STAMICARBON: ENABLING THE WORLD TO FEED ITSELF

Company introduction

ECRI Meeting, Nov. 30th, Amsterdam
Huug Bischoff, VP Technology
GLOBAL CHALLENGE: INCREASING POPULATION, INCREASING FOOD DEMAND

The challenges:

• Population will grow to about 9 billion by 2050. Arable land can’t be expanded to the same extent.
• Growing prosperity worldwide needs six times more fertilizer for rice and grain.
• More people means more pollution.

What needs to be done:

• Enhancing agricultural production.
• Increasing crop yields and farming in more sustainable ways.
• Improving air quality.

Urea can help solve these challenges by:

• Increasing crop yields.
• Improving air quality using urea as a NO\textsubscript{X}-reduction agent in DEF/AdBlue®.
Fertilizers

- Nutrients have specific and essential functions in plants’ metabolism
- There are three main primary nutrients
  - Nitrogen (N)
  - Phosphorus (P)
  - Potassium (K)

Nitrogen is the main driver of crop yield

Key Global Fertiliser Products | Production

- Nitrogen (N) | 113 MT
- Phosphorus (P₂O₅) | 44 MT
- Potassium (K₂O) | 34 MT

THE UREA MARKET

• Urea is a widely produced chemical (>170 million t/y).

• Synthesized from ammonia and carbon dioxide and mainly used as fertilizer (>80%).

• The most used fertilizer in the world, due to:
  • the highest nitrogen content (46%).
  • the lowest transportation cost.

• Other applications are feedstock for resins, melamine, biofuels, cattle feed, pharmaceutical applications and NO\textsubscript{x} reduction fluids.
UREA: FROM PLANT TO PLANT

$\text{NH}_3 \rightarrow \text{Plant} \rightarrow \text{CO}_2 \rightarrow \text{UREA} \rightarrow \text{H}_2\text{O} \rightarrow \text{Plant}$
MANUFACTURING UREA

- **Gas / Coal** (CH\textsubscript{4})
- **Water** (H\textsubscript{2}O)
- **Air** (O\textsubscript{2})

Syngas (H\textsubscript{2}+CO)

- **Ammonia** (NH\textsubscript{3})

Nitric Acid (HNO\textsubscript{3})

- **Nitro-benzene**, TDI, adipic acid, etc.

Hydrazine, hydrogen, cyanide, phenol, amino acids, etc.

- **Urea**

- **UAN**

- **AN**

Melamine, DEF, Resins

Fertiliser application

Explosives

Nitro-benzene, TDI, adipic acid, etc.

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# APPLICATIONS OF UREA

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<th>% of total</th>
<th>Comments</th>
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| Fertiliser   | ![Fertiliser](image) | • Use of urea as fertiliser for plants  
• Provides the most nitrogen at the lowest costs for farmers  
• Manually distributed or scattered with the aid of farming equipment |
| Resins       | ![Resins](image) | • Urea is the base material for production of melamine  
• Melamine and urea are both used as a base product in the manufacture of resins which are used by the wood industry as adhesive and glues in furniture and buildings |
| Feed         | ![Feed](image) | • Use of urea as a protein supplement in cattle feed or as feedstock for other animals  
• The nitrogen in urea generally aids animal growth |
| SCR (Selective catalytic reduction) | ![SCR](image) | • Using urea in SCR lowers NOx emissions from on- and off- highway vehicles, as well as for stationary engines such as power stations, industrial boilers and incinerators  
• SCR is also useful in meeting greenhouse gas targets |
| Other        | ![Other](image) | • Pharmaceutical/ cosmetic uses of urea include: hair conditioning, facial cleaners and teeth-whitening products  
• Urea is sometimes found in cigarettes as an enhancer of flavour |
US, India and Brazil major import countries (41%). Continuing strong Chinese exports in 2015 as a result of low coal prices and devaluation Renminbi
As the market leader in urea fertilizer technology licensing, Stamicarbon has designed >50% of the world’s urea plants.
• Stamicarbon is the leading technology provider and licensing company of the **Maire Tecnimont Group**, a top level international player in Engineering & Construction, Technology & Licensing, Energy Business and Development & Ventures.

