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SYMPOSIUM 2022

KNOWLEDGE • OPTIMIZATION • INNOVATION

Stamicarbon 75 YEARS

Experiences with MicroMist™ and Jet Venturi scrubbing systems

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19 May 2022

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First MicroMist™ Venturi scrubber reference

Innovative client:

- Large-scale single-line urea granulation plant with acid scrubbing and ammonium salt recycled back into the granulator

Requested scrubbing efficiency:

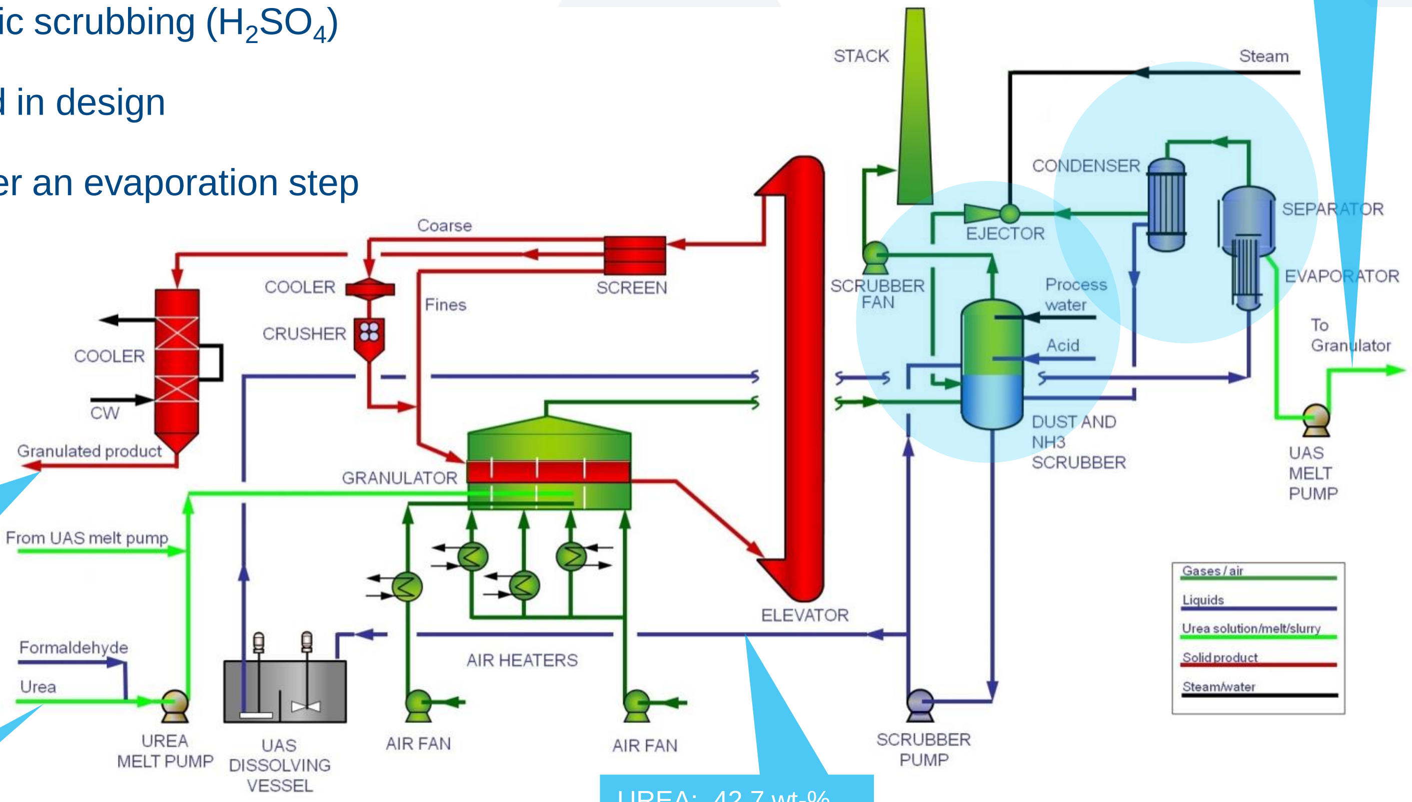
- Urea dust emission < 5 mg/Nm^3
- Ammonia emission < 20 mg/Nm^3

