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Emissions from urea plant finishing sections

Pure Knowledge

Presented by: Jo Meessen

At: IFA Technical Symposium, 25 – 28 April 2006

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Wet section versus finishing section

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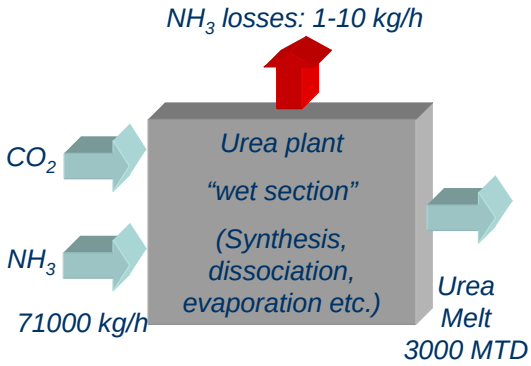

Ammonia losses from wet section: 0.05 – 0.005% of feed.

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Wet section versus finishing section

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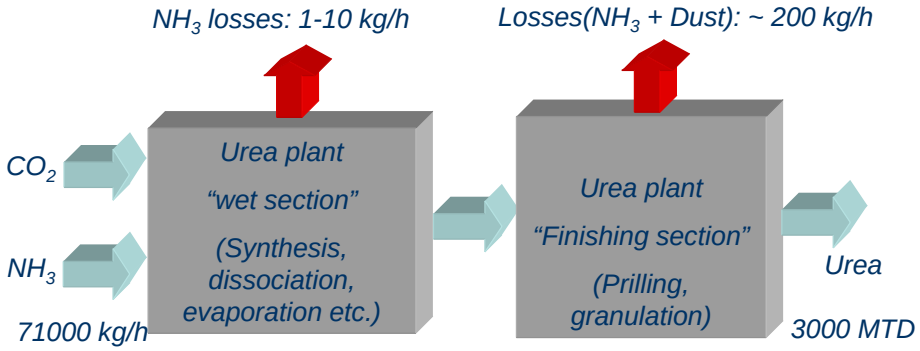

Ammonia losses from wet section: 0.05 – 0.005% of feed

Losses from finishing section: 0.4 % of feed

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Dust from prilling

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- Prilling: cooling down coarse droplets (1.5-2.5 mm) with air.
- Slow process
- Long contact time between urea melt and air
- Evaporation of urea from prill surface
- Sublimation of vapours in cold air

Prilling results in the formation of very fine urea dust: 50% < 1 µm

(" Sub-micron dust")

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Dust from prilling

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- Prilling: Cheap, but environmentally unfriendly technology.
- End of pipe solutions (scrubbing): expensive

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Dust from granulation processes

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- Classical granulation technology:
  - Drum granulation, fluid-bed granulation, spouted bed granulation.
  - Urea melt sprayed into fine droplets (20-100 µm)
  - Catching of fine droplets by granules
  - Layering of granules from the outside
  - Effective drying process
  - Heat balance: less air required as compared to prilling.

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Classical granulation processes

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- Classical granulation processes: Dust formation
  1. Limited efficiency of "catching the droplets" process: Some of the mist formed at the sprayers leaves granulator as dust: **Coarse dust.**
  2. Evaporation/sublimation from urea melt: **Fine dust.**
  3. Dust formation in the crushing of oversize product: **Coarse dust.**

Classical granulation technologies:

- ***Less air as compared to prilling***
- ***Mix of coarse/fine dust in off-gas***
- ***Scrubbing with moderate efficiency economically feasible.***

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Stamicarbon film spraying concept

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Classical granulation technolgies → *Fine droplet spraying*

