensuring a significantly more sustainable supply to society.

While the use of materials with particle sizes well below one micrometer is now state of the art for pharmaceuticals, printing inks, coatings and materials for the microelectronics or battery industry, the use of nanomaterials for agrochemicals is still largely in the development and testing phase.

In combination with targeted modification of the substances through encapsulation, granulation or concentrate, it will be possible to increase crop yields. At the same time, the use of chemical substances can be reduced through controllable release of the active substances and through lower drift and leaching effects. This leads to considerable savings potential and to significantly increased environmental compatibility.

Very similar substances, such as titanium dioxide, graphene or CNTs, can be found here, as in other branches of industry, where they are sustainably crushed or dispersed on a large scale with the aid of agitator bead mills or homogenizers from NETZSCH Feinmahltechnik GmbH.

[i] Dengjun Wang et al. Nano-enabled pesticides for sustainable agriculture and global food security. Nature Nanotechnology volume 17, pages 347–360 (2022)

[ii] Husen, A. Carbon-based nanomaterials and their interactions with agricultural crops. Nanomaterials for agriculture and forestry applications, pages 199-218 (2020) Elsevier. Available at: https://doi.org/10.1016/B978-0-12-817852-2.00008-1

[iii] Aacharya, R. Chhipa, H. Nanocarbon fertilizers: Implications of carbon nanomaterials in sustainable agriculture production. Carbon Nanomaterials for Agri-Food and Environmental Applications, pages 297-321 (2020) Elsevier. Available at: https://doi.org/10.1016/B978-0-12-819786-8.00015-3

If you have any questions please contact our application specialists
hans.kisswetter@netzsch.com **or** jan.wolfrum@netzsch.com