Leading fertilizer know-how – Urea

In order to secure global food supplies, our engineers at ThyssenKrupp Industrial Solutions have been developing large-scale plants for the fertilizer industry for over 80 years now. As a leading general contractor we offer our customers throughout the world a wide range of cutting-edge Uhde know-how.

3,500 t urea solution per day

In Sluiskil, Netherlands, we built the 3,500 t/day urea plant for Yara based on the Stamicarbon urea melt process and our Uhde know-how.
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Having erected several thousand plants, ThyssenKrupp Industrial Solutions is one of the world’s leading engineering companies. Our Business Unit Process Technologies supplies chemical plants, refineries and coking plants on the basis of tried-and-tested technologies made by Uhde, while the portfolio of the Business Unit Resource Technologies comprises complete cement plants and grinding systems of the Polysius brand, as well as machines, plants and systems for mining, extraction, preparation, processing or transshipment of commodities.

With many years of experience in the EPC business, we offer our customers concepts, market studies, plant layouts, design engineering, supplies, manufacturing services, erection and commissioning – all from a single source. Our employees on all continents use their knowledge and engineering competence to create innovative solutions and to look for ways to conserve natural resources.

Over 40 locations in 25 countries – divided into six regions – form a close-meshed network that allows us to align our services to local conditions consistently. Thanks to this on-site expertise and global networking, we are able to set standards that offer our customers a true competitive edge.

Our comprehensive service concepts take the entire life cycle of a plant into account. We offer OEM spare parts service and complete maintenance management, as well as servicing, modernisation projects and conversions.
ThyssenKrupp Industrial Solutions has inherited a wealth of know-how and experience from Uhde, a renowned partner in the engineering and construction of urea plants for more than four decades and now a constituent part of the company. Plants built by the company are located all over the world, some in regions with extreme climatic conditions.

In the last ten years ThyssenKrupp Industrial Solutions has boasted a further landmark in its fertiliser plant business. Fourteen new fertiliser plants with a total annual urea capacity of almost twelve million tonnes have been constructed and commissioned.

Three years ago ThyssenKrupp Industrial Solutions achieved successfully to conquer the North American market with the award of the contracts for two large CFI Industries fertiliser complexes, in Donaldsonville, Louisiana and Port Neal, Iowa, respectively and a first-of-its-kind 2,200 t/day Urea Pool Reactor plant with an MP instead of HP Scrubber for AIR Orascom, Wever, Iowa. The Donaldsonville complex and the Wever plant are expected to be commissioned in 2015 and the Port Neal complex in 2016.

One highlight of the previous years was the engineering and commissioning of the biggest urea solution plant in Europe, YARA Sluiskl B.V., which was built on a brownfield site near a village. The plant was designed to produce two different qualities of urea solution: for production of AdBlue/DEF and feed for granulation and prilling.

To meet stringent emission requirements special features were provided, such as acid washing of process off-gases and an automatic catch pot system including a blow-off absorber for the event of a tube rupture in the HP synthesis equipment. Another special feature of the plant is that it includes 28 air coolers with a total heat duty of 187 megawatts and a total area of 3,900 m² for plant cooling and turbine steam condensing.

For the production of urea ThyssenKrupp Industrial Solutions offers a portfolio containing the top state-of-the-art technologies from leading licensors:

- Urea technology from Stamicarbon, Netherlands, including Urea 2000plus™ and Avancore™, Stamicarbon’s latest developments for their CO₂ stripping process.
- Fluid bed granulation from Uhde Fertilizer Technology and Stamicarbon, both of Netherlands
- Prilling technology from Stamicarbon.

With the acquisition of the exclusive licence rights for the fluid bed urea granulation technology from Yara Fertilizer Technology, Uhde Fertilizer Technology (UFT) has taken over the full rights to this outstanding granulation technology, which is used in more than 50 urea plants and is thus the world’s most successful.

ThyssenKrupp Industrial Solutions’ references, which include a wide range of services from revamps to turnkey projects, have contributed to our reputation for plants with high process efficiency and reliability, low emissions and excellent product quality.