First MMV reference – plant PFD

Main Features:

- MicroMist™ Venturi (MMV) scrubber with acidic scrubbing (H_2SO_4)
- Wet electrostatic precipitator (WESP) included in design
- Wet recycle going back into the granulator after an evaporation step
- No disposal stream going OSBL
- Final product with 0.1 wt-% S

UREA: 92 wt-%
HCHO: 0.3 wt-%
AS: 4.7 wt-%
H2O: 3 wt-%

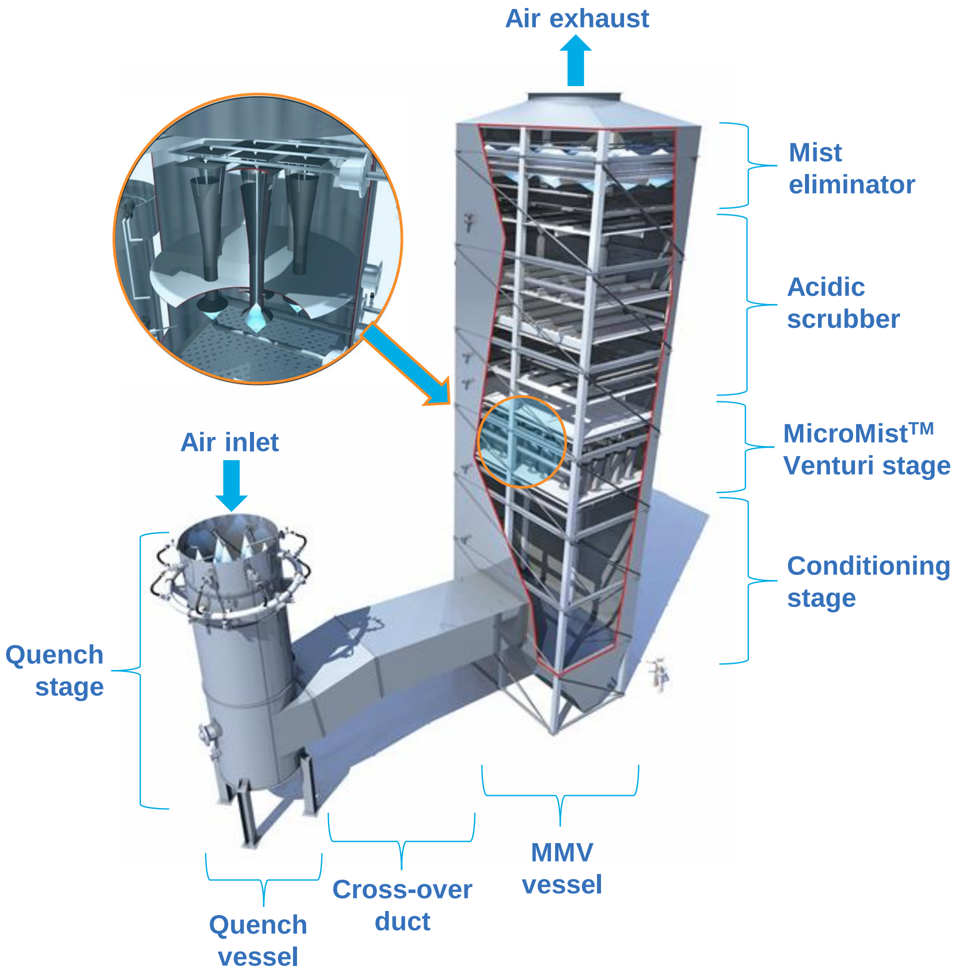


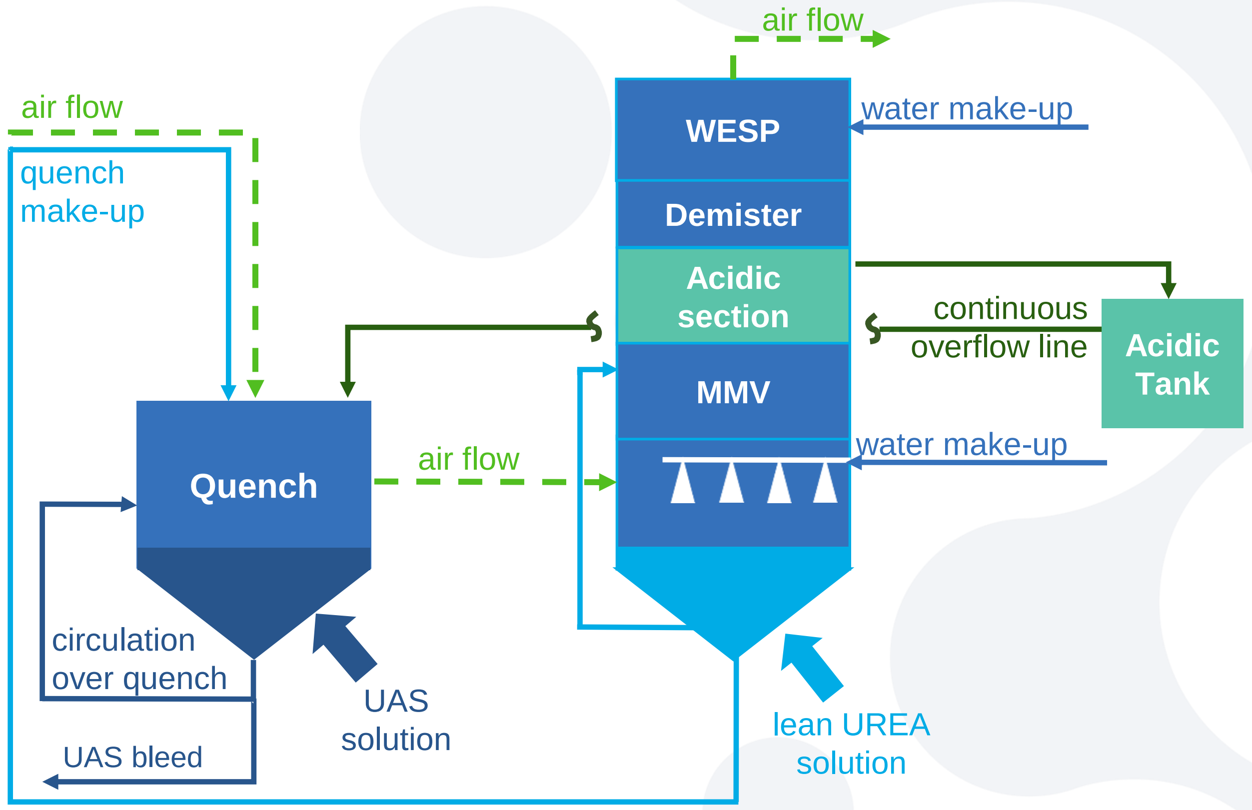
UREA: 99.25 wt-%
HCHO: 0.3 wt-%
AS: 0.25 wt-%
H2O: 0.2 wt-%