Stamicarbon granulation technolgy → ***Film Spraying***

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Fine droplet spraying

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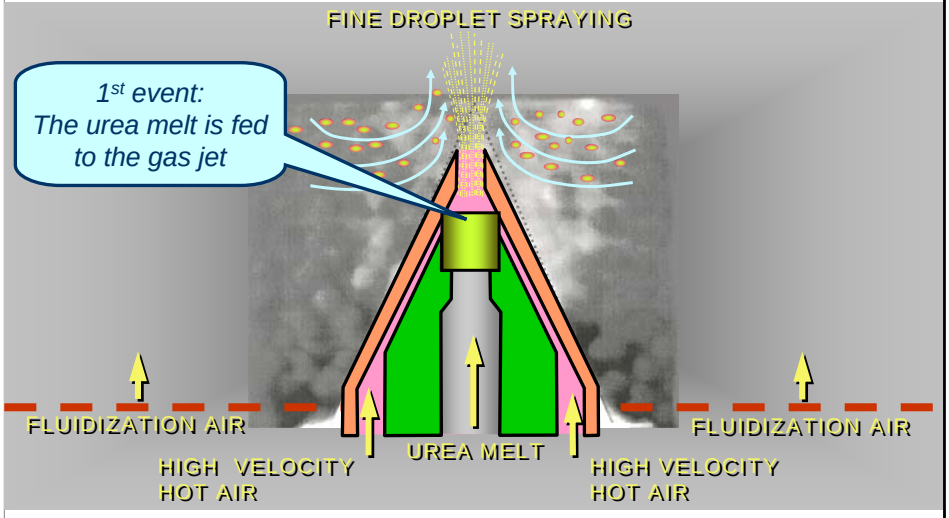

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Fine droplet spraying

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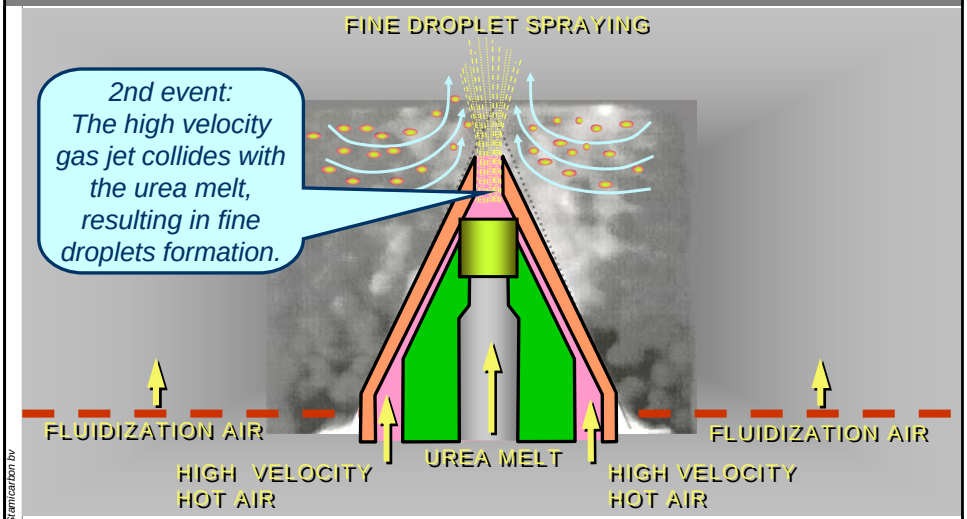

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Fine droplet spraying

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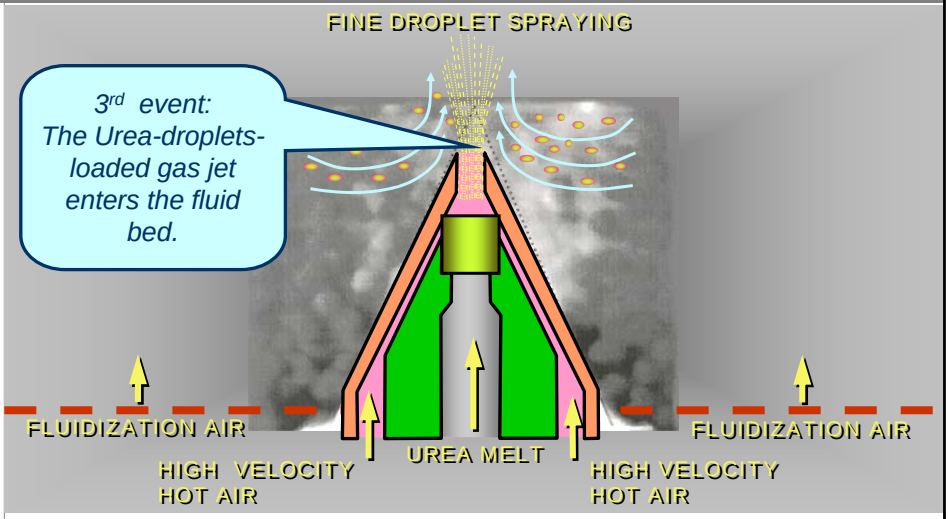

