

STAMI UREA LAUNCH

Creating your plant



STAMI UREA



HOW CAN WE HELP YOU?

We help you
find the right
technologies.





INTRODUCTION

Stamicarbon is the **world market leader in designing, licensing and developing urea plants**. Through our Stami Urea business unit we apply our expertise, knowledge and experience to help you find the right fertilizer production technologies, emission reduction technologies and all technologies

for the integration of urea and adjacent processes. Moreover, we are beside you every step of the way: from creating a new plant to optimizing and upgrading existing facilities in light of a sustainable and futureproof production. We are there throughout your plant's entire life cycle.

LICENSING STATE-OF-THE-ART UREA PLANTS

When it comes to creating a urea plant, our engagement and commitment does not stop after signing the contract and building your plant. We have developed an extensive technology, product and service portfolio for urea plants. We distinguish ourselves from the competition with our high-quality standards and our **Full Life Cycle philosophy**.

Enjoy a full service

With continuous **support through the whole life cycle of your plant**, regardless of what stage your plant is at, we offer you bespoke technological solutions, products and/or services that match your requirements. We offer a **set of three series** that suit a wide range of real world specifications. We call these our **LAUNCH, ADVANCE and EVOLVE** series. Your plant's life cycle starts with

We offer you technological solutions, products and/or services that match your requirements.

launching the design, executing the engineering, procurement and finally, construction of your plant. After the **LAUNCH** phase of the plant, you enter into the next stage – **ADVANCE**. Our products and services optimize the plant's performance. Furthermore, we provide you with the knowledge and latest designs in urea technology to upgrade your plant to **EVOLVE** to the next level.

LAUNCH™

Creating your plant

Launch a new plant, with all the technologies, products and services needed for successful, sustainable and profitable urea production.

Solutions for melt synthesis

Solutions for urea finishing

ADVANCE™

Optimizing your plant

Advance your plant performance, reduce downtime, improve product quality and increase efficiency with these products and services:

Support and plant staff training

Optimizing plant output and operation control

Improving product quality

Improving safety and environmental impact

Inspections and plant maintenance

EVOLVE™

Upgrading your plant

Evolve your plant to the next level with revamp and debottlenecking:

Increase product capacity

Reduce emission output

Reduce energy consumption



We support the full life cycle of a urea plant.



LAUNCHTM

Our LAUNCH series is a group of technologies, products and services that ensure an effective design and optimal development of a new urea plant. From the moment you start to investigate the possibilities of building a urea plant, there are several economic and technical choices to be considered. We will support you in this orientation phase and will be your partner throughout the whole journey of process design, project management through to plant start-up. When your plant is up and running you are able to produce the highest quality urea.

INTRODUCING A FULL START-UP SERVICE FOR UREA PLANTS

1

Full start-up service

We support you all the way in launching your urea plant. From project development to feasibility services and the design of a technical solution that fits your needs. We provide you with a full start-up service. Customized training courses included.

2

Melt technologies

Increased plant efficiency reduced operating and maintenance costs and minimized plant emissions. Our solutions for melt synthesis like our Pool Condenser Design, Pool Reactor Design and Ultra Low Energy Design result in direct gains.

3

Finishing technologies

From our three different finishing technology solutions, our most important one is a state-of-the-art fluid-bed granulation technology to produce tailor-made high-quality urea granules. Next, we also have solutions for prills and pastilles as well as liquids.

Since the 1950s we designed and installed more than 225 urea melt plants worldwide.



A FULL START-UP SERVICE



LAUNCH SUPPORT SERVICE

In general, we offer various solutions for melt synthesis and urea finishing. But let's start with showing you **how we can support you in launching a urea plant**. After all, it takes lots of preparation, the right insights and experience to make this process run smoothly. An overview of our services.

Project Development

Whether you work with a government seeking to monetize natural gas resources or secure national fertilizer supply, or individually you are interested to diversify your business activities, you will need to make two fundamental decisions – what to invest in and where. Fertilizers may be a lucrative option; for many an ammonia-urea plant, in particular, has shown a good return on investment; after all, urea is the world's most used fertilizer. From the outset, we like to be engaged in the development of your urea plant project.

Our activities can include **researching project feasibility, exploring conceptual plant designs, evaluating investment cost, identifying equity/debt financing possibilities and assessing Return-On-Investment**. We are able to identify and involve relevant parties in the value chain and support the permitting process to successfully guide the urea plant construction project.

Feasibility Studies

We can conduct feasibility studies (including Front End Engineering and Design) from a market, logistical, regulatory, economic and technical perspective.