In addition, ThyssenKrupp Industrial Solutions meets customer requirements in offering tailored emissions management (e.g. acidic scrubbing, flaring of emissions, absorbing technology, etc.), as well as safety analyses and assistance in permitting management (including HAZOP, SIL, LOPA, QRA, safety reports, dispersion calculations).
SAFCO IV fertiliser complex in Al Jubail, Saudi Arabia.
Capacities:
- 3,300 t/day of ammonia
- 3,250 t/day of urea
- 3,600 t/day granulation unit
The urea process
Fundamentals

Urea is formed by reacting ammonia with carbon dioxide. This first forms the intermediate, carbamate, which then breaks down into urea and water. The reaction is relatively slow and incomplete so unreacted feedstocks need to be removed from the reaction product after the reaction. This can be done by using fresh feedstock, either CO₂ or ammonia, as the stripping agent. When CO₂ is used, it is known as a CO₂ stripping process.

ThyssenKrupp Industrial Solutions licenses Stamicarbon’s CO₂ stripping process variants, which are unrivalled in their efficiency.

As shown in the block diagram, the process is simplicity itself, allowing excess unconverted ammonia from the synthesis section to be recycled as carbamate in just one single stage. In this recirculation section the unconverted NH₃ and CO₂ are removed from the main product stream, condensed back into carbamate and recycled to the synthesis section using a high-pressure carbamate pump.

The feedstock consumption figures are almost equal to the stoichiometric values for ammonia and carbon dioxide, leaving no room for further reduction.

The effluent and emission values are extremely low and meet the environmental requirements of most countries.

Process simplicity, with less equipment and fewer process steps than any other process, guarantees high on-stream reliability, ease of operation and low maintenance costs. Furthermore, high capacities are feasible in single-line plants.

Reaction sequences in the urea process

Block diagram of the CO₂ stripping process

![Diagram of the CO₂ stripping process]
Yara Sluiskil, Netherlands
Commissioned by ThyssenKrupp Industrial Solutions in 2011
Capacity: 3,500 t/day of urea solution
The urea process

Synthesis

It is our policy to offer our customers the most reliable synthesis processes based on state-of-the-art technology.

These include:
(see following pages for diagrams)

- Urea 2000plus™ with standard pool condenser.
- Urea 2000plus™ with pool reactor.
- Urea Avancore™ with pool condenser.
- Urea 2000plus™ with pool reactor and MP srubber.

The pool condenser is basically a horizontal reactor vessel with a submerged U-tube bundle. It combines the function of the falling-film-type carbamate condenser in the conventional CO₂ stripping process with part of the reactor function. A 30-40% reduction in the reactor volume is achieved by shifting this reaction volume to the pool condenser.

This is of particular advantage for high-capacity single-train plants since the reactor is one of the heaviest items of equipment.

The pool condenser represents the state-of-the-art concept in modern urea plants.

ThyssenKrupp Industrial Solutions engineered and constructed its first Urea 2000plus™ urea plant with pool condenser for the QAFCO 4 fertiliser complex. The SAFCO IV ammonia/urea fertiliser complex provides ThyssenKrupp Industrial Solutions with a further reference for this technology.

The advantages of Stamicarbon’s proven Urea 2000plus™ technology with pool condenser are:

- Investment cost savings due to the reduction in size of high-pressure items.
- Operational advantages drawn from recent experience with a pool condenser within a synthesis loop, which include:
  - more stable level/pressure control
  - less sensitivity to changes in the load or the N/C ratio.
- A reduced construction height, resulting in reduced construction costs.

A further step towards full integration of equipment items, such as the high-pressure scrubber, the pool condenser and the urea reactor, is the horizontal pool reactor, as used in Stamicarbon’s Urea 2000plus™ with pool reactor technology.

ThyssenKrupp Industrial Solutions was Stamicarbon’s partner of choice in launching this synthesis technology on the market by integrating the world’s first pool reactor into DSM’s new urea plant at Geleen, Netherlands, and commissioning the world’s second pool reactor in 2004. Meanwhile, the world’s biggest pool reactor has been engineered by ThyssenKrupp Industrial Solutions and is expected to come on stream in 2016.