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Fine droplet spraying

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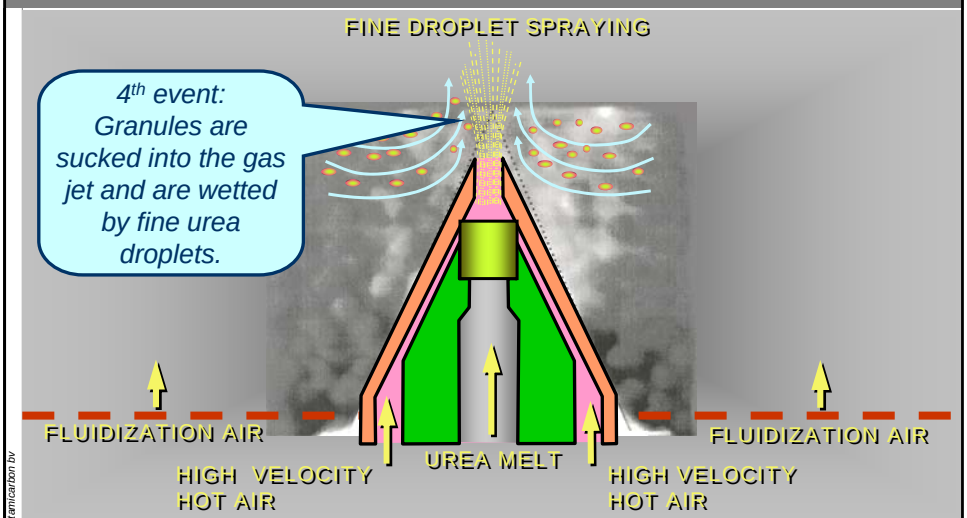

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Fine droplet spraying

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- Fine droplet spraying; Research results:
  - Good water evaporation due to high droplets surface. Therefore relative high water contents of urea melt (>2%) is possible.
  - Dust formation in the granulator is a critical factor; high levels of formaldehyde are needed for dust reduction.

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Film spraying

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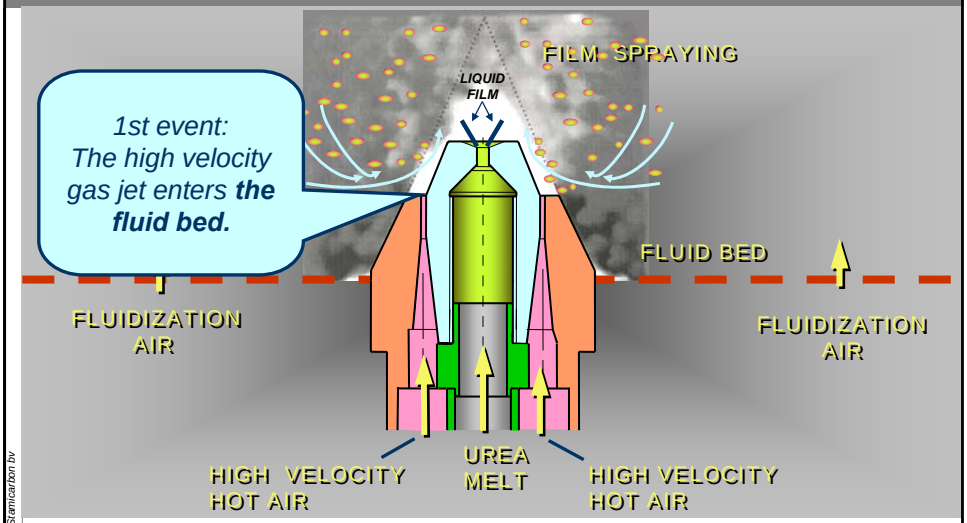