These studies will result in a **thorough understanding of the technical and economic viability** of your urea project which is important for the bankability and final investment decision.

Technical & Commercial

Based on the plant's feasibility study, we design a **technological solution** that best fits your needs. A **commercial proposal** will be generated containing the technology specifications, prices, guarantees and conditions of use.

Proposal Process Design & Basic Engineering

Based on your technology choice we work on a comprehensive **Process Design Package (PDP)** and **Basic Engineering**

Package (BEP). This contains all engineering specifications and criteria to enable your Engineering Procurement and Construction (EPC) contractor to make the detailed engineering and build your plant.

Our design package includes amongst others:

- Process basis of design
- Material balance, steam balance and cooling water balance
- Piping and instrumentation diagrams (PID's)
- General design and material specifications
- Equipment data sheets
- Process flow diagrams
- Equipment & piping specifications
- Instrumentation & electrical specifications
- Design HSE and safety criteria
- Civil and structural design criteria
- Plot Plan
- Operating & Analysis Manuals

Our equipment supply services are based on outstanding design and engineering expertise.

Proprietary Equipment

The design of proprietary high-end equipment needs to be superior to secure the **best performance of your plant and a long operating lifetime**. Our equipment supply services are based on outstanding design and engineering expertise, combined with in-depth knowledge of the fabrication process for which we only work with first-rate vendors qualified by us. By maximizing on the integration of our work process with the work process of the vendor, we can offer the shortest delivery times possible.

Detailed Engineering, Procurement & Construction

We can support you with our **network of licensed contractors** that have a wealth of experience in implementing our state-of-the-art technology. As an independent licensor and partner in related services, we cooperate with many contractors around the globe. During the EPC phase, we support you in reviewing design documents and HAZOP activities.

Pre-Commissioning

During the pre-commissioning stage our engineers complete a **thorough check** to ensure that everything has been built

according to the Process & Instrumentation Design specifications (P&IDs). Amongst others we check the physical layout of the plant, accessibility, logics, water-based flushing and metering. Finally, we support you in the first start-up of the urea plant up to full capacity and completion of the acceptance test.

Training

Competent and skilled personnel are key to a successful operation. We conduct various **customized training courses** for operators and the maintenance crew on site or at our premises.



MELT TECHNOLOGIES

SOLUTIONS FOR MELT SYNTHESIS

Stamicarbon is well known for its technology solutions, for example, the invention of the **CO₂ stripping process** in the 1960s. More, we are dedicated to continuously improve and innovate our technologies. This has inspired us to develop melt technology solutions that best matches your needs, in terms of capacity size, CAPEX and OPEX.

Let's keep it simple

As you will see, our CO₂ stripping process designs simplify your plant's overall design. Capital investment is reduced due to the **compact designs that require less equipment**. This makes the process easier and more stable, and your plant much less maintenance intensive. Take a look.

Designed to your needs

Our LAUNCH MELT™ series not only help you to reduce investment. They also **increase plant efficiency, reduce operating and maintenance costs and minimize plant emissions**. In other words, our LAUNCH MELT™ series greatly improve operability and reliability, plus guarantee maximum production output over the full lifetime of the plant. Depending on your capacity requirements, we offer **three designs** based on well-established technology with an extensive proven track record.



Your benefits

- Easy and stable plant operation due to pool condensation principal pool reactor
- Well established technology with an extensive proven track record
- Compact and low elevation plant design results in lower construction costs
- Easier maintenance and longer time between turn arounds with significant reduction on corrosion issues with Safurex®
- Suitable for any type of plant capacity (suitable for low and highest single line capacities)