In the synthesis section ammonia and CO₂ are exothermically condensed to ammonium carbamate and the resulting carbamate is endothermically dehydrated to urea and water.

The main quantity of ammonia is fed to the synthesis process via a high-pressure pump. The required carbon dioxide is mixed with a small quantity of air to prevent corrosion and compressed to synthesis pressure in a multi-stage compressor. It is then fed via the stripper into the synthesis section under maintenance of the optimum process conditions of approx. 140 bar and 180°C.
In the proven 2000plus™ process hydrogen is removed from the fresh carbon dioxide feed stream in the H₂ removal reactor located between the compression stages. The synthesis reaction results in a chemical equilibrium; part of the ammonia and carbon dioxide is not converted to urea and water and needs to be removed from the reaction mixture by means of a stripping process, using carbon dioxide to strip off the unreacted ammonia (see page 6). This design feature is highly effective because of its low energy requirement and retention of the unconverted reactants in the synthesis section.

After stripping, the stripper offgas is then introduced into the high-pressure pool condenser together with fresh ammonia and the carbamate solution from the high-pressure scrubber. The heat released by the formation of carbamate in the high-pressure pool condenser is recovered to generate low-pressure steam.

Subsequently, the gas and liquid mixture flows into the urea reactor, in which the main urea formation takes place. The liquid reaction mixture, which leaves the reactor via an overflow, is sent to the top of the stripper.

The exhaust gases (inert gases, NH₃, CO₂ and H₂O) which are separated from the liquid at the reactor top are scrubbed in the high-pressure scrubber with carbamate solution from the low-pressure recirculation section. Thus, most of the gases are recovered and returned to the pool condenser via the high-pressure ejector. The non-condensables withdrawn from the high-pressure scrubber are scrubbed in a low-pressure absorber, thereby minimising ammonia emissions.

The high-pressure sections of recently built urea plants are made of Safurex®, a duplex steel specially developed for the Stamicarbon urea process by Sandvik of Sweden. This steel offers excellent corrosion resistance and high tenacity, as well as the possibility of reducing or omitting the addition of passivation air.

Safurex® is also used systematically in the new Avancore™ process. As passivation air is no longer required, there are the following advantages:

- Lower investment costs
- Reactor can be placed at ground level, resulting in savings due to reduced construction height
- H₂ removal reactor and air blower are no longer needed;
- HP scrubber can be replaced by a much simpler MP scrubber
- Higher safety standard. The formation of explosive gas mixtures at the plant is ruled out as oxygen is no longer added.
Stamicarbon Urea 2000plus™ synthesis with pool condenser

- **Gases**: NH₃, CO₂, Air
- **Liquids**: Urea, Steam, Acid / Salt Solution of acid
- **Steam / cooling water**: UF process water

1. CO₂ compressor
2. H₂ removal reactor
3. HP ammonia pump
4. HP heat exchanger (stripper)
5. HP carbamate condenser (HPCC)
5.a Pool condenser
5.b Pool reactor
6. Reactor
7. HP scrubber
7.a HP scrubber sphere
7.b MP scrubber
8. LP absorber
9. Dissociation heater and separator
10. LP carbamate condenser
11. Level tank for LPCC
12. HP carbamate pump
13. Atmospheric absorber
13.a Acid scrubber
14. Flash tank
15. Pre-evaporator
16. Urea solution tank

Recirculation

- Recycling from granulation

Evaporation

- **Recycle to evaporation**
- **Recycling from granulation**

Stamicarbon Urea 2000plus™ synthesis with pool reactor

1. CO₂ compressor
2. H₂ removal reactor
3. HP ammonia pump
4. HP heat exchanger (stripper)
5. HP carbamate condenser (HPCC)
5.a Pool condenser
5.b Pool reactor
6. Reactor
7. HP scrubber
7.a HP scrubber sphere
7.b MP scrubber
8. LP absorber
9. Dissociation heater and separator
10. LP carbamate condenser
11. Level tank for LPCC
12. HP carbamate pump
13. Atmospheric absorber
13.a Acid scrubber
14. Flash tank
15. Pre-evaporator
16. Urea solution tank