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Film spraying

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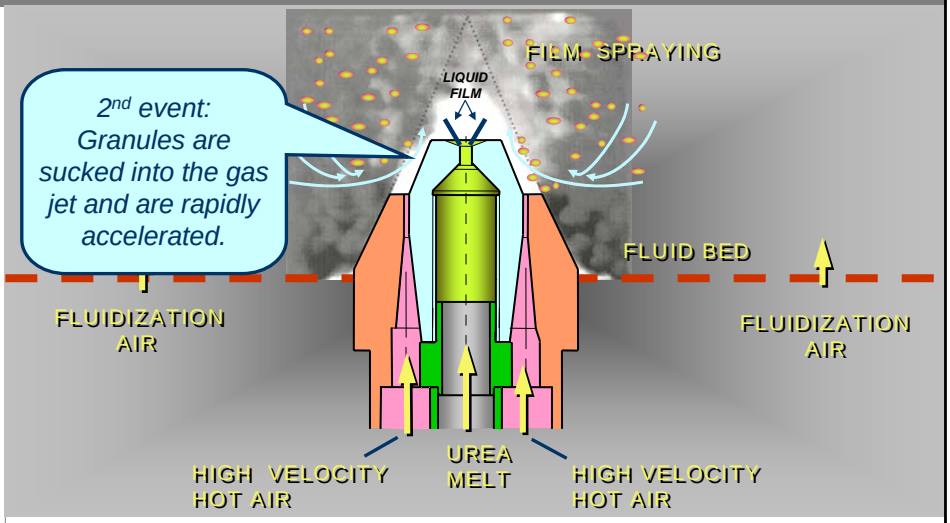

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Film spraying

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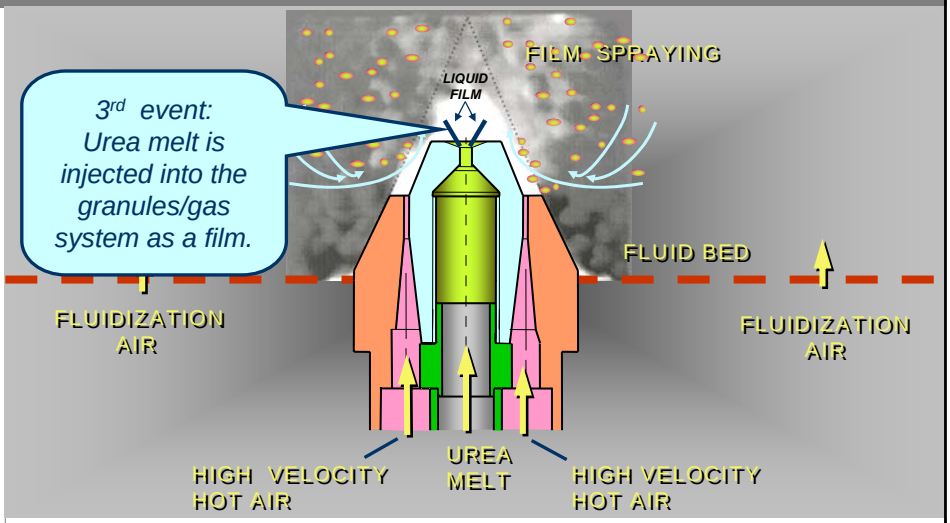

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Film spraying

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- Film spraying; Research results:
  - Limited water evaporation due to low melt surface available for evaporation; therefore low water concentration of the melt is required.
  - No submicron dust formation !!
  - Low requirement of formaldehyde.

Stamicarbon film spraying technology:

- ***No sub-micron dust***
- ***Dust scrubbing is easy***

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Ammonia in the off-gasses from prilling and granulation

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- Urea melts to finishing section: Free ammonia 100-1000 ppm.
- Air used in prilling/granulation: 5 – 20 kg air/kg urea
- Ammonia in the off-gas from prilling granulation: 10 – 200 ppm
- Freight of ammonia to the environment: 0.1 – 1 kg of NH^3 per ton of urea produced.