LAUNCH MELT™

Pool Condenser Design

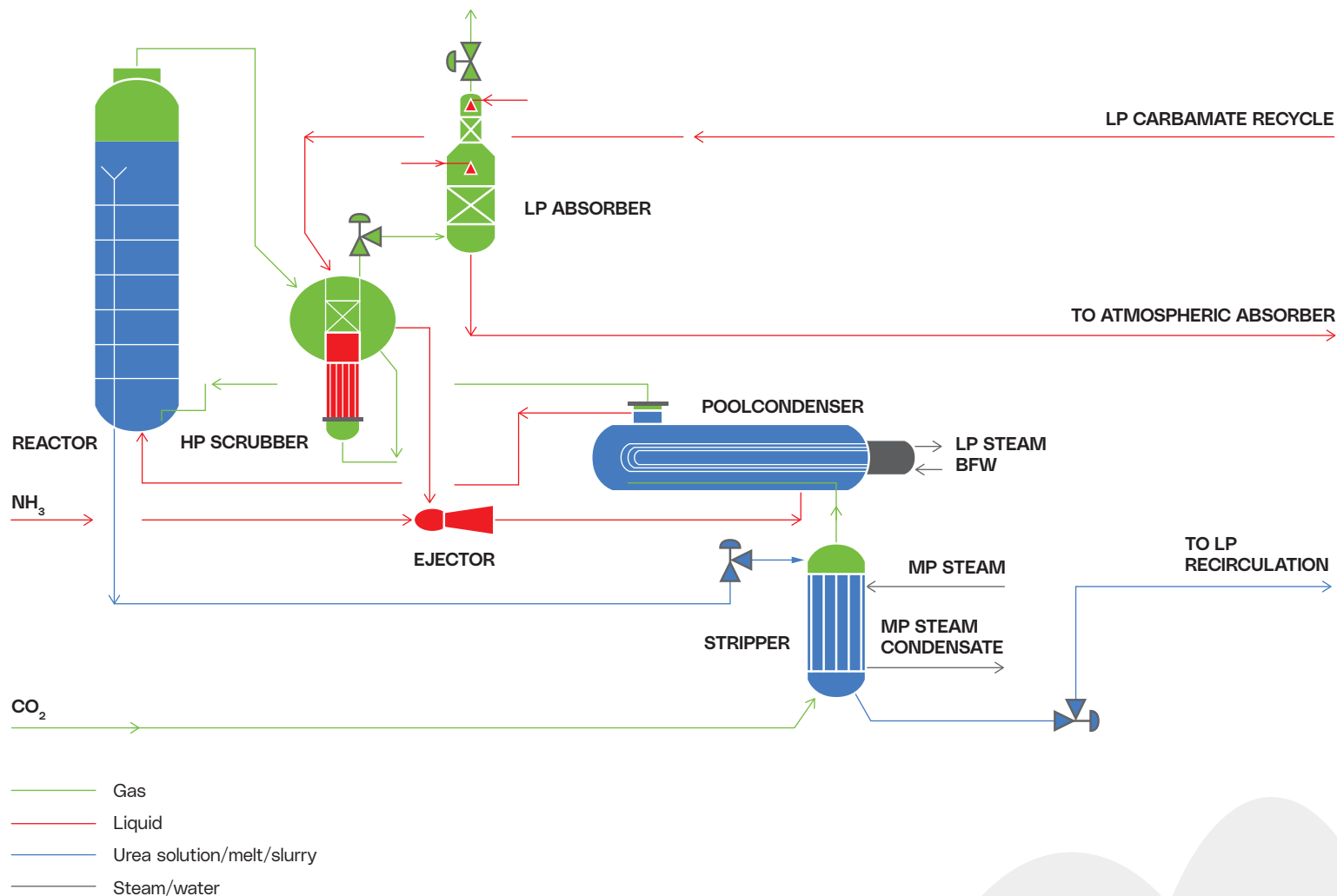
This widely used design guarantees **optimal heat transfer, excellent process stability and high onstream time**. It includes a high-pressure pool condenser combined with a relatively short vertical reactor. If you want the most efficient technology for capacities from about 2500 up to 6000 metric tons per day (mtpd), this is it!

How does it work?

Ammonia and carbon dioxide are introduced to the high-pressure synthesis using a high-pressure ammonia pump and a carbon dioxide compressor. The ammonia then drives an ejector, which conveys the carbamate solution from the high-pressure scrubber to the pool condenser. In the high-pressure stripper, the carbon dioxide, entering the

synthesis as a feed, flows countercurrent to the urea solution leaving the reactor. On the shell side, the high-pressure stripper is heated with steam. The off-gas of the high-pressure stripper, containing the carbon dioxide, together with the dissociated carbamate, is then fed into the pool condenser, where ammonia and carbon dioxide are condensed to form carbamate. The heat released by condensation and subsequent formation of carbamate is used to produce re-usable low-pressure steam. After the pool condenser, the remaining gases and a liquid containing urea and carbamate enter the vertical reactor. Here, the final part of the urea conversion takes place. The urea solution then leaves the top of the reactor (via an overflow funnel)

before flowing back into the high-pressure stripper. Ammonia and carbon dioxide conversions in the synthesis section of a Stamicarbon carbon dioxide stripping plant, are particularly high. As a result of that, our CO₂ stripping process is the only commercially available process that does not require a medium-pressure recirculation stage downstream from the high-pressure stripper. Gases leaving the reactor are fed into the high-pressure scrubber. Here, the gases are washed with the carbamate solution from the low-pressure recirculation stage. The enriched carbamate solution is then fed to the high-pressure ejector and, subsequently, to the pool condenser. Inert gases, containing some ammonia and carbon dioxide, are then released into the 4-bar absorber.



