

U H D E
SOLUTIONS

UFT®
Fluid Bed
Granulation

High Performance Urea Granulation

Benefit from our best-in-class technology
and scalable solutions

engineering.tomorrow.together.



thyssenkrupp

Why we are best in class.

thyssenkrupp Uhde Fertilizer Technology is the global market leader for urea Fluid Bed Granulation technology and an independent licensor for this technology.

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Based on more than 40 years of experience in developing and licensing urea Fluid Bed Granulation technology and on the practical experience of more than 80 plants in operation all over the world, we have built up a strong reputation as a highly reliable and independent partner in the fertilizer industry.

About thyssenkrupp Uhde

thyssenkrupp Uhde combines unique technological expertise and decades of global experience in engineering, procurement, construction and service of chemical plants. We develop innovative processes and products for a more sustainable future and thus contribute to the long-term success of our customers in almost all areas of the chemical industry. Our portfolio includes leading technologies for the production of base chemicals, fertilizers and polymers as well as complete value-chains for green hydrogen and sustainable chemicals.

www.thyssenkrupp-uhde.com

Three questions for ...

Dr Matthias Potthoff, Managing Director of thyssenkrupp Uhde Fertilizer Technology (UFT), provides a personal insight into the challenges of the fertilizer industry and our response to these challenges and opportunities.



Dr Matthias Potthoff

What challenges do you see in the fertilizer industry and how do you master them?

In general the fertilizer industry is a growing business with sound underlying drivers like global population growth and a shift in diets away from vegetarian to more protein- and fruit based food in many parts of the world. However, like any commodity business the fertilizer industry faces investment cycles that are leading to declining product prices in oversupply situations. This in turn results in phases of reduced investment activities until demand growth has absorbed the overcapacities installed or the most uncompetitive plants close down. Since 2024 we see an increasing demand for Ammonia/Urea plants. Traditional Urea producers massively expand their capacities and newcomers, especially from the Southern Hemisphere, are requesting proposals. In earlier investment periods the request was for one, sometimes two trains. Now requests are for four or more large-scale trains in one project. Handling such mega projects is a challenge for licensors and contractors. UFT reacts with standardization of our proprietary equipment design while staying with our well acknowledged tailor-made process design.

In view of the increasing uncertainties of traditional fertilizer production regions and trading routes, resilience and independency is another driver for building new urea plants. These plants might not always have outstanding economics but reduce dependencies and ensure food security in concerned countries or regions.

What particularly characterizes your cooperation with your customers?

To understand the interaction between our customers and us it is important to understand the business model in general. As a licensor for Fluid Bed Granulation technology we have basically two customer relationships to maintain. The first one is the relationships to customers who already operate a Fluid Bed Granulation plant. Their plants have been established between very recently and up to more than 40 years ago. In such cases the operating companies are interested in continuous operational support for optimizing plant operations, sometimes trouble shooting as well as spare part supply. They want to keep their plants up to date with small modifications, e.g. increases in capacity, modifications in product specification or adjustment to new emission limit requirements. Here the customers benefit from our very experienced staff who can provide support in these areas, as well as from the worldwide thyssenkrupp Uhde network, which allows us as a group to offer engineering and other services going beyond the usual scope of a licensor from a single source. This is a big advantage for the customer as he has a single point of contact and can choose services from pure basic or detail engineering up to a maintenance contract for his plants.

For new grassroots installations the focus is on minimizing the overall investment cost without sacrificing product quality and plant reliability. Here we work closely with the end user and the EP/EPC contractor to develop tailor-made solutions applying our cutting-edge technologies. In light of the ambitions to reduce CO₂ emissions, reduction of energy consumption is another focus of UFT's development activities. Here UFT can offer top-notch solutions.

And finally, a personal question: What do you find particularly fascinating about your work at UFT?

The history of UFT goes back to the 70s of last century when the original technology was developed by predecessors of Yara. In 2005 thyssenkrupp acquired the worldwide exclusive license rights for the fluid bed urea granulation technology. Thanks to our customers' trust and confidence in our technology the installed capacities have nearly doubled during the past 20 years with many repeated orders from established customers. This is a very strong testimony to our ability to meet our customers' needs. It was and is fascinating to be part of this success story.

The challenges new competitors have given us in the last couple of years have inspired and spurred us on to intensify our R&D activities with remarkable results.

Many new developments have been launched, such as the low dust generating spray nozzles for the granulator, the low pressure drop ultra-low emission scrubbing system, Ammonia Convert Technology (ACT) that allows ammonium salt to be recycled from the acidic scrubbing into the final product and provides reduced operating costs, a formaldehyde-free additive, and production diversification into sulfur-enhanced urea granules.

With these developments UFT has become the trend-setter in the market and our aim is to provide cutting-edge technology to all our customers in the future as well. Last but not least, it is very inspiring to work in a business area which is key to ensuring food security for billions of people and future generations of a growing global population.