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Film spraying

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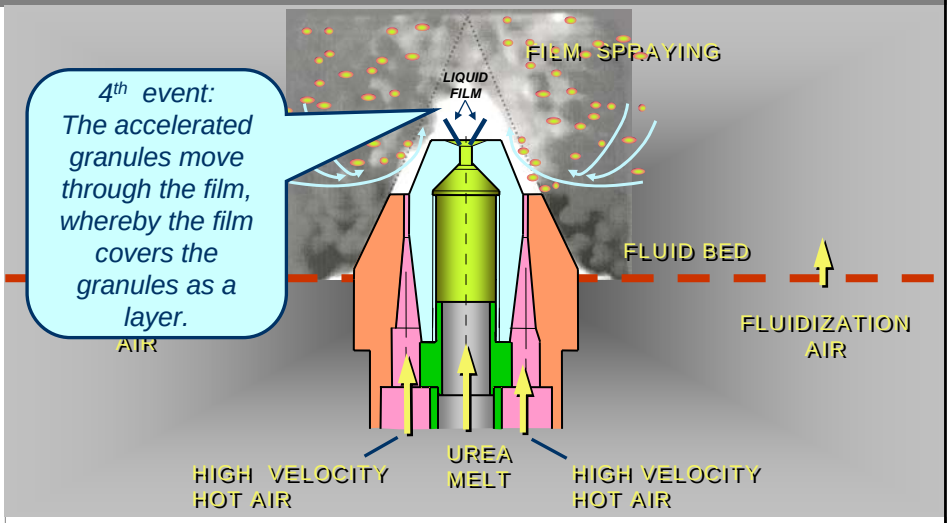

Film spraying

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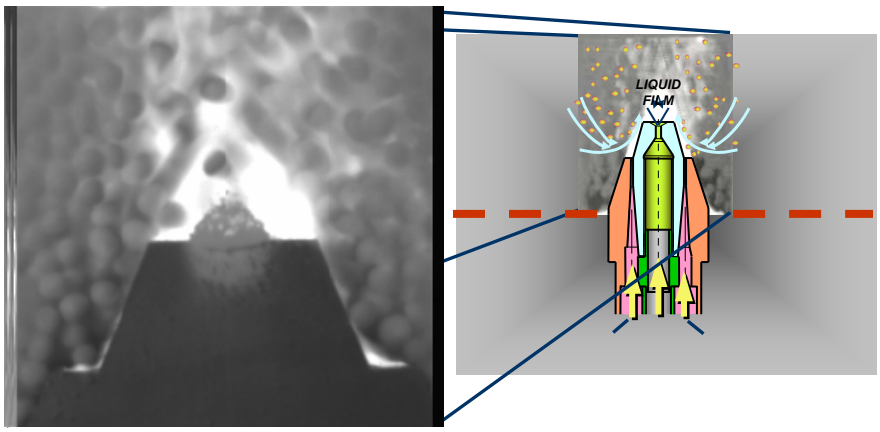

Ammonia in the off-gasses from prilling and granulation

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- Scrubbing with water: not feasible because of high amount of air and resulting low concentration of ammonia.
- Scrubbing with acidic compounds (e.g. Sulphuric acid, Nitric acid etc.):
  - Production of ammonia salt as by-product
  - Feasible if combined with UAN production
  - Otherwise: **What to do with this by-product ?**

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Residue free ammonia abatement

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- Acidic scrubbing of the prilling/granulation off-gas with e.g. sulphuric or nitric acid.
- Electrolytical decomposition of the produced ammonia salts
- Stripping of the ammonia using steam stripping, recycle of the ammonia to the urea plant.
- Recycle of the sulphuric/nitric acid to the scrubbing operation.