LAUNCH MELTTM

Pool Reactor Design

Looking for a **low-height plant design with a minimal amount of piping and high-pressure equipment**? This specific design integrates the pool condenser and a vertical reactor into one piece of equipment: the pool reactor. It is perfectly suited for smaller capacities up to about 2500 metric tons per day (mtpd).

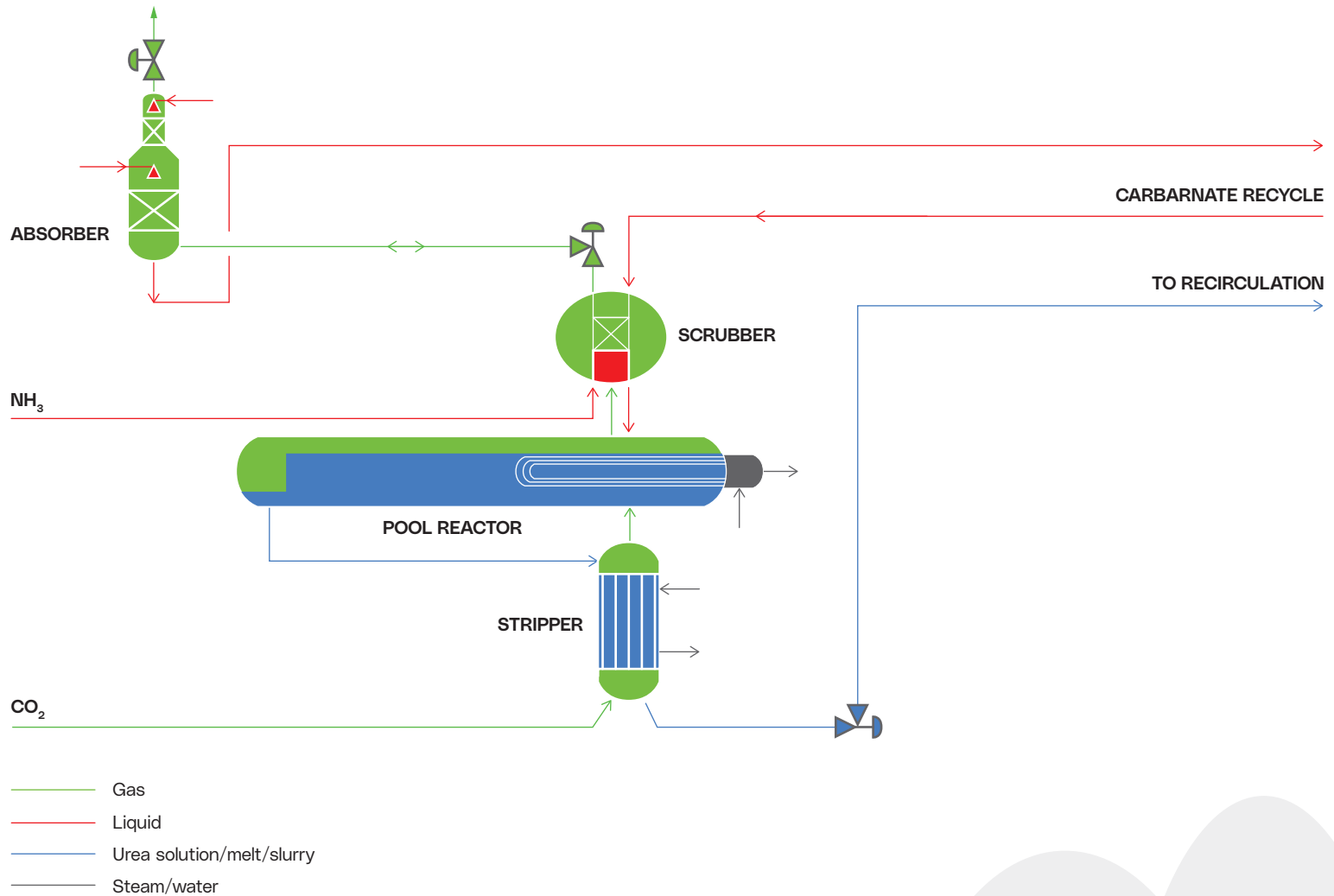
How does it work?