• The Maire Tecnimont Group is focused on plants for the hydrocarbon processing industries (Oil & Gas, Petrochemicals and Fertilizers), with competences in Power Generation and Infrastructure.

• Listed on the Milan Stock Exchange and headquartered in Milan, with presence in over 30 countries. It controls 45 operating companies around the world and can count on approx. 4,300 employees.
STAMICARBON: ALMOST 70 YEARS IN LICENSING TECHNOLOGIES, 60 YEARS OF UREA EXPERIENCE

1947
Foundation of Stamicarbon; licensing of coal washing plants, eventually specializing in fertilizers and urea

1956
Flagship urea plant commissioned in Geleen, the Netherlands

1957
First urea license sold to Soc. Carbochimique, Tertre, Belgium

1964
Expansion into chemicals: First caprolactam license granted in Russia

1965
Licensing of first Stamicarbon urea CO2 stripping plant

1970s
High and low-density polyethylene licensing

1970s-1990s
Plant Management Consultancy introduced

1990s
New technologies:
• Pool Condenser & Reactor Design
• Safurex® steel
• Stamicarbon fluid-bed granulation technology

2000
Mega Plant concept for production capacities up to 6000 mt/d

Today
Stamicarbon is the global leading player with a >50% market share in urea licensing technology

December 1, 2016

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ABOUT US: STAMICARBON

• We are world leaders in the licensing and design of urea plants, including the supply of proprietary equipment, and related services.

• Active in licensing of various technologies and in project development.

• A pioneering company with a single-minded vision to help enable the world to feed itself and improve quality of life.
STAMICARBON: A RENOWNED REPUTATION GLOBALLY
MORE THAN 250 LICENSES SOLD AND OVER 65 YEARS OF EXPERIENCE

Licenses sold

Stamicarbon Offices
 ABOUT US: WHAT WE DELIVER

1. **Outstanding technology, materials & high quality standards by passionate people**
   - Experienced, skilled and passionate engineers, striving for the best solution to your needs, enabling us to be the leader in innovation.
   - Best corrosion-resistant material for HP synthesis: Safurex®.
   - Simple & reliable design thanks to unparalleled synthesis conversion.
   - Granulation technology with the lowest emissions and longest on-stream times.

2. **Our full life cycle philosophy**
   - Deliver continuous support during the entire life cycle of your urea plant.
   - Provide tailored advice to create new plants, optimize existing plants and upgrade older plants.

3. **Renowned reputation globally**
   - Largest number of references: licensed over 250 urea plants worldwide with a 50% world market share in urea licensing.
   - Over 65 years of proven experience in designing and innovating the urea manufacturing process.
   - Cooperationships with contractors globally and with a variety of renowned ammonia licensors.
ABOUT US: OUR FULL LIFE CYCLE PHILOSOPHY

Creating your plant
Launch a new plant with all technologies, products and services needed for a successful and profitable urea production

Optimizing your plant
Advance your plant performance with products and services to support and train your plant staff, replace equipment and improve product quality

Upgrading your plant
Evolve your plant to the next level with revamp and debottlenecking to increase production capacity and reduce energy consumption
LAUNCH- SERIES: CREATING YOUR PLANT

- Project Development
- Feasibility Studies
- Technical & Commercial Proposal
- Process Design & Basic Engineering
- Equipment Supply & Design Services
- Engineering, Procurement & Construction
- Commissioning & Start-up

December 1, 2016
ADVANCE- SERIES: OPTIMIZING YOUR PLANT

Enhancement of Safety & Reducing the Environmental Impact

Maintenance of Plant & Equipment Renewal

Improvement of Product Quality

Optimization of Plant Output

Support & Plant Staff Training
EVOLVE- SERIES: UPGRADING YOUR PLANT

Decrease Emissions

Reduce Energy

Increase Capacity
Solutions for Melt Synthesis

- **LAUNCH MELT™ Pool Condenser & Pool Reactor Design**
  - Simplifies plant’s overall design, which greatly improves operability and reliability.