Stamicarbon Urea 2000plus™ synthesis with pool reactor and MP scrubber
Acid AS/AN

Desorption & hydrolysis

Fluid bed granulation

17. Urea solution
18. Evaporator
19. Condenser
20. Flash tank condenser
21. NH₃ water tank
22. Reflux condenser
23. Level tank f. reflux cond.
24. First and second desorber
25. Hydrolyser

26. Urea melt pump
27. Granulator
28. First cooler
29. Bucket elevator
30. Vibrating screens
31. Final cooler
32. Granulator scrubber
32a Granulator scrubber with acid stage
33. Cooler scrubber
34. Roll crusher

Special features for reduction of plant emissions

Acid scrubbing for process vents

Nitric acid + NH₃ → Ammonium nitrate (AN) solution
Liquid fertilizer

OR

Sulphuric acid + NH₃ → Ammonium sulphate (AS) solution

Ammonium nitrate (AN) solution
Liquid fertilizer

UAN solution

Or

Ammonium sulphate (AS) solution

AS crystals or pellets

Incorporation in granules

11
The urea process
Recirculation and evaporation

Only one recirculation stage is required due to the low ammonia and carbon dioxide concentrations in the stripped urea solution.

The ammonia and carbon dioxide still contained in the urea solution discharged by the stripper are recovered in this low-pressure stage. The ideal ratio of ammonia and carbon dioxide in the recovered gases means that dilution by the resulting ammonium carbamate solution is minimised despite the low pressure of around 4 bar. As a result, the carbamate pump requires a much lower capacity and less unwanted water is recycled to the synthesis section.

The urea solution leaving the recirculation section is further concentrated in the evaporation section to meet the requirements of the granulation process. Vacuum evaporation is chosen to minimise biuret formation. A urea solution tank is provided to collect the solution during periodic cleaning of the granulator.

The entire process condensate is collected in a process condensate tank, from where it is sent to the desorption section.
In the first desorber, ammonia and carbon dioxide are expelled from the process condensate. The condensate is then pumped to the hydrolysis column, where any urea that is still present is dissociated. The ammonia and carbon dioxide thus liberated are desorbed in the second desorber with the aid of steam.

The gas leaving the first desorber at the top is fed to the reflux condenser, where the NH₃, CO₂, and H₂O vapours are condensed, and the majority is then pumped to the LP carbamate condenser. The rest is returned to the first desorber.

The process water leaving the second desorber meets even the most stringent statutory environmental requirements, allowing this wastewater to be used as make-up for the cooling water system or even as boiler feedwater. Consequently, there is no wastewater effluent stream from this urea process.
The Stamicarbon Urea 2000plus™ CO₂ stripping process offers a variety of benefits, including lower capital investment and operating costs; a reduction in energy consumption, maintenance costs and emissions; increased efficiency and on-stream time; and improved safety and reliability. These benefits are described in greater detail on the right:

**EASY MAINTENANCE**
The limited amount of equipment and the plant’s compact arrangement greatly facilitate plant maintenance.
Furthermore, our layout guarantees easy access for servicing and maintenance with all rotating equipment located at ground level.

**LARGE SINGLE-STREAM PLANTS**
ThyssenKrupp Industrial Solutions is a world leader in the construction of urea plants and our commitment to providing advanced technology for the future constitutes the driving force behind our in-house research and development:
Over the past four years a daily production capacity of 3,500 t/day of urea solution has become the normal capacity for single-train urea solution plants engineered, built and commissioned by ThyssenKrupp Industrial Solutions.
Engineering studies for even larger plants have already been completed. Single-train capacities of 4,000 t/day and more are technically possible, which means Stamicarbon technology and ThyssenKrupp Industrial Solutions’ know-how are available to build the largest urea plants in the world.
The Abu Qir III plant in Egypt provides a foretaste of the future, since its desorption and hydrolysis section purifies the process condensate from two plants and is equivalent in size to a condensate treatment section of a 3,700 t/day urea plant.