Unlike the Pool Condenser concept, the Pool Reactor concept combines the condenser

and reactor in a single pool reactor. This is achieved by enlarging the horizontal condenser so as to incorporate additional reactor volume. As a result, it becomes possible to achieve sufficiently high residence times, eliminating the need for a separate vertical reactor, while creating the conditions that will allow the reaction to reach its optimum condition with the advantage of having a plant height of about 30 meters. The high-pressure scrubbing operation can also be simplified in the Pool

Reactor concept by placing the scrubber sphere above the pool reactor and adding the ammonia to the synthesis via this scrubber. This ensures that no separate heat exchanging section in this scrubbing operation is required. In the Pool Reactor concept, carbamate from the low-pressure recirculation section flows together with the absorbed gases and the ammonia into the pool reactor. As the static liquid height ensures gravity flow, no high-pressure ejector is needed.

It is perfectly suited for smaller capacities.



LAUNCH MELTTM

Ultra Low Energy Design

With this unique plant design, based on years of experience and using industrially proven elements, we minimize the steam intake of the urea plant to an unprecedented lower level. This results in **the most energy efficient design available on the market** (HP steam consumption less than 566 kg/ton). The perfect solution for locations where the cost of energy is high. In fact, our Ultra Low Energy design results in overall reduction in the investment costs of the urea section.

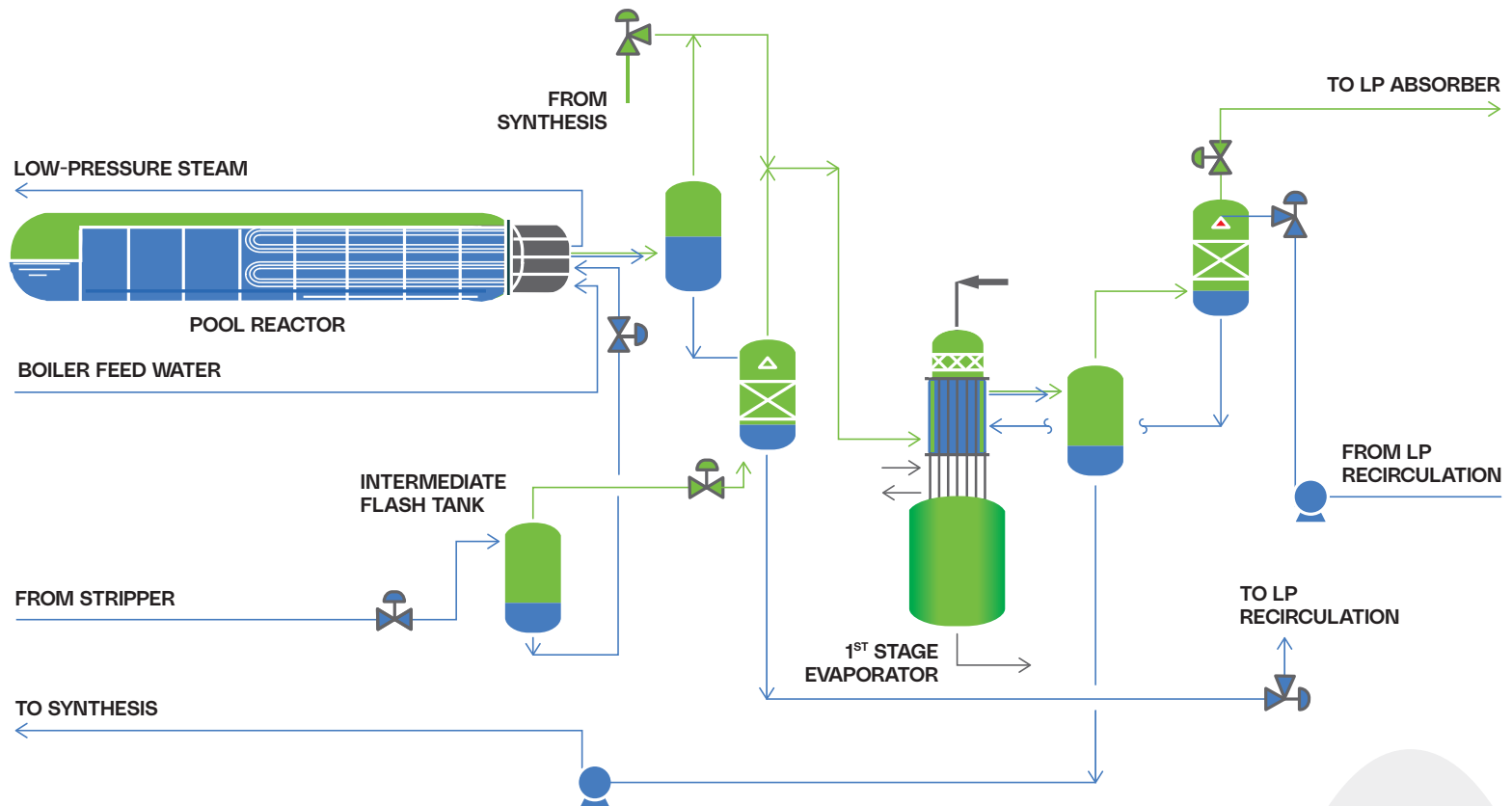
How does it work?