- **LAUNCH MELT™ Mega Capacity Design**
  - For large capacities up to 6000 mtpd.

- **LAUNCH MELT™ Compact Design**
  - Plant height is brought down to 22 meters and as a result reduces construction work and investment costs.

- **LAUNCH MELT™ Low Opex Design**
  - The most energy efficient design available on the market due to minimizing the steam intake substantially.
Solutions for Urea Finishing

• **LAUNCH FINISHING™ Granulation Design**
  • Tailor-made, high quality granules using minimum formaldehyde.
  • Low dust and ammonia emissions.
  • Requires minimum equipment, resulting in reduced CAPEX and maintenance costs.

• **LAUNCH FINISHING™ Prilling Design**
  • Most cost-effective method of finishing.
  • Suitable for local product distribution.

• **LAUNCH FINISHING™ Pastillation Design**
  • Premium quality pastilles.
  • Low investment cost with minimum emissions.
Solutions for Urea Finishing

• **LAUNCH FINISHING™ Urea Ammonium Nitrate (UAN)**
  • Alternative fertilizer (liquid) with a low crystallization temperature, facilitating transport and storage.

• **LAUNCH FINISHING™ AdBlue® / (DEF)**
  • When sprayed into the exhaust of automobiles, it reduces the NO\textsubscript{x} gases to nitrogen and oxygen (clean air).

• **LAUNCH FINISHING™ Technical Grade Urea for Melamine, Resins and Pharmaceutical applications**
  • Used in the coating layer on tabletops, work surfaces and laminate floors, or as molding powder for kitchenware.
Our leading position is the result of our continuous innovation in close cooperation with:

- Research Institutes
- Suppliers & Contractors
- Customers

This has lead to breakthrough innovations- for example:

- **LAUNCH MELT™ Low Opex Design**
  - Minimize the steam intake to the urea plant to an unprecedented low level.

- **ADVANCE COAT™**
  - Strengthen your urea prills to reduce caking and increase moisture resistance.

- **EVOLVE OPTIMIZER™**
  - Push your plant to its maximum capable capacity with our Efficiency and Capacity Optimizer.

Stamicarbon owns more than 90 patent families registered in many countries around the world, with over 1000 individual patents.
<table>
<thead>
<tr>
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For a complete list of our references please visit our website: https://www.stamicarbon.com/references

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GLOBAL UREA MARKET & STAMICARBON SHARE

Capacity share 2000-2015
Urea synthesis plants - grass roots *

- Saipem (Snamprogetti): 34%
- Stamicarbon: 53%
- Casale: 1%
- TEC: 12%

Capacity share 2000-2015
Urea granulation plants*

- Stamicarbon: 33%
- UFT: 55%
- TEC: 12%

Saipem (Snamprogetti); TEC: Toyo Engineering Corporation; UFT: Uhde Fertilizer Technology

* Percentages are capacity based
WHY STAMICARBON?

1. **Outstanding Technology, Materials and Quality Standards,** ensuring a reliable and stable operation using the latest technology.

2. **Our Full Life Cycle Philosophy,** ensuring an optimal performance throughout the entire lifetime of your plant.

3. **Renowned Reputation Globally,** ensuring you to benefit from global experience for local purpose.
STAMICARBON AND RISK MITIGATION

1. PDP design process
   • Standardized design documents
   • Verification of design
   • Design hazard study

2. During engineering process
   • Review of documents
   • P&ID review
   • 3D model review
   • Hazop support or review

3. (Pre-)commissioning
   • Inspections (equipment supply, welding)
   • P&ID field check
   • Logics & loop testing
   • Operator training / training simulators
   • Startup support
Together we can enable the world to feed itself and improve the quality of life.
THANK YOU!