“By providing leading-edge technology and services we enable our customers to deliver top-level quality products in a most cost-efficient and environmentally friendly manner.”



UFT® Fluid Bed Granulation

Full flexibility for maximum success

The UFT® Fluid Granulation process can produce all required product sizes (2–8 mm) in the same plant with only minimal adjustments. The urea granules are well rounded, very hard, and ultra-resistant to crushing and abrasion. Consequently the urea granules remain dust-free, non-caking and completely free-flowing, even after long storage, frequent handling and shipping. With the superior features of bulk transportability, bulk blending suitability and greater agronomical efficiency, granular urea can be substituted for prilled urea in all applications.

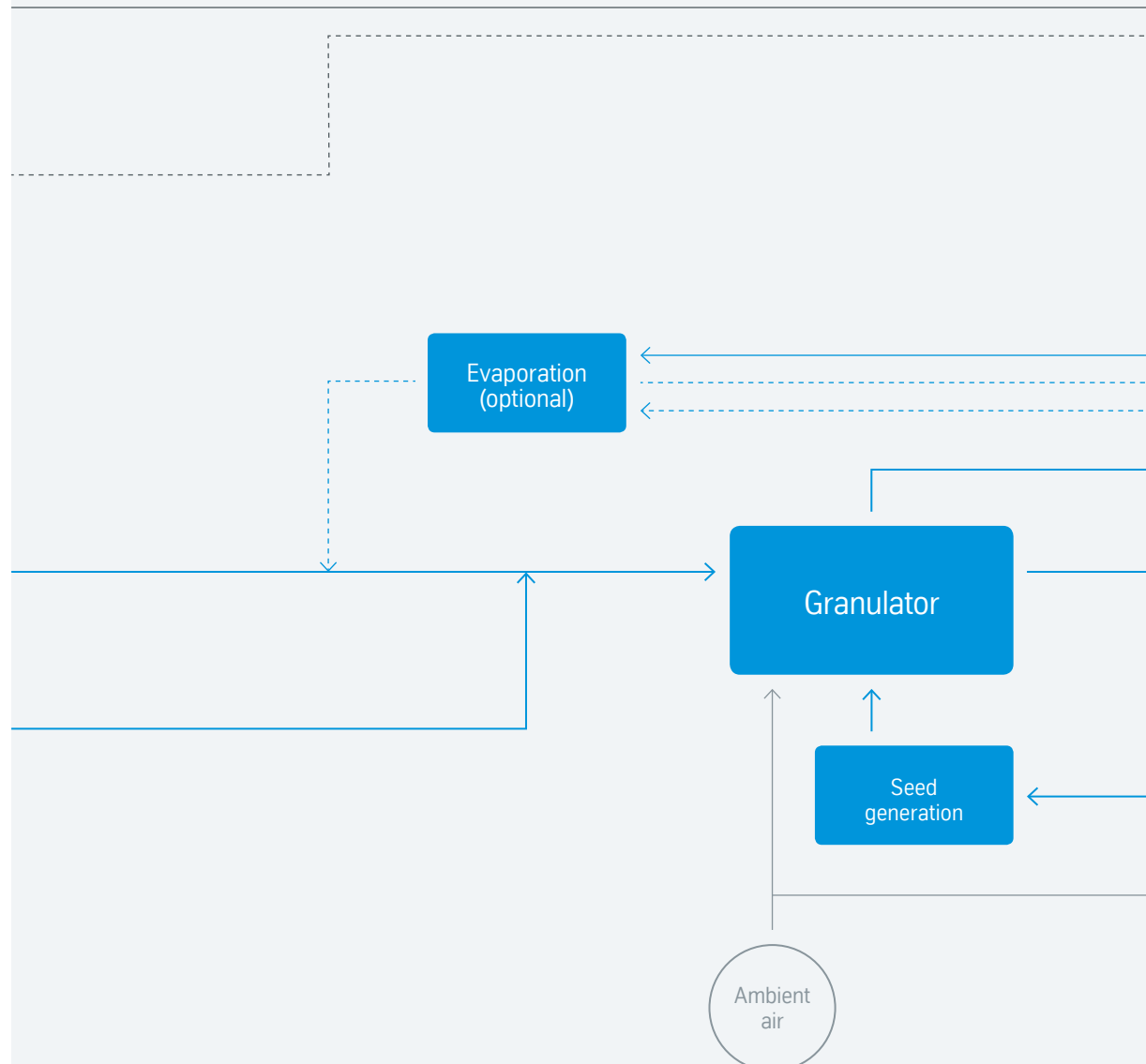
Feedstocks

Sulfuric acid

Nitric acid

Urea

Additive

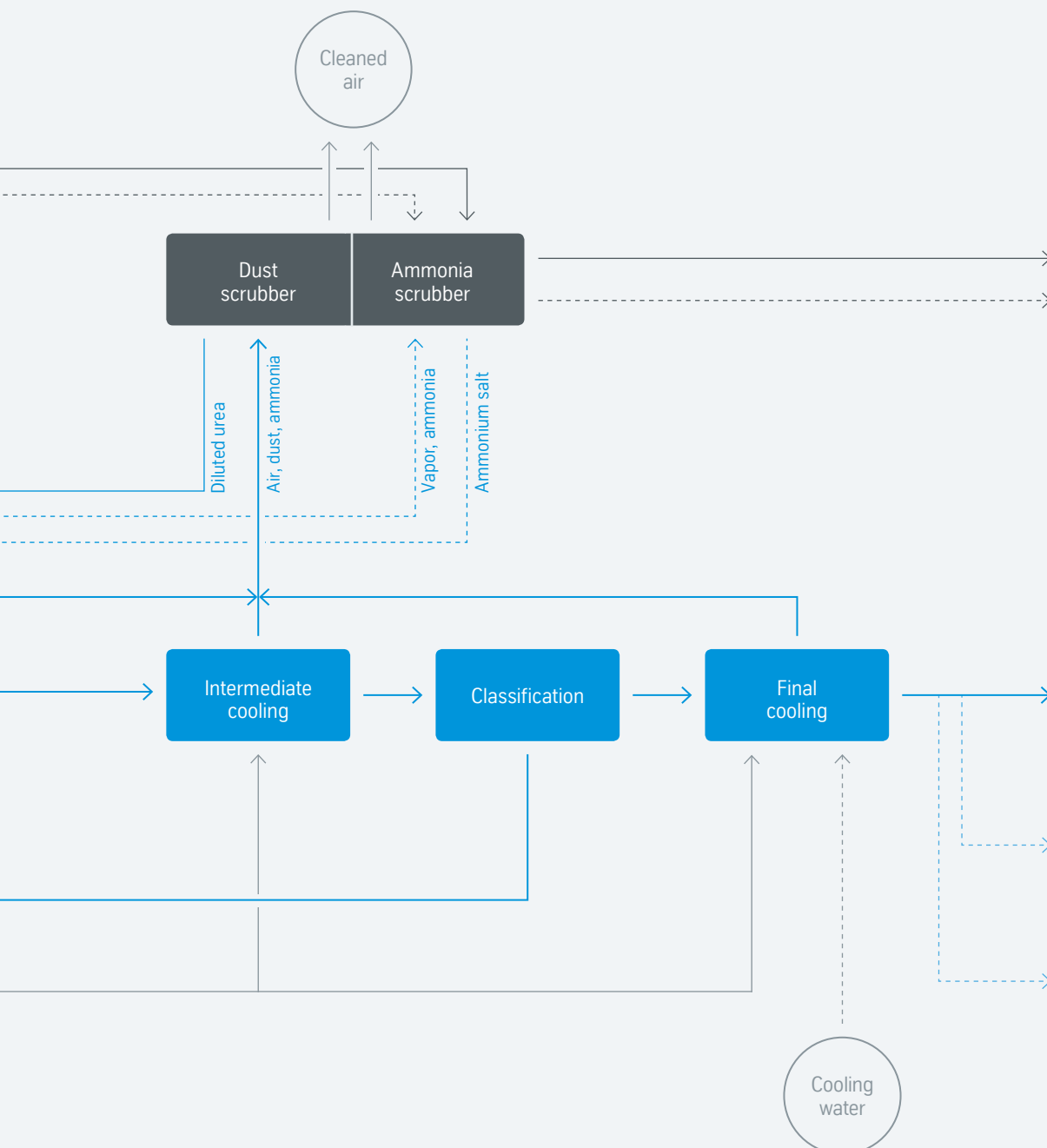


The granulation mode is accretion, which delivers a very hard granule that is far superior in quality to granules produced through layering or agglomeration-based processes.

Our Fluid Bed Granulation plants are easy to operate and very reliable which results in a high on-stream factor. The granulator contains no moving parts, thus minimizing maintenance. The number of solid-handling equipment is significantly reduced compared to other technologies to maximize plant uptime and reduce investment costs.

Urea product specification (typical)

	Standard size	Large size
Total nitrogen	46.3 wt %	46.3 wt %
Biuret	0.7-0.8 wt %	0.7-0.8 wt %
Moisture	0.2 wt %	0.3 wt %
Crushing strength	4.1 kg (Ø:3 mm)	10.0 kg (Ø:7 mm)
Average diameter	3.2 mm	6.3 mm
Size distribution	95 wt % (2-4 mm)	95 wt % (4-8 mm)
Formaldehyde	0.4 wt %	0.4 wt %



Products

Ammonium sulfate

Ammonium nitrate

Urea granules

Technical grade* granules

Stabilized Urea granules

--- optional

* Technical grade granules = formaldehyde-free granules

A vital boost to your competitiveness

There are many good reasons for choosing our benchmark-setting UFT® Fluid Bed Granulation technology, as our global market share of over 70% in capacity terms proves. The benefits our plants bring to your bottom line are operational flexibility, production security and product quality.