The Ultra Low Energy Design solution substantially reduces the steam and cooling water consumption of our CO₂ stripping urea plant. How? By direct heat integration between the high-pressure condenser and the medium pressure rectifying heater followed by direct heat exchange between the medium pressure condenser and the first-stage evaporator heater.

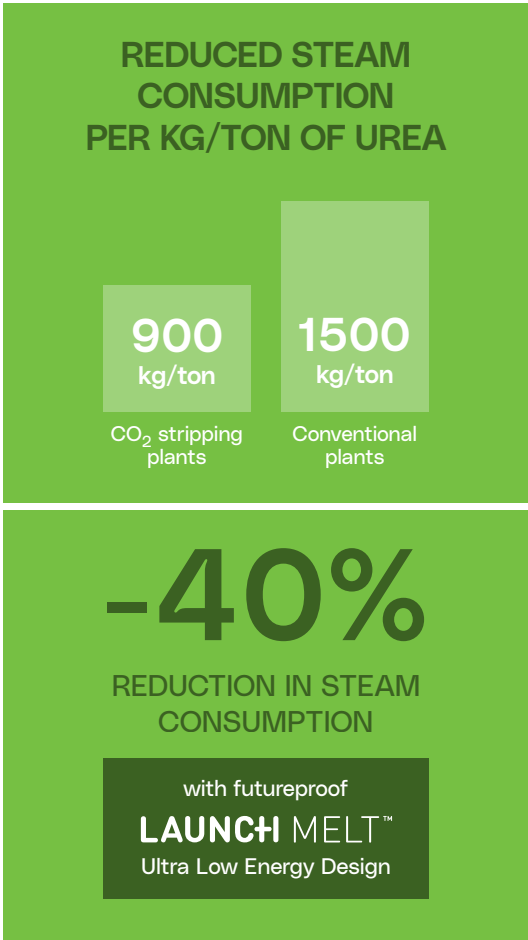
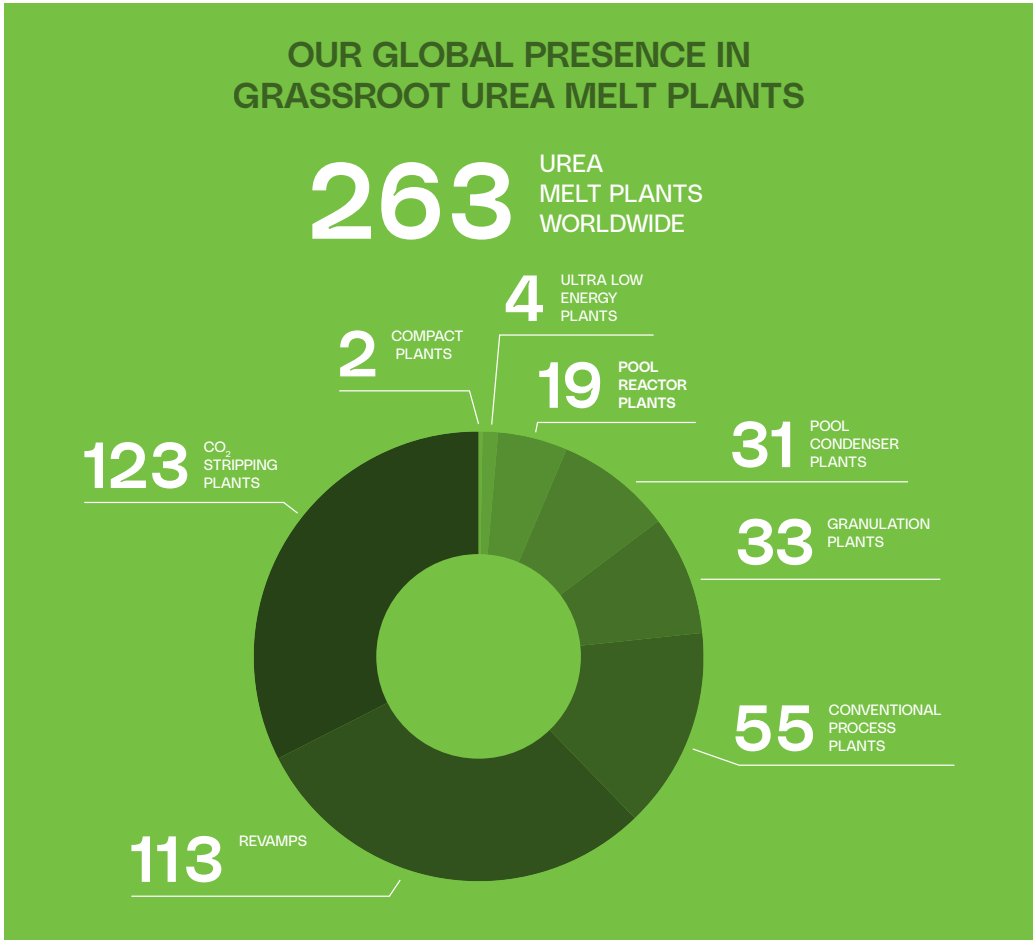


