



thyssenkrupp

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## Fertilizers for life

Freiburg im Breisgau. At the farmers' market Marina (23) stands gazing at the greengrocer's display. Potatoes, parsnips and an eggplant have already been weighed out for her. But the bright red of the strawberries and cherries is just too tempting. "And two pounds of those, please!"

Kassel. Tomatoes, bell peppers, a cucumber, garlic, and a selection of fresh herbs. In his kitchen, David (36) is busy putting the finishing touches to his gazpacho. A final seasoning: perfect, done! His date can come.

Nuremberg. Ida (38), Benni (39) and little Tom (2) have been in the greenhouse for three quarters of an hour, looking for plants to put in their flower boxes. Tom is fascinated by the two-tone petunias, while Benni is set on growing his own chillies.

The delicious-looking fruit and veg on the farmers' market, David's meticulous preparations for his date, and the plants for Ida, Benni and Tom's window boxes – all made possible by the power of nature. Plants provide us with vitamin-rich fruit, countless vegetables, herbs, tubers, salad, and cereals. Shrubs and flowers adorn our parks, gardens, interiors and balconies. For plentiful harvests and healthy seedlings, it's essential that plants get all the nutrients they need. And thyssenkrupp Industrial Solutions has the technology for this, with its mineral fertilizer production facilities.

Alongside air, water and sun, there's one thing plants need in order to flourish: nutrients. A good mix of nutrients consists of 17 basic components. The most important are nitrogen, potassium and phosphorus. If one of these nutrients is missing, a plant's growth potential is inhibited. Crops yield less and ornamental plants are more susceptible to disease. But often the nutrients are not present in sufficiently high concentrations in the soil. When crops such as corn, potatoes or vegetables are harvested, the nutrients they have absorbed from the soil go with them. To provide enough nutrients for the next generation of plants, the soil has to be replenished. Fertilizers supply the right cocktail of nutrients. They are key to rejuvenating the soil and lay the foundation for our balanced diet. It is estimated that around half of the world's population today has food on the table due to fertilizers.

thyssenkrupp Industrial Solutions has almost 100 years' experience in the development, construction and maintenance of fertilizer production plants. For example: One of the most important nutrients is nitrogen, the chemical element with the symbol "N". Absorbed by plants from the soil, it is needed for the growth of shoots and leaves – and is therefore sometimes called the "engine of plant growth". Nitrogen fertilizers are produced by synthesizing various chemical elements to make ammonia ( $\text{NH}_3$ ), nitric acid ( $\text{HNO}_3$ ) and finally ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ). But mineral fertilizer production has one big disadvantage: a nasty by-product in the form of nitrous oxide ( $\text{N}_2\text{O}$ ) – better known as laughing gas. This greenhouse gas is 300 times more harmful to the environment than carbon dioxide ( $\text{CO}_2$ ). But engineers from thyssenkrupp Industrial Solutions have come up with an ingenious solution to prevent this problem: In the EnviNOx process, laughing gas and nitrogen oxide emissions are converted into harmless nitrogen and oxygen by a catalytic reactor in the tail gas stream. This technical breakthrough is so important for environmental protection that it has been added to the EU's list of the best available techniques for limiting industrial emissions.

### Green ammonia

And that's not all: Thanks to the expertise of thyssenkrupp Industrial Solutions, [ammonia can now be produced entirely from renewable feedstocks](#) – without the use of fossil fuels. First water is broken down into its hydrogen and oxygen molecules by means of water electrolysis. The electricity required for this comes from renewable energy sources. The nitrogen required for ammonia synthesis is produced by an air separation unit which breaks down "normal" air into its individual components – one of which is nitrogen. The result is clean, "green" ammonia – the key to climate-friendly mineral fertilizers. But synthesized ammonia isn't just an important intermediate product for the manufacture of valuable

mineral fertilizers. It has an interesting side-effect: ammonia is an excellent energy storage medium. In the future fluctuations in the availability of renewable energies could be offset by storing the energy in tanks of ammonia for transportation from A to B. A real boost for the transition to renewables! Learn more about our expertise in the fertilizer industry here: <https://www.thyssenkrupp-industrial-solutions.com/en/industries/fertilizer>



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**The bottom line:** Marina's fruit and veg, David's gazpacho, and Tom's petunias ... all rely on nutrient-rich soils. And providing the soil with nutrients is the specialty of thyssenkrupp Industrial Solutions' experts.

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