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Residue free ammonia abatement

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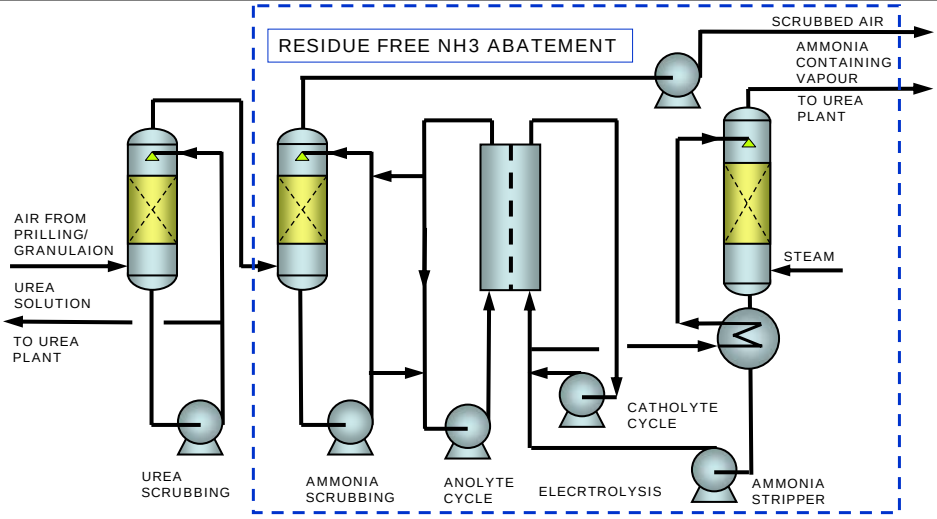

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Residue free ammonia abatement: status

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- Developed together with UHDE
- Small scale experiments have been executed.
- Cells for electrolytical decomposition of salts are well proven technology in other processes.
- All other process steps: well proven technology
- In situ test required in order to study potential by-product formation
- Stamicarbon/UHDE looking for Urea producer to carry out in-situ experiments.

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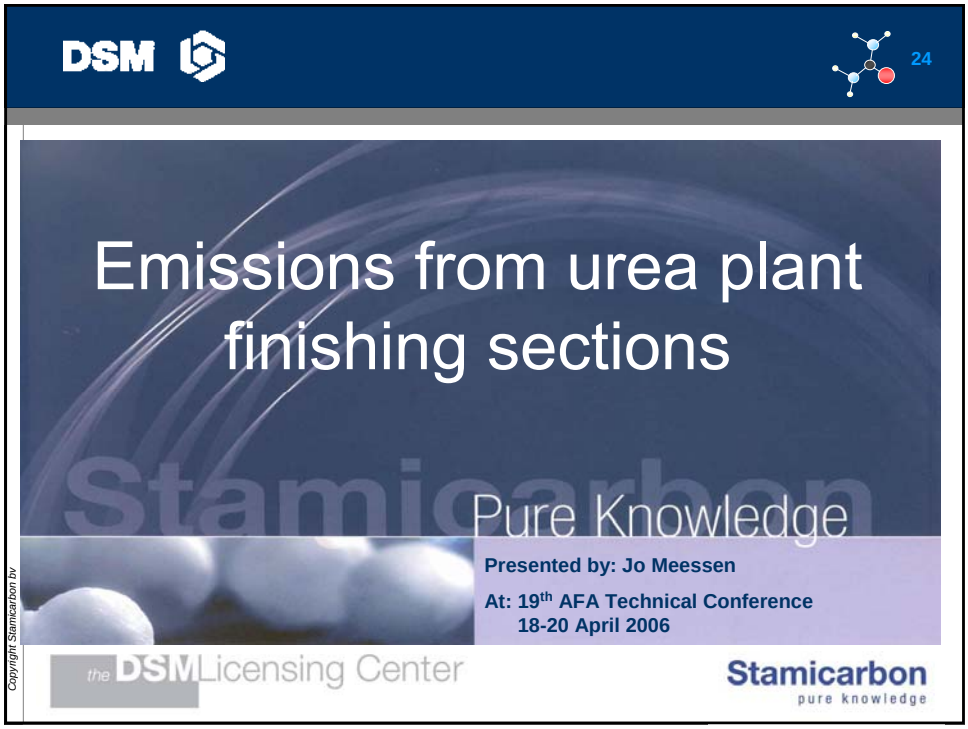
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Pure Knowledge
Presented by: Jo Meessen
At: 19th AFA Technical Conference
18-20 April 2006
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