Your benefits

- Lowest steam consumption
- Lowest cooling water consumption
- Easy to operate
- Reliable
- Lower overall investment costs for the urea section



Synthesis technologies facts & figures







FINISHING TECHNOLOGIES

We produce tailor-made urea granules of the highest possible quality.





SOLUTIONS FOR UREA FINISHING

Depending on your market needs, we offer three different finishing technology solutions. Our most important one is a proven, state-of-the-art **fluid-bed granulation technology**

to produce tailor-made urea granules of the highest possible quality. Besides that, we also have solutions for **prills and pastilles** as well as **liquids**.



1

GRANULATION DESIGN

Fact: There is a need for large volumes of exportable granules with **low formaldehyde content**, **low environmental emissions** and **high on-stream time**.

Our proven granulation technology answers this need. Granulation is regarded as the best suited end-product for export purposes and storage in large quantities, because of its higher crushing strength, low caking tendency and lower dust formation. Our fluid-bed granulation technology produces a superior product that complies with all

required product quality standards. The key to our technology success is the minimum amount of formaldehyde used, allowing for substantial savings. Thanks to the film-spraying nozzles our design has the world's lowest dust production, ensuring less fouling and long production times between the cleaning cycles. In other

words: less down-time required for clean-ups, high on-stream time (more than 150 days). Furthermore, thanks to our unique proprietary scrubbing design, this urea granulation solution meets the lowest plant emissions available on the market.



Your benefits

- Large reductions in formaldehyde consumption compared to other fluid-bed granulation technologies, making it more cost effective.
- Unprecedented uninterrupted run times, which exceeds 150 days before washing of the granulator is required due to less dust formation owed to the applied film spray nozzles.
- Unmatched, low dust and ammonia emissions from the granulation vent stack, meeting the most stringent environmental emission standards.
- Minimum equipment requirement, resulting in reduced CAPEX and less maintenance costs.
- Low urea dust formation, resulting in a lower wet-recycle, resulting in lower OPEX costs.

Our fluid-bed granulation technology produces a superior product that complies with all required product quality standards.

How does it work?

The heart of the granulation is the fluid-bed granulator. Here, urea melt with a urea concentration of 98.5 wt.% is introduced via multiple spray nozzles and deposited on the seed particles/granules in the fluid bed. The Stamicarbon nozzles ensure that the urea melt is sprayed in the form of a film, which has the benefit that only 0.3 wt.% or less of formaldehyde needs to be dosed to the urea melt. A continuous stream of secondary air is introduced via a ring in each spray nozzle and takes care

of transport of the seeds/granules through the urea melt-film. The fluid-bed granulator is divided in multiple granulation sections in which urea melt is introduced via nozzles and cooling sections in which the formed granules are cooled down, for further processing. As the granules move through the granulation section, their size steadily increases by layering until they reach the required granule diameter. Fluidization air is distributed over the granulation sections and cooling sections. The granules leaving the granulator pass a safety screen (to remove

lumps/agglomerates) and are transported by a bucket elevator to the main screens where the granules are separated in three fractions. The in-spec product is cooled and transported to storage. After cooling and crushing, the coarse product, together with the fines from the main screens, is sent back to the granulator as seed-material for granulation. The fluidization and secondary air are exhausted from the granulator and sent to a dust/ammonia scrubber.