**HIGH SAFETY STANDARDS**
The process feed, in particular CO₂, contains combustibles such as hydrogen. If precautions are not taken, these combustibles can combine with the oxygen in the passivation air to create a highly flammable atmosphere. Although this phenomenon exists in all competitive processes, none use Stamicarbon’s safety precautions, primarily a hydrogen removal reactor and continuous monitoring. Equipment designed to cope with the failure of these eliminates the danger to personnel and equipment.

**LOWER INVESTMENT AND HIGHER RELIABILITY**
SAFUREX®, a new material specially developed for the Stamicarbon process by the company Sandvik, now enables ThyssenKrupp Industrial Solutions to offer its customers an even greater degree of plant reliability.
Its improved corrosion resistance in carbamate solutions and greater resistance to stress corrosion cracking make the new material a perfect choice. In addition, its superior mechanical properties allow wall thicknesses to be reduced without compromising strength. As a synthesis unit made completely of SAFUREX® does not require the addition of passivation oxygen, its efficiency is enhanced and the risk of explosion is eliminated.
SAFUREX® pays off, both in investment and in the service life of your plant.
SAFCO IV is the world’s first plant in which the entire synthesis unit is manufactured from SAFUREX®.

**ON-STREAM TIME**
In today’s competitive market unscheduled downtime is more costly than ever before. Operational simplicity combined with gravity flow, fewer process steps, less synthesis equipment and extremely moderate synthesis conditions facilitate operation and guarantee high on-stream times.
The operating time between planned shutdowns has, in the meantime, been increased to a remarkable four years of operation.
PROCESS EFFICIENCY

The process conditions in the CO₂ stripping process result in an optimum conversion of both reactants, eliminating the need for an MP recirculation section and a pure ammonia recycle.

Stripping with CO₂, which is much less soluble in urea than NH₃, contributes substantially to the extremely low recycle rates.

CO₂ and NH₃ consumption have been reduced to almost stoichiometric values through continuous process improvement with respect to emissions.

LOW CORROSION

The aggressive nature of the process fluids means that the process with the lowest temperature will ultimately create the least corrosive conditions.

Unique preventive process conditions and application of the best available construction materials minimise corrosion and achieve outstanding on-stream factors. There is no need for costly zirconium or titanium materials.

LOW UTILITIES CONSUMPTION

The favourable process conditions allow excellent heat recovery within the urea unit, for instance the recovery of heat released during carbamate condensation.

A steam system integrated into the ammonia complex improves overall utility consumption. Low synthesis pressure, low carbamate recycle and the fact that we do not have a separate ammonia recycle, are all factors which minimise energy consumption.

LOW EMISSIONS

The low NH₃/CO₂ ratio reduces the content of free ammonia in the urea solution, thereby minimising ammonia emissions in the finishing section.

Application of state-of-the-art technology for treating gaseous and liquid effluents ensures minimal environmental impact. The result: a purified process condensate that can be reintroduced as make-up water for cooling water or as boiler feedwater.

SIMPLE OPERATION

The process involves far less equipment and fewer process steps than competitive processes and, with its unique measurement of the NH₃/CO₂ ratio using an advanced density meter, operational comfort is always ensured.

We take full advantage of the advances in computer control technology and supply advanced process control systems to suit the needs of your operators.

To facilitate process handling even further, we also provide operator training on process simulators.

Blocking-in of the synthesis loop during plant shutdown (up to 72 hours) greatly facilitates restart and enables a rapid return to production.

The high pressure centrifugal pumps in ammonia and carbamate service, which were introduced by ThyssenKrupp Industrial Solutions and developed together with Flowserve (Irving, USA), have more than lived up to expectations: In operation at the QAFCO 4 plants since late December 2004, they have proved themselves to be highly reliable and to require minimal maintenance.
The UFT fluid bed granulation process is the leading granulation technology because of its high efficiency and a granulator that ensures excellent product quality with extremely low solids recycle rates. The process offers maximum operating flexibility and reliability as well as minimum maintenance requirements and the need for fewer operating staff. Moreover, the fact that it produces no wastewater and only minimal dust emissions also means it conforms to the most stringent environmental laws, while producing extremely hard, round granules that are resistant to crushing and abrasion. These granules can be produced in a wide range of pre-defined sizes (see page 17 for more details of the advantages.)

