Stamicarbon granulation: From conventional to multi-functional design

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Agenda

- **Conventional granulation design**
  - Large scale granulation plant

- **Simplified granulation design**
  - Micro-mist venturi (MMV) scrubbing technology

- **Multi-product granulation design**
  - Urea ammonium sulfate (UAS) production plant
Stamicarbon granulation

- **History:**
  - 2002: Grodno, Belarus (280 MTPD) revamped plant
  - 2003: Agrium, Canada (2 x 625 MTPD) revamped plant
  - 2006: EFC, Egypt (2000 MTPD) grass root plant
  - 2018: More than 15 reference plants

- **Properties of Stamicarbon fluid-bed granulation:**
  - Low formaldehyde consumption ( < 0.3 wt.-% )
  - Low dust formation
  - Long on-stream times ( > 90 days )
  - Ease of operation
Conventional granulation design

- **UREA**: 99.5 wt-%
- **HCHO**: 0.3 wt-%
- **H2O**: 0.2 wt-%

- **UREA**: 44.9 wt-%
- **HCHO**: 0.1 wt-%
- **H2O**: 55 wt-%

- **UREA**: 98.2 wt-%
- **HCHO**: 0.3 wt-%
- **H2O**: 1.5 wt-%

**Key Components**
- *Granulator*
- *Cooler*
- *Elevator*
- *Main Screen*
- *Stack*
- *Urea melt / solution*
- *Solid product*
- *Air and process gases*
- *Utilities*
Conventional granulation design

Large scale granulation plant

- Client: Pardis Petrochemical Co., Assaluyeh, Iran
- 3250 MTPD Urea Melt and Granulation plant
- Contractor: Hedco, Iran
  - Date of contract: 2011
  - Mechanical completion: 2017
  - Commissioning & Start up: 2018
- Plant status:
  - Plant capacity: 100% name plate capacity
  - On-stream time (in summer): > 2 months
New frontiers and opportunities

Conventional granulation design

Granulation design optimization

Urea melt / solution
Solid product
Air and process gases
Utilities

Urea

NH₃ liq.
NH₃ gas

Formaldehyde

Wet Recycle

Granulated product

70 °C

95 °C → 85 °C

70 °C

COOLER

SCRUBBER

MAIN SCREEN

CRUSHER

GRANULATOR

ELEVATOR

GRANULATE

COOLER

STACK

Process water

Urea melt / solution
Solid product
Air and process gases
Utilities
Simplified granulation design

Granulation design optimization

- CW in
- Granulated product
- CW out

Wet Recycle
- Formaldehyde
- Urea

Fines
- Coarse

Main Screen
- Elevator

Granulator
- CRUSHER

Elevator
- STACK

Granulated product
- CW out

Final cooler
- Dissolving vessel

Melt pump
- Air fan

Urea melt / solution
- Solid product
- Air and process gases
- Utilities

UREA: < 30 mg/Nm³
NH₃: ≈ 120 mg/Nm³

MMV + Acidic Scrubbing:
UREA: < 10 mg/Nm³
NH₃: < 20 mg/Nm³

New frontiers and opportunities
Simplified granulation design

Benefits

- Reduction in CAPEX: 20%
  ✓ Equipment, transportation, insurance, erection and labor

- Reduction in OPEX
  ✓ Electricity consumption reduced for 20%

First reference plant

- Client: BCIC Shahjalal, Sylhet, Bangladesh

- 1760 MTPD Urea Melt and Granulation plant

- Contractor: Complant/Chengda
  ✓ Date of contract: 2011
  ✓ Commissioning & Start up: 2015

<table>
<thead>
<tr>
<th>Product properties</th>
<th>Unit</th>
<th>Guaranteed</th>
<th>Measured</th>
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<tbody>
<tr>
<td>Total Nitrogen</td>
<td>%</td>
<td>&gt; 46.1</td>
<td>46.4</td>
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<tr>
<td>Biuret</td>
<td>%</td>
<td>&lt; 0.9</td>
<td>0.82</td>
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<td>Moisture</td>
<td>%</td>
<td>&lt; 0.3</td>
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<td>Formaldehyde</td>
<td>%</td>
<td>&lt; 0.35</td>
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<td>Crushing strength</td>
<td>kgf</td>
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<td>PSD: 2.0 &lt; x &lt; 4.0 mm</td>
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<td>&gt; 90</td>
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<tr>
<td>PSD: x &lt; 1.0 mm</td>
<td>%</td>
<td>&lt; 0.05</td>
<td>n/a</td>
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</tbody>
</table>
New frontiers and opportunities

Simplified granulation design

MMV scrubbing technology in operation

Dakota Gasification Company, Beulah, North Dakota, USA
• 1000 MTPD Urea Granulation
  ✓ Emission Control Technology: Micro-Mist Venturi (MMV)
    Dust < 10 mg/Nm$^3$
    Ammonia (H$_2$SO$_4$) < 25 mg/Nm$^3$

KOCH Fertilizer, Enid, Oklahoma, USA
• 2676 MTPD Urea Granulation
  ✓ Emission Control Technology: MMV + WESP
    Dust < 5 mg/Nm$^3$
    Ammonia (H$_2$SO$_4$) < 20 mg/Nm$^3$

All conducted emission measurements are below expected emission figures!
Multi-product granulation design

On macro and micro nutrients

- Sulfur is nowadays often considered the 4th plant-nutrient after N, P and K.

- Nitrogen-to-Sulfur demand ratio for crops:
  - Normal: 10:1 to 12:1
  - Oil crops: 5:1

- World sulfur consumption in fertilizers is estimated at 13.3 Mt/year (IFA 2017). This is barely half of what crops need.

- Sulfur source: elemental sulfur or ammonium sulfate
Multi-product granulation design

Urea Ammonium Sulfate (UAS) process
Multi-product granulation design

UAS process peculiarities

- AS (solid) as by-product from caprolactam production, coke ovens, etc.
- No surfactants and no granulation additives (besides formaldehyde) needed
- Feasible for production of UAS with AS content 0 to 50 wt-%
- UAS granules have same particle size range as Urea granules
- Expected emission levels are the same as for the urea production
- Presented UAS plant concept is capable of handling other solid additives:
  ✓ Free flowing
  ✓ Average particle size of around 1 mm and dust free
  ✓ Low hardness/abrasiveness
  ✓ Stable suspension
Multi-product granulation design

UAS plant in operation

- Client: JSC MCC Eurochem, Novomoskovsk, Russia

- 600 MTPD UAS granulation plant
  - Date of contract: 2011
  - Commissioning & Start up: Q3 2018

- Commissioning milestones (based on Product portfolio):
  - Urea with no AS (pure; 0.0 wt-% S) ✅ reached
  - Urea with 16.8 wt-% AS (4.0 wt-% S) ✅ reached
  - Urea with 31.5 wt-% AS (7.5 wt-% S) ✅ reached
  - Urea with 50.0 wt-% AS (12.0 wt-% S) □ Q4 2018

UAS plant in operation
Conclusions

• New references in Stamicarbon granulation portfolio:
  ✓ Large scale granulation plant (3250 MTPD)
  ✓ Micro-mist venturi scrubbing technology (<10 mg/Nm³)
  ✓ Urea ammonium sulfate plant (600 MTPD, 0-50 wt-% AS)
Thank you

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