Advances in Urea Process and Product Technology

Mark Brouwer, UreaKnowHow.com
Agenda

1. Introduction
2. Enhance Performance
3. Improve Safety & Reliability
4. Improve Product Margins
5. Conclusions
UreaKnowHow.com:
Largest independent network in the nitrogen fertilizer industry to exchange technical information with the target to **improve Safety and Performance** of all nitrogen fertilizer plants worldwide.

12,000 Members representing of all urea plants worldwide

**UreaKnowHow.com catalyzes Safety and Performance**
GOING TO THE NEXT LEVEL TOGETHER

OPERATION, ENGINEERING AND MAINTENANCE SUPPORT FOR NITROGEN FERTILIZER PLANTS
TODAY’S NAME OF THE GAME:
IMPROVE YOUR COMPETITIVE ADVANTAGE

Worldwide 500 urea plants are in operation
350 Revamp Projects have been implemented
Typical urea cost price structure

NH₃, steam and fixed costs are major parts of cost price (90%)
Revamp Projects

Focus on
1. Safety and reliability
2. Capacity increase
3. Ammonia and steam consumption reduction

Typical Features
1. Low investment
2. Short implementation time
3. Short pay back time
Greenify your site
Covert solar energy in steam and/or power

Reference example
Andasol 3 in Spain
- In operation since 2011
- 50 MW
- 100 bar steam
- 150-180 mln Euro
Improve Safety & Reliability

AmmoniaKnowHow.com

NH₃ HNO₃ CH₃OH NPK (NH₄)(NO₃)

Risk Registers

Incident Databases & HAZOP’s

FIORDA

UreaKnowHow.com
Where the Urea industry meets
110 Safety Hazards per Plant Section

Plant section
110 safety hazards

- Synthesis: 45%
- Feed: 26%
- Recirculation: 13%
- Finishing: 8%
- Others: 8%

Synthesis section

- Equipment: 63%
- Piping: 31%
- Pumps: 6%

Feed section

- NH3: 66%
- CO2: 34%

110 Safety Hazards per Plant Section

Improve Safety & Reliability
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<th>Consequence</th>
<th>Category</th>
<th>Rare</th>
<th>Unlikely</th>
<th>Moderate</th>
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**57 Intolerable Risks before Prevention and Mitigation Measures**
### Risk Matrix After Prevention and Mitigation Measures

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**Likelihood**

- Intolerable Risk
- High Risk
- Moderate Risk
- Low Risk

Still 64 High Risks after Prevention and Mitigation Measures
Main Safety Hazards

1. Leaks with toxic ammonia release
2. Carbamate corrosion risks
3. Backflow risks
4. Vibration, cavitation and hammering risks
5. Crystallisation risks
6. Hydrogen explosion risks
7. Corrosion Under Insulation / Atmospheric corrosion risks
UreaKnowHow Leak Detection System

✔ 75% of the safety hazards in urea high pressure equipment can be prevented with a proper leak detection system

✔ Use the same system to reduce ammonia emissions

The Money Machine with a Guaranteed Pay Back
N is most important Fertilizer nutrient but not the only one
Improve Product Margins

Know what your enduser (farmer) needs!

From Bulk to Multi-nutrient Specialties
Fertilizers create environmental issues: 4R can reduce GHG 7-14%
30-50% N losses… Higher Efficiency is required!
Some innovations to improve NUE

CFA
COOL FARM ALLIANCE

Tool to calculate Impact of Fertilizers on GHG of crops
www.coolfarmtool.org

Yara transforms smartphones into Nitrogen sensors
www.yara.com/news-and-media
NH₃ as a CO₂ Free Fuel
Green NH₃ or Nfuel
Low cost long term storage
Several demonstration scale plants to produce Green NH₃ are in operation and under construction.

Its potential impact is huge…Examples

Japan: Tokyo CO₂ free Olympics in 2020
In case Japan would switch from carbon fuel to Nfuel: 4000 NH₃ plants would be required

IMO (International Maritime Organisation)
In case IMO would switch to Nfuel: 350 NH₃ plants would be required
Green (CO₂ free) Nitrogen Fertilizer:

For example: (Calcium)AN with Green NH₃ as feedstock produced from wind and solar energy

- No CO₂ emissions
- Less NH₃ losses
- Higher Yields
Green Urea:

Hydrogen + Nitrogen = Ammonia + CO₂ = Urea

Steam Reforming
Biomass
Gasification
PV Electrolysis

Air Separation Unit

O₂

Ammonia plant
Flue gas of fossil power plant
Focus Revamp projects on:
Safety and reliability, Capacity increase and Ammonia and steam consumption reduction

Improve Safety & Reliability by:
Knowing your major Safety Hazards including prevention and mitigation measures, especially Leak Detection Systems

Improve Product Margins via:
Multi-nutrient specialties, higher efficiency urea products and Green Nitrogen Fertilizers
Any Questions?
Thank You!

Mark Brouwer, UreaKnowHow.com