The Stamicarbon nozzles ensure that the urea melt is sprayed in the form of a film.

2

PRILLING DESIGN

Prilling is the most cost-effective method of finishing and very suitable for local product distribution. Stamicarbon designs rotating prilling buckets, through which the liquid urea droplets are evenly distributed in the prilling tower, crystallizing to become prills when falling down in countercurrent with the prevailing air draft. Using an optional technique of seeding, the impact-strength can be enhanced even further, leading to better resistance to degradation during product handling.

3

PASTILLATION DESIGN

An enriching addition to the traditional finishing techniques is the Rotoformer® pastillation process designed by Sandvik Process Systems, which we can handily integrate with your urea plant. The pastilles can be produced at low investment costs, low operating costs and with a minimum of emissions. Moreover, as pastillation is already economically feasible at small capacities starting from 120 mtpd, and is ideally suited for producing specialty fertilizers and technical urea.





WE SHARE OUR KNOWLEDGE WITH YOU

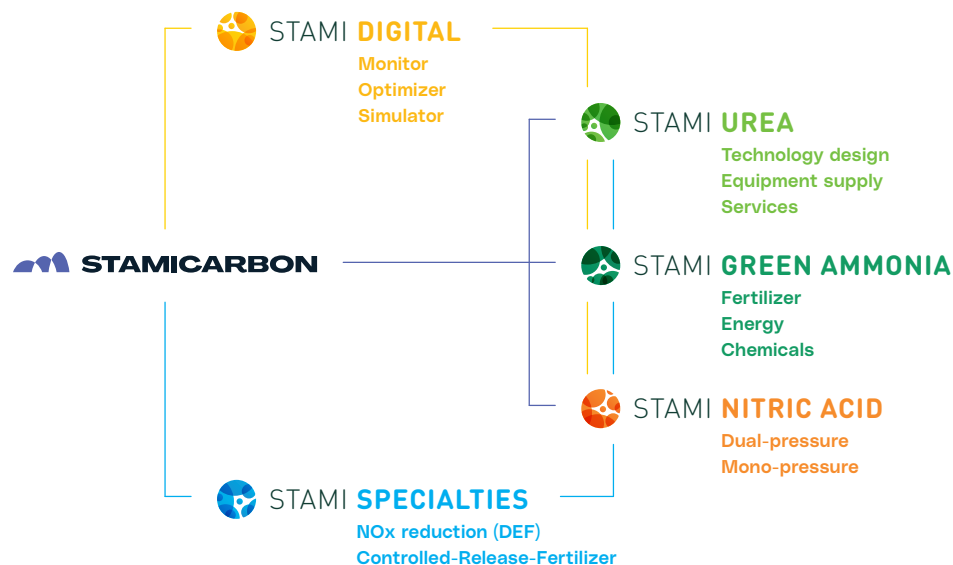
CONCLUSION

Our solutions are built on 75 years of high-quality research and in-depth industry knowhow. We work closely with the entire value chain to improve and innovate our technologies. As the world's leading urea authority, we show our commitment to driving the long-term success of the industry by sharing our insights, solutions and knowledge.

Get more insights

Brochures, papers and other information published over many decades are available at www.stamicarbon.com.

We also share our knowledge at various conferences to keep you up to speed on the latest developments in urea.



Contact us

Interested in advancing your plant?
We look forward to discussing your requirements and putting together a personalized proposal.

WE ARE STAMICARBON

Stamicarbon is the Nitrogen innovation and license company of the MAIRE Group. We are a trailblazing specialist in the fertilizer industry, with the vision needed to help feed the world and improve everyone's quality of life. As a global leader in fertilizer technologies, we have licensed more than 260 urea plants and completed more than 110 revamping and optimization projects.

Our leading position is based on more than 75 years' licensing experience and maintained by continuous innovation in terms of technologies, products and materials. Headquartered in Sittard, the Netherlands, Stamicarbon has a sales office in the USA and representative offices in Russia and China. For more information, see www.stamicarbon.com.

WHAT CAN WE DO FOR YOU?

Any questions about Stami Urea? Like to know how our expertise, knowledge and experience creating, optimizing and upgrading fertilizer plants can help you make the switch to sustainable, futureproof production? We are here for you. Contact our experts at www.stamicarbon.com.



Stamicarbon

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