This advanced process has enabled the construction of the world’s largest single-train granulation plants with a capacity of 3,850 t/day.

The UFT process comprises the following steps. Formaldehyde is added to the urea melt as a granulation aid before it is injected into the granulator. The granulation mode causes accretion, which means that granules are formed through solidification of the urea melt deposited on the seed material.

Fluidisation air, which is not dehumidified even in very hot, damp climates, is supplied to the product layer through a perforated plate. The granulated product extracted from the granulator is cooled down in the first fluid bed cooler and lifted by bucket elevators to the screening section.

Any oversize material is crushed and returned to the granulator as seeding particles together with any undersize grains.

The specification-grade product is sent to storage after final cooling.

Urea dust entrained in the air from the granulator, the fluid bed coolers and various de-dusting points, is recovered in a scrubbing system.

Process condensate from the desorption section is used as make-up water for the scrubbing liquid, which is recycled to the evaporation section as 45% solution.

Stamicarbon’s granulation technology
In 1995 Stamicarbon introduced its patented granulation technology, which was developed in the 1970s and 1980s. This technology, first applied by ThyssenKrupp Industrial Solutions for three grassroots plants in Egypt, can be offered as an alternative.
The urea process
Features of the UFT fluid bed granulation process

The UFT fluid bed technology is renowned as the most successful granulation process. ThyssenKrupp Industrial Solutions now has unlimited access to this technology, which features the following highlights:

- **Flexibility**
  Its outstanding flexibility allows the production of virtually all requested product size distributions, from an average diameter of 2 to 8 mm, in the same plant without interrupting operation for size change. Adjustable turndown ratios with less than 50% of the nominal capacity are feasible. Furthermore, the granulation unit has simple start-up and shutdown procedures.

- **On-stream time**
  The inherent reliability of the process is largely due to the fact that the granulators have no moving parts, the blowers and fans are only used for the treatment of ambient or scrubbed air and no belt conveyors are required to transport solids within the granulation unit.

- **Emissions**
  A new exclusive cooperation with KIMRE means that an even more cost-effective scrubbing technology is now used to recover the valuable product. The horizontal-type scrubbers allow customised configurations with specially designed scrubbing pads for very high separation efficiency and low pressure drop to meet the most stringent environmental requirements.

- **Large single-train capacities**
  With its compact granulation unit the process is the ideal choice for large single-train urea production plants. The granulation units for SAFCO IV in Saudi Arabia and QAFCO 4 in Qatar are excellent examples with their capacities of 3,600 t/day and 3,500 t/day of urea granules, respectively.

- **High efficiency**
  With its sophisticated product size selectivity, the granulator minimises both the urea recycle and the load for the evaporation section.

- **Product quality**
  The granules produced are of a high quality with a well-rounded shape, and they are very hard and particularly resistant to crushing and abrasion, making them dust free, non-caking and completely free-flowing.

- **The world’s biggest granulation plant**
  The world’s biggest granulation plant already has a capacity of 3,850 t/day.
## Consumption figures and product characteristics

### Feedstock
- **NH₃** (100%) ................................................... kg .............. 564
- **CO₂** (100%) ................................................... kg .............. 730

### Utilities, power and auxiliary materials<sup>(1)</sup>
- Steam (108 bar abs. / 505°C) ................................................................. kg .............. 860
- Cooling water (T = 10°C) ................................................................. m³ .................. 88
- Electric power ................................................................. kWh .................. 58
- Formaldehyde ................................................................. kg .................. 4.5

### Product quality
- N content ................................................................. wt.% .............. 46.2
- Biuret content ................................................................. wt.% .............. 0.8
- Moisture content ................................................................. wt.% .............. 0.2
- Formaldehyde content ................................................................. wt.% .............. 0.45
- Crushing strength ................................................................. kg .............. 3.0 (3.0 mm Ø)
- Particle size (typical) ................................................................. % .............. 90 (2.0-4.0 mm Ø)