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

UREA: 42.7 wt-%
HCHO: 0.1 wt-%
AS: 2.2 wt-%
H2O: 55 wt-%

Original scrubber design





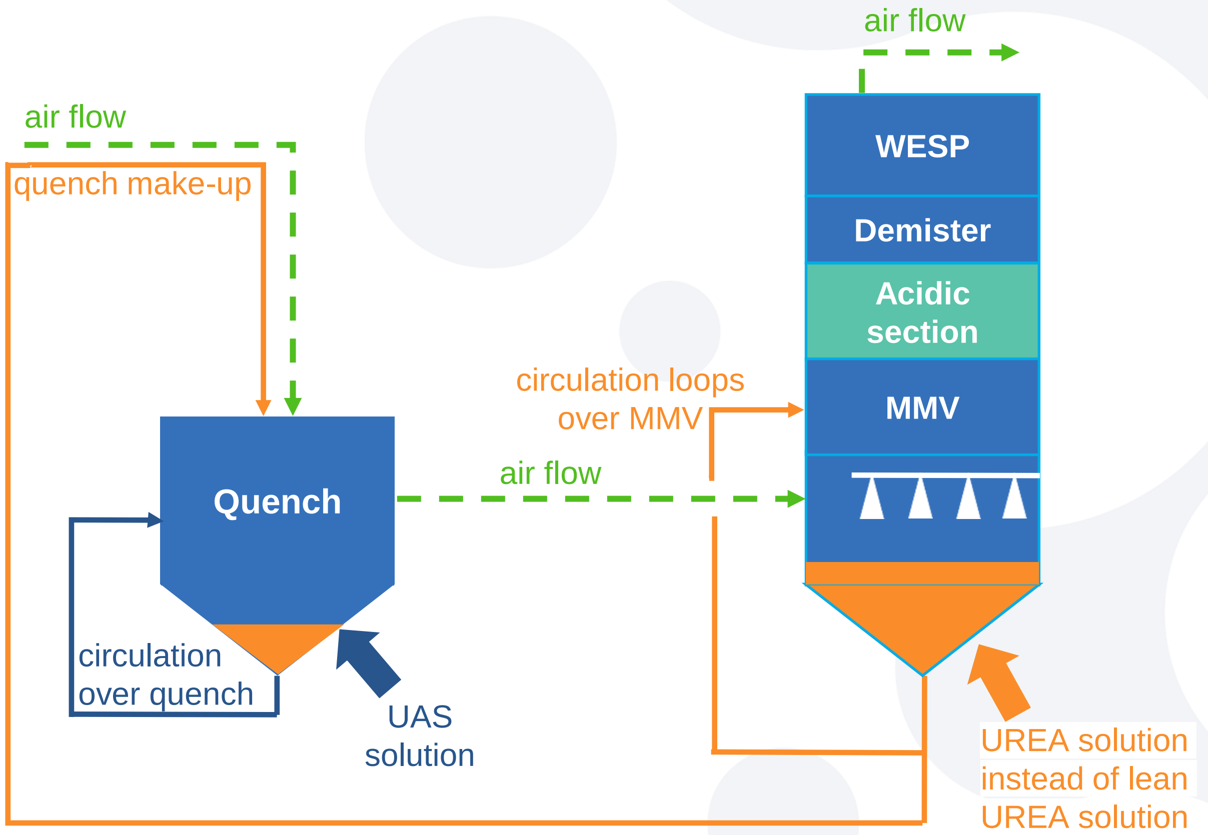
MMV performance after initial start-up

Initial experience:

- Scrubbing system operational
- Scrubbing efficiency satisfactory
- Some deviations compared to expected operation

Operational deviations:

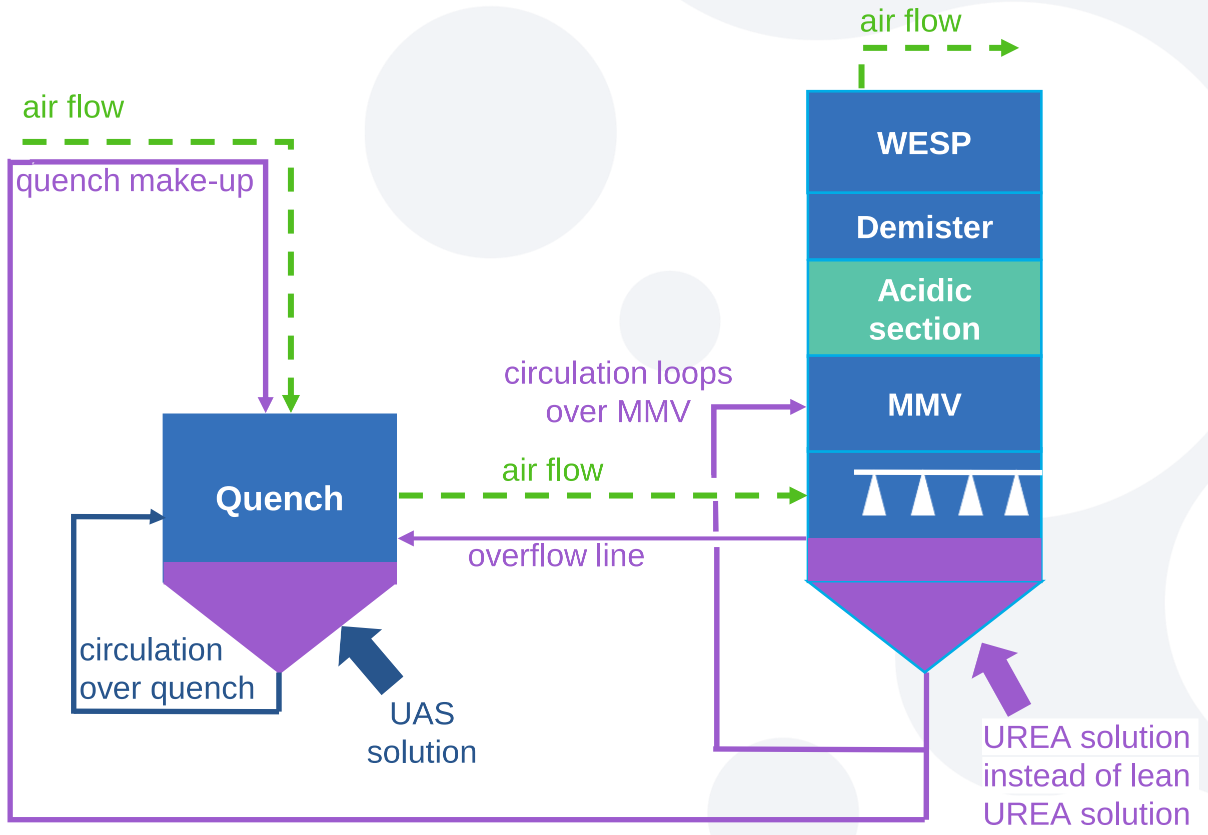
- No lean solution in the MMV sump but urea solution
- No sufficient lean urea solution available to compensate for the evaporation losses in the quench vessel



Initial operational solution for overcoming deviations

Measures taken:

- Level in the MMV vessel sump increased to the maximum
- Overflow line used for supplying make-up liquid to the quench vessel