World-class experience

The excellent product quality of UFT® Fluid Bed Granulation technology has made it the global market standard for granular urea. What's more, this technology looks back on some 40 years of proven operational successes. More than 80 of our plants are now operating worldwide under widely varying climatic conditions. We are the only licensor of urea granulation technology to have licensed more than 25 plants with capacities of more than 3,500 mt/d of which 6 plants have a capacity of more than 4,200 mt/d or more.

Excellent design

Our single-stream capacities are always large enough to handle the largest urea synthesis units developed to date. With various alternative plant concepts for small or medium-sized plants available, you can also be sure of a customized design concept to meet your specific needs. The use of a 97% urea solution coupled with low recycle ratios results in a simplified design concept requiring only a single-stage evaporation unit in the Urea Synthesis. This leads to lower steam and cooling water consumption, minimal power consumption, and reduced investment and operating costs for the urea synthesis plant. The compact layout ensures maximum operability coupled with minimum investment and operating cost. Our low dust generating spray nozzles lead to lower steam consumption and less Granulator washing events.

One for all – for optimal operation

Our process design takes climatic conditions, product quality, product size distribution, environmental regulations, product diversity, and utility costs into account to ensure you obtain a plant with the lowest costs per product ton. We utilize state-of-the-art computer-based design tools backed by over 40 years of operating experience. Each plant is designed to operate optimally under its specific operating conditions.





Typical specific consumption

Electric power	25 kWh/mt ¹
LP steam	35 kg/mt
Process water	0.5 m ³ /mt
Cooling water ²	none

¹ depending on climatic conditions and plant concept

² with Fluid Bed Cooler for final product cooling

Reducing emissions right from the start

UFT® Fluid Bed Granulation technology not only improves plant economics but also offers significant environmental advantages. For example, our proprietary horizontal cross-flow scrubbing system reduces dust emissions to below 1 mg/Nm³, while its horizontal configuration prevents back-mixing and cross-contamination between the dust-removal and acid-handling streams.

Urea dust removed

Dust removal to below 0.01 kg/t of urea produced is possible. The horizontal cross-flow scrubbing system that enables such outstanding emission figures is proprietary equipment in combination with our Fluid Bed Granulation technology.



99.9%
dust removal efficiency

> 90%

ammonia removal efficiency

Ammonia emissions efficiently controlled

By using acid scrubbing systems ammonia emissions can be reduced to $<15 \text{ mg/Nm}^3$ of air, thus complying with the most stringent environmental regulations. A conventional acidic scrubbing system produces a side stream of dilute ammonium sulfate solution. Our proprietary Ammonia Convert Technology (ACT) eliminates this side stream by recycling the ammonium sulfate solution into the final product. Traces of the micronutrient ammonium sulfate in the urea granules upgrade the resultant fertilizer with an additional economic benefit.

Lowest emissions and lowest pressure drop

Our scrubbing system consists of horizontal cross-flow scrubbers with specially designed scrubbing pads. These scrubbers have the following features:

- Pressure drop much lower than other technologies to reduce overall power consumption of the granulation plant
- Proven dust emission figures to $<1 \text{ mg/Nm}^3$ of air
- Clear separation between dust and acid stages to avoid backmixing and cross-contamination
- An Optional low pressure drop AEROSEP® stage allows removal of fine urea dust particles
- Thanks to the horizontal gas flow design, the scrubbers integrate seamlessly between the granulator and the vent stack, reducing ductwork requirements and associated costs.



0

liquid effluents

No contaminated water

Another key environmental benefit of our Fluid Bed Granulation technology is zero discharge of liquid effluents to the sewage system.

Formaldehyde-free urea

Although urea formaldehyde is still the state-of-the-art urea granulation additive, it is categorized as a carcinogenic substance by the International Agency for Research on Cancer and adds to the VOC emissions from an ammonia/urea complex. That is why we have developed a new formaldehyde-free additive that significantly reduces the environmental impact by virtually eliminating VOC emissions and ensures compliance with health and safety regulations on formaldehyde, while guaranteeing the same or even better granulation performance and product quality. Besides, the new formaldehyde-free additive, UFT® Add, extends the application range of urea granules with no or negligible impacts on plants.

How our **Research and Development** makes your plant more profitable

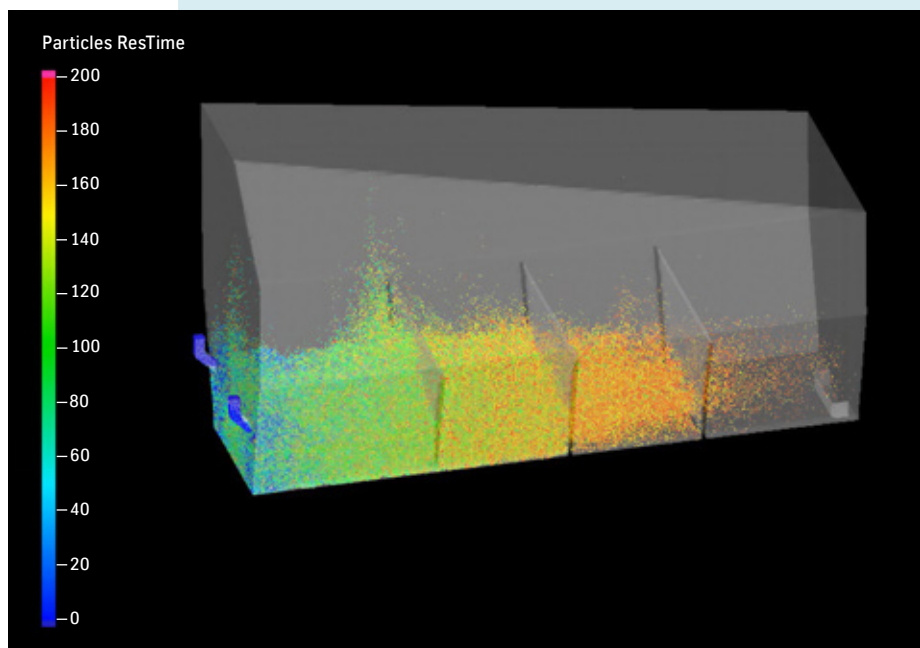
Research and Development is one of our major activities. The main objective is to further improve our Fluid Bed Granulation technology and keep it in line with market requirements. To this end, we cooperate with universities, research institutes and industrial partners worldwide so that your operations can become more competitive and profitable.



BoPP pilot plant

At tk UFT we operate our own Batch-operated Pilot Plant (BoPP). It is mainly used for continuously improving our technology but also is available to customers for product or process tests. The plant is capable of producing granulated urea products with or without sulfur and utilizing different additives. Even combinations of additives or micronutrients are possible.





New spray nozzles

The UFT® Fluid Bed Granulation process requires micro-droplets with a uniform size distribution. This reduces dust formation in the fluidized bed, which in turn reduces scaling, ensures high operability and plant availability, and reduces the evaporation load. A new spray nozzle design makes uniform-sized micro-droplets possible. The low dust generating spray nozzles are installed in all new granulators and are available as retrofit for existing plants as well.

State-of-the-art fluidized bed process simulator

Fluidized bed granulation processes are difficult to simulate as a result of the huge number of particles and the complicated interactions between the particles and the droplets from the nozzles. This is due to extensive particle size distribution (from μm to cm) and the high complexity of solid recycling. Intensive research and testing activities as well as feedback from more than 80 operating plants worldwide have resulted in a sophisticated software tool. This combination of theoretical simulation and vast operating experiences enables us to provide you optimized and tailor-made equipment design.



Cutting-edge R&D

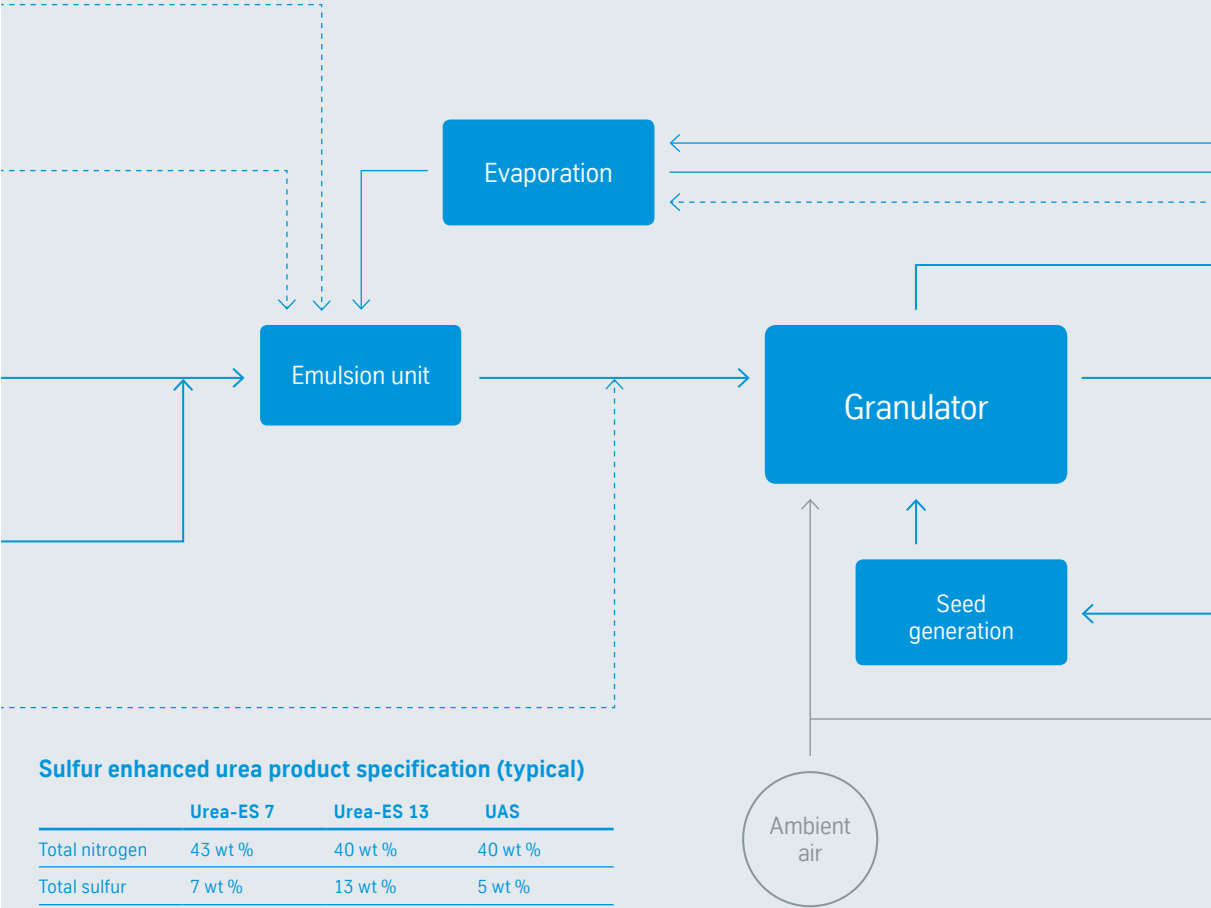
Our ability to carry out tests in pilot plant-scale facilities, coupled with the experience gained from operating the plants of selected customers, enables our R&D results to be implemented in industrial-scale plants. And all this ensures you continue to enjoy a future-proof and scalable technology for granulated urea production that safeguards your ongoing profitability and competitiveness.

Inherent process flexibility enables higher-margin products

We are always open for new product developments – in collaboration with you. As our UFT® Fluid Bed Granulation process is very flexible, it can be used for the production of different products. Our main research focus is on urea-based products for agricultural and technical applications that bring clear benefits for agriculture, operator health, and your profit margins.

Feedstocks

- Sulfuric acid
- Ammonium Sulfate
- Sulfur
- Urea melt
- Additive
- Urease Inhibitor



Sulfur enhanced urea product specification (typical)

	Urea-ES 7	Urea-ES 13	UAS
Total nitrogen	43 wt %	40 wt %	40 wt %
Total sulfur	7 wt %	13 wt %	5 wt %
N/S ratio	6	3	7
Biuret	0.7–0.8 wt %	0.7–0.8 wt %	0.8–1.0 wt %
Moisture	0.2 wt %	0.2 wt %	0.2 wt %

Sulfur enhanced urea helps boost crop yields

The decline in atmospheric sulfur and changes in farming practices have created widespread soil sulfur deficiencies that reduce crop yields. To address this, agriculture needs an additional 40–60 million tonnes of sulfur annually. Urea-based fertilizers, particularly Urea-Ammonium-Sulfate (UAS), provide an efficient solution by delivering both nitrogen and sulfur in one application, improving nutrient management and eliminating the need for separate sulfur fertilization.

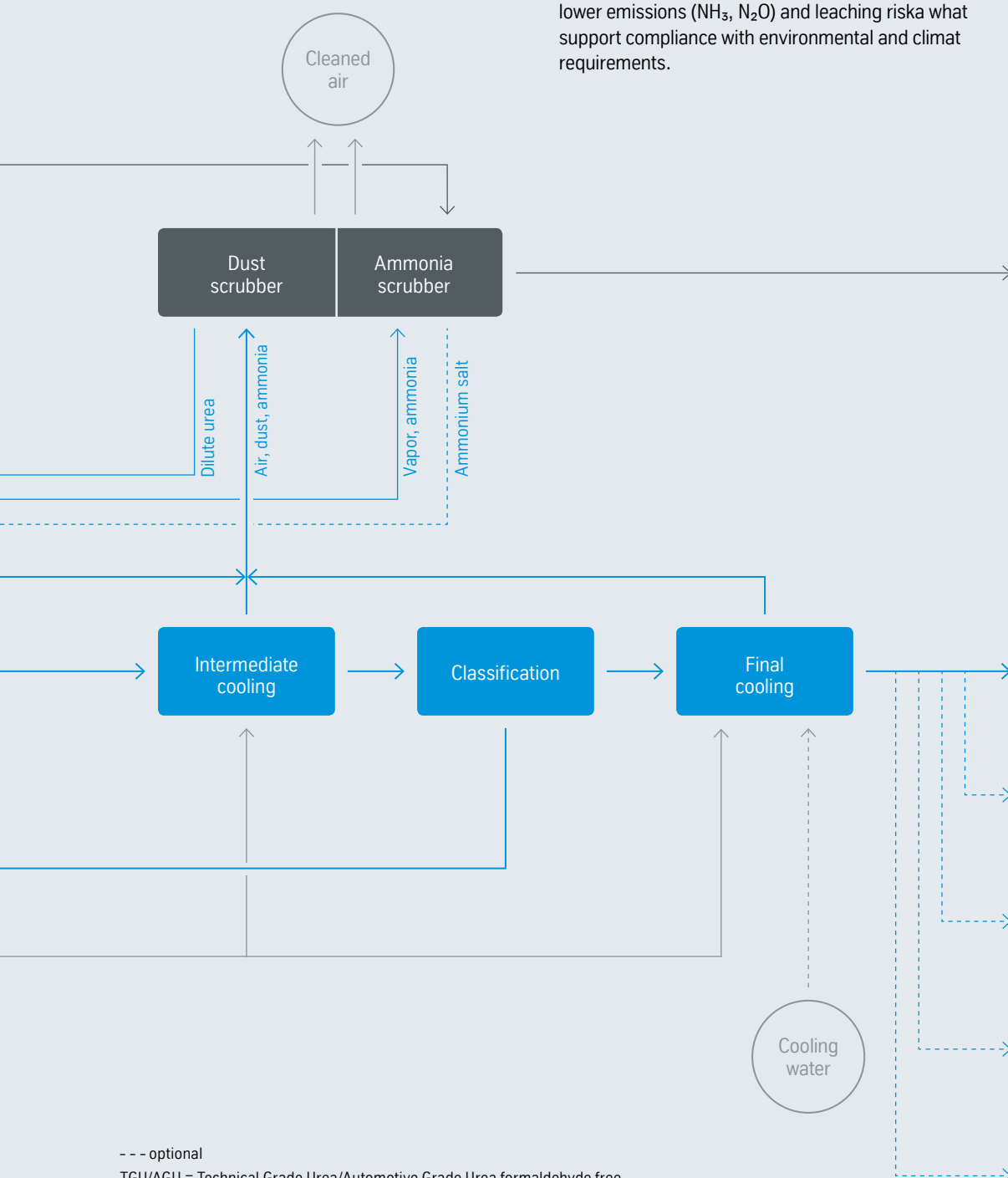
By integrating the Shell Thiogro® technology into our UFT® Fluid Bed Granulation process micro-particles of elemental sulfur can be included into urea to form Urea-ES®. Besides agronomic advantages, our sulfur-enhanced urea granules considerably improve your production efficiency.

Formaldehyde-free granules for DeNO_x and other applications

Our series of formaldehyde-free additives, UFT® Add, enables the production of Automotive Grade Urea (AGU), Technical Grade Urea (TGU), Food grade and further urea products. At the same time it improves the working environment by replacing hazardous formaldehyde. The new formaldehyde-free product opens new market opportunities for you, e.g. for DeNO_x applications in power plants or as a fuel additive.

Inhibitor treated, stabilized urea granules

Inhibitors slow urease activity or nitrification, significantly lowering ammonia volatilization and nitrogen leaching. More applied nitrogen remains available to the crop, improving yield and protein formation per unit of fertilizer. Nitrogen is released more gradually to better match crop uptake over time. Inhibitors lower emissions (NH₃, N₂O) and leaching risks what support compliance with environmental and climate requirements.



--- optional

TGU/AGU = Technical Grade Urea/Automotive Grade Urea formaldehyde free

SNF = Stabilized Nitrogen Fertilizer

Products

Ammonium sulfate

Urea granules

Urea-ES® granules

Urea Ammonium Sulfate (UAS)

TGU/AGU

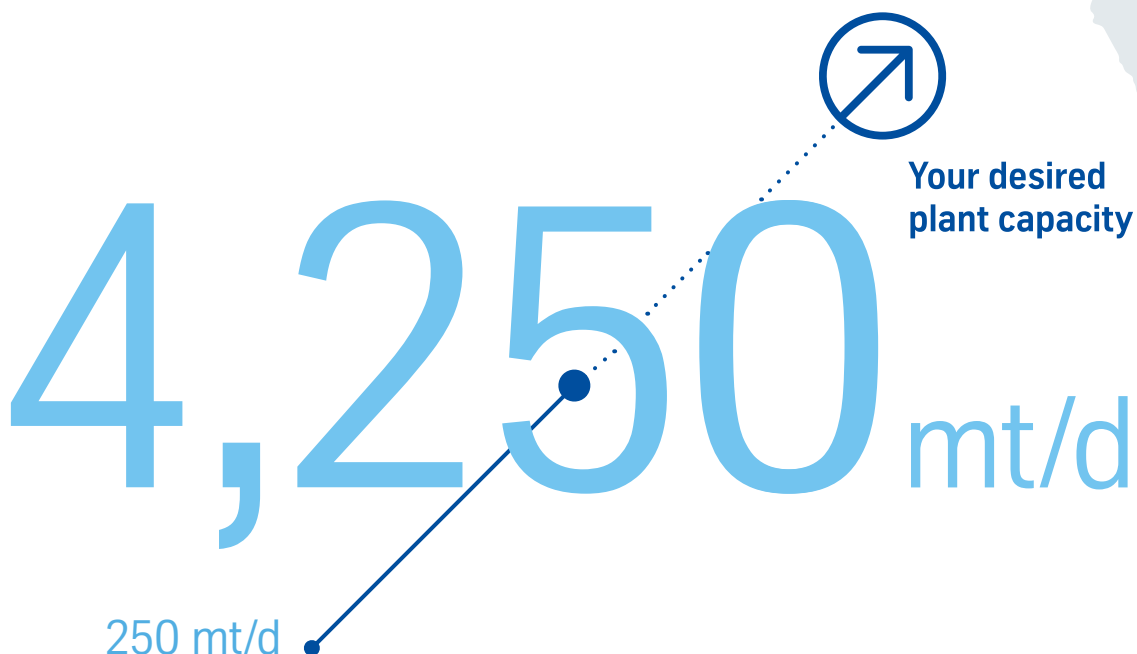
SNF

Where **proven scalability** makes all the difference

The scalability of our Fluid Bed Granulation technology enables standard, mega or jumbo plants to be designed and built, as more than 70 plants operating worldwide prove. The flexibility of this technology gives you a competitive advantage. Our worldwide presence ensures efficient service and support, wherever your plant may be located.

Global benchmark

The Fluid Bed Granulation technology we license has been setting the global market standard in granular urea for more than four decades. Whatever size of plant you require, we can deliver a tailor-made design. One of the biggest single-line plant in operation to date has a nameplate capacity of 3,850 mt/d and is running at 4,250 mt/d under stable operating conditions.



Market share of more than

70%

of global urea Fluid Bed
Granulation production
in operation

Selected references

Customer	Location	Capacity (mt/d)	Special features
Dangote	Nigeria/Ethiopia	6 x 4,235	Repeat order, Ammonia Convert Technology
Perdaman chemicals and fertilisers	Australia	2 x 3,100	Australia's first urea export project
Brunei Fertilizer	Brunei	3,900	Largest plant in Asia, Ammonia Convert Technology
Turkmenchimya	Turkmenistan	3,500	Repeat order
CFI	USA	2 x 3,500	Repeat order
QAFCO 5 & 6	Qatar	2 x 3,850	Repeat order
AOFP	Algeria	2 x 3,850	2 x 4,200 design capacity/acidic scrubbing
Petrobas	Brazil	3,600	Ammonia Convert Technology
SAFCO 5	Saudi Arabia	3,600	Repeat order
CNOOC	China	2,700	Largest UFT® plant in China
AFC, EFC & MOPCO	Egypt	3 x 2,000	Identical design

How we make your plant **future-proof**

Our Fluid Bed Granulation technology has been bringing customers benefits for decades. Our Revamps, world-wide Service, and Research and Development activities ensure this technology stays future-proof.





“Our understanding of service is that we assume joint responsibility for your production.”

Global service from a single source

Hand in hand with our customers and based on our worldwide network infrastructure we can offer a 360° service that includes after-sales service, troubleshooting, and delivery of spare parts. Our service team is ready to assist you at any time and any location.

Operator Training Simulator – OTS

Our OTS delivers a highly realistic simulation of plant operations, allowing personnel to develop critical skills in a safe and controlled environment. It enables operators to practice routine procedures as well as challenging process upsets and emergency situations without impacting production. By improving operational readiness, reducing human error, and accelerating workforce development, OTS helps ensure safer, more efficient, and more reliable plant operations.

Upgrading operating performance

We are continuously developing our Urea solution spray nozzles and have successfully replaced older nozzle types with our new developed ones and hence reduced dust creation and extended the run length between washings. This results in significant (20–30%) reduction of the recycle flow to the evaporation section of the Urea Synthesis plant which optimizes its performance, too.

Tailored revamps

Small revamps (10–15%) at Fluid Bed Granulation plants are easy to implement if spare fluidization air is available. In such cases, the urea spray system can cope with the extra capacity with no modifications. Larger revamps are achievable, either. The granulator can be upgraded by increasing the number of urea sprayers installed and the residual cooling section enlarged by adding an additional cooling section. All other equipment can be adapted to the new capacity requirement on a case-by-case basis. Notable revamps include:

References of note

Customer	Location	Increase
KAFCO	Bangladesh	1,725–2,100 mt/d (22%)
EFC	Egypt	2,000–2,250 mt/d (13%)
ABF	Malaysia	1,500–2,450 mt/d (63%)*
Yara Belle Plaine	Canada	2,000–2,850 mt/d (43%)
PCS Nitrogen	Trinidad	1,620–1,800 mt/d (11%)

* in two steps

UFT® Fluid Bed Granulation

Benefit from our best-in-class technology
and scalable solutions



CONTACT US
TO GET STARTED!

thyssenkrupp Uhde Fertilizer Technology GmbH
Karl-Marx-Str. 75, 44141 Dortmund, Germany
www.uhde-fertilizer-technology.com