### Wastewater quality
- Urea concentration ................................................................. ppm by wt. .............. 1
- Ammonia concentration ................................................................. ppm by wt. .............. 1

### Effluents from granulation
- Urea dust ................................................................. mg/Nm³ .............. 30
- **NH₃**<sup>(2)</sup> ................................................................. mg/Nm³ .............. 30/140

<sup>(1)</sup> Including CO₂ compression

<sup>(2)</sup> With/without acidic scrubbing, which generates a small quantity of ammonium sulphate or ammonium nitrate solution.

All consumption figures are per metric ton of final product and serve as general information only. Local conditions may have a considerable influence on the performance figures.

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The world’s largest urea store at the DAFCO 4 fertiliser complex in Mesaieed, Qatar. With a size of about six football pitches and a capacity of 160,000 tonnes it is truly gigantic.
Fertiliser complex no. 4 (SAFCO IV) for Saudi Arabian Fertilizer Company in Al Jubail, Saudi Arabia

Capacities:
- 3,300 t/day of ammonia
- 3,250 t/day of urea
- 3,600 t/day granulation unit
ThyssenKrupp Industrial Solutions is dedicated to providing its customers with a wide range of services and to supporting them in their efforts to succeed in their line of business.

With our worldwide network of local organisations and experienced local representatives, as well as first-class backing from our head office, we have the ideal qualifications to achieve this goal.

We at ThyssenKrupp Industrial Solutions place particular importance on interacting with our customers at an early stage to combine their ambition and expertise with our experience.

Whenever we can, we give potential customers the opportunity to visit operating plants and to personally evaluate such matters as process operability, maintenance and on-stream time. We aim to build our future business on the confidence our customers place in us.

We provide the entire spectrum of services associated with an EPC contractor, from the initial feasibility study, through financing concepts and project management right up to the commissioning of units and grassroots plants.

Our impressive portfolio of services includes:

• Feasibility studies/technology selection.
• Project management.
• Arrangement of financing schemes.
• Financial guidance based on an intimate knowledge of local laws, regulations and tax procedures.
• Environmental studies.
• Licensing incl. basic/detail engineering.
• Utilities/offsites/infrastructure.
• Procurement/inspection/transportation services.
• Civil works and erection.
• Commissioning.
• Training of operating personnel using operator training simulator.
• Plant operation support/plant maintenance.
• Remote Performance Management (Teleservice).

We like to cultivate our business relationships and learn more about the future goals of our customers. Our after-sales services include regular consultancy visits which keep the owner informed about the latest developments or revamping options.

Our policy is to ensure utmost quality in the implementation of our projects. We work worldwide to the same quality standard, certified according to:

DIN / ISO 9001 / EN29001.

We remain in contact with our customers even after project completion. Partnering is our byword.

By organising and supporting technical symposia, we promote active communication between customers, licensors, partners, operators and our specialists. This enables our customers to benefit from the development of new technologies and the exchange of experience as well as troubleshooting information.

ThyssenKrupp Industrial Solutions stands for tailor-made concepts and international competence.

For more information contact one of the ThyssenKrupp Industrial Solutions offices near you or visit our website:

www.thyssenkrupp-industrial-solutions.com
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<td>Urea plant Granulation</td>
<td>Urea solution Urea granules</td>
<td>3,450 t/d 3,450 t/d</td>
<td>Stamicarbon UFT</td>
</tr>
<tr>
<td>2011</td>
<td>Yara Sluiskl B.V.</td>
<td>Sluisk, Netherlands</td>
<td>Urea plant</td>
<td>Urea solution</td>
<td>3,500 t/d</td>
<td>Stamicarbon Turnkey</td>
</tr>
<tr>
<td>2008</td>
<td>Misr Oil Processing Co</td>
<td>Damietta, Egypt</td>
<td>Urea plant Granulation</td>
<td>Urea solution Urea granules</td>
<td>1,925 t/d 2,000 t/d</td>
<td>Stamicarbon UFT</td>
</tr>
<tr>
<td>2007</td>
<td>Helwan Fertilizer Co.</td>
<td>Helwan, Egypt</td>
<td>Urea plant Granulation</td>
<td>Urea solution Urea granules</td>
<td>1,925 t/d 2,000 t/d</td>
<td>Stamicarbon Turnkey</td>
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<td>2006</td>
<td>Egyptian Fertilizer Co. (EFC II)</td>
<td>Ain Sukhna/ Suez, Egypt</td>
<td>Urea plant Granulation</td>
<td>Urea solution(1) Urea granules(2) expansion to 2(2)</td>
<td>1,925 t/d 2,000 t/d 2,250 t/d 2,250 t/d</td>
<td>Stamicarbon UFT</td>
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<td>Alexandria Fertilizer Co. (AlexFert)</td>
<td>Alexandria, Egypt</td>
<td>Urea plant Granulation</td>
<td>Urea solution Urea granules</td>
<td>1,925 t/d 2,000 t/d</td>
<td>Stamicarbon Turnkey</td>
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<tr>
<td>2006</td>
<td>Saudi Arabian Fertilizer Company (SAFCO IV)</td>
<td>Al Jubail, Saudi Arabia</td>
<td>Urea plant Granulation</td>
<td>Urea solution Urea granules</td>
<td>3,250 t/d 3,600 t/d</td>
<td>Stamicarbon UFT</td>
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<tr>
<td>2004</td>
<td>Turkmenokunhiyamiya via Gap Insaat</td>
<td>Tecen, Turkmenistan</td>
<td>Urea plant Granulation</td>
<td>Urea solution Urea granules</td>
<td>1,050 t/d 1,050 t/d</td>
<td>Stamicarbon UFT</td>
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<td>Qatar Fertilizer Company (QAFCO 4)</td>
<td>Masaideed, Qatar</td>
<td>Urea plant Granulation</td>
<td>Urea solution Urea granules</td>
<td>3,200 t/d 3,500 t/d</td>
<td>Stamicarbon Turnkey Pool condenser</td>
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<tr>
<td>2004</td>
<td>ASEAN Bintulu Fertilizer Sdn Bhd (ABF)</td>
<td>Bintulu, Malaysia</td>
<td>Urea plant Granulation</td>
<td>Urea solution Expansion by Urea granules Expansion by</td>
<td>2,250 t/d 2,400 t/d 446 t/d 550 t/d</td>
<td>Stamicarbon UFT</td>
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<td>2003</td>
<td>Qatar Fertiliser Company (Qafco 3)</td>
<td>Masaideed, Qatar</td>
<td>Urea plant Granulation</td>
<td>Urea solution Expansion by Urea granules Expansion by</td>
<td>3,000 t/d 3,000 t/d 1,000 t/d 800 t/d</td>
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</tr>
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<td>Egyptian Fertilizer Co. (EFC I)</td>
<td>Ain Sukhna/ Suez, Egypt</td>
<td>Urea plant Granulation</td>
<td>Urea solution(1) Urea granules(2) expansion to 2(2)</td>
<td>1,925 t/d 2,000 t/d 2,250 t/d 2,250 t/d</td>
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<td>Gibson Island, Australia</td>
<td>Urea plant Granulation</td>
<td>Urea solution Urea granules</td>
<td>740 t/d 950 t/d</td>
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<tr>
<td>1999</td>
<td>Incitec Ltd.</td>
<td>Donaldsonville, USA</td>
<td>Urea plant Granulation</td>
<td>Urea solution Urea granules</td>
<td>2,000 t/d 2,000 t/d</td>
<td>Stamicarbon UFT</td>
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<tr>
<td>1998</td>
<td>CF Industries Inc. (CFI)</td>
<td>Donaldsonville, USA</td>
<td>Urea plant Granulation</td>
<td>Urea solution Urea granules</td>
<td>2,000 t/d 2,000 t/d</td>
<td>Stamicarbon UFT</td>
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**Legend:**
- **E**: Engineering
- **P**: Procurement
- **C**: Construction