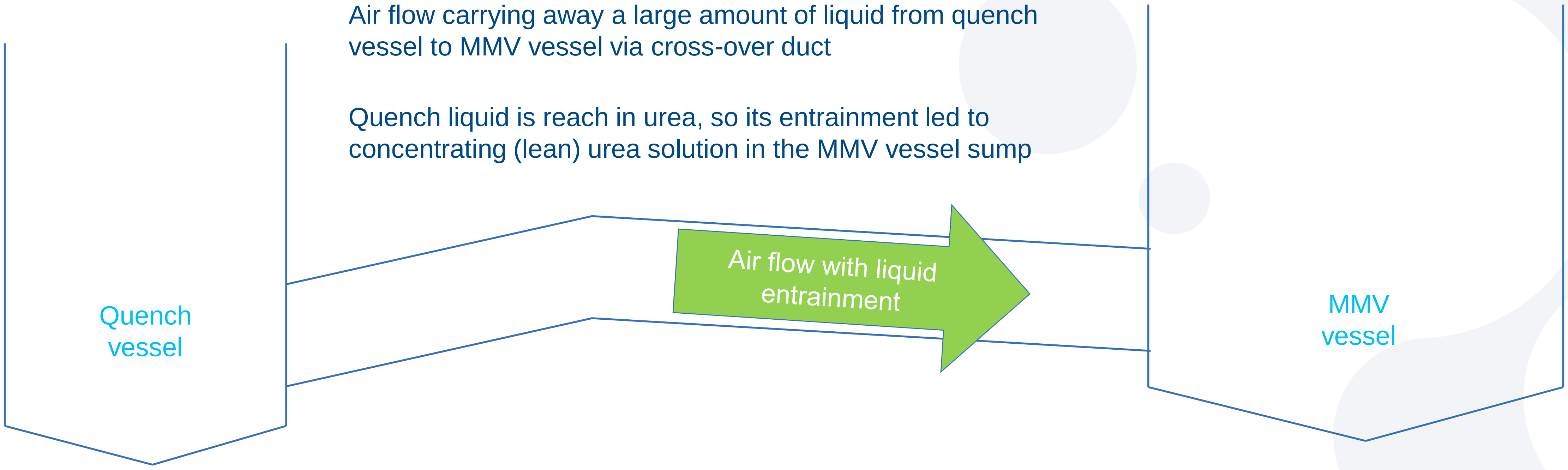


Root cause initial deviations

Root cause:

Air flow carrying away a large amount of liquid from quench vessel to MMV vessel via cross-over duct

Quench liquid is reach in urea, so its entrainment led to concentrating (lean) urea solution in the MMV vessel sump



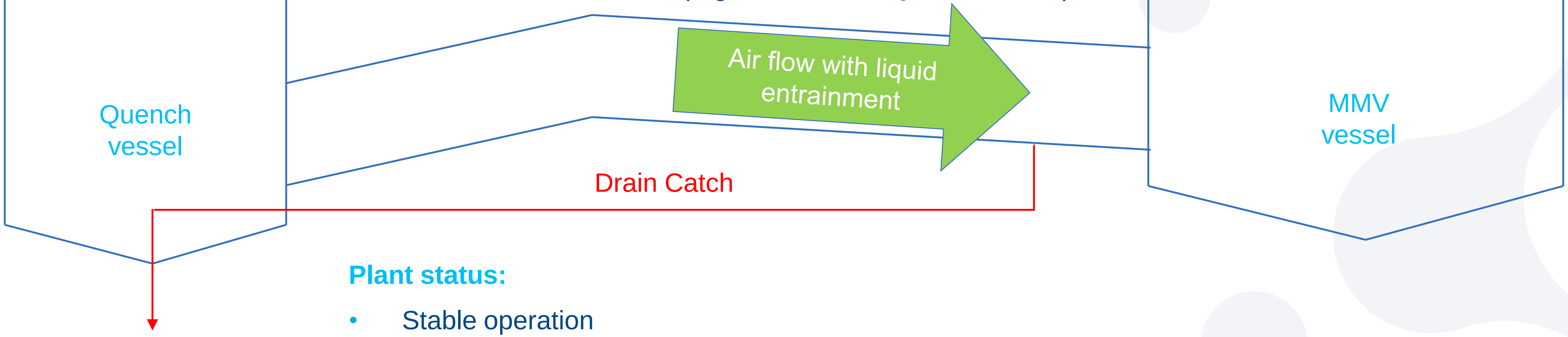
Resolving entrainment issue

Solution:

Trench installed in the cross-over duct, acting as a drain catch and sending back the liquid entrainment to the quench vessel by gravity

Result:

- Urea concentration in the MMV vessel sump reduced to acceptable operational level
- Water balance restored (regained level in Quench vessel)



Plant status:

- Stable operation
- Measured UREA dust emission (official measurements) way below requested 5 mg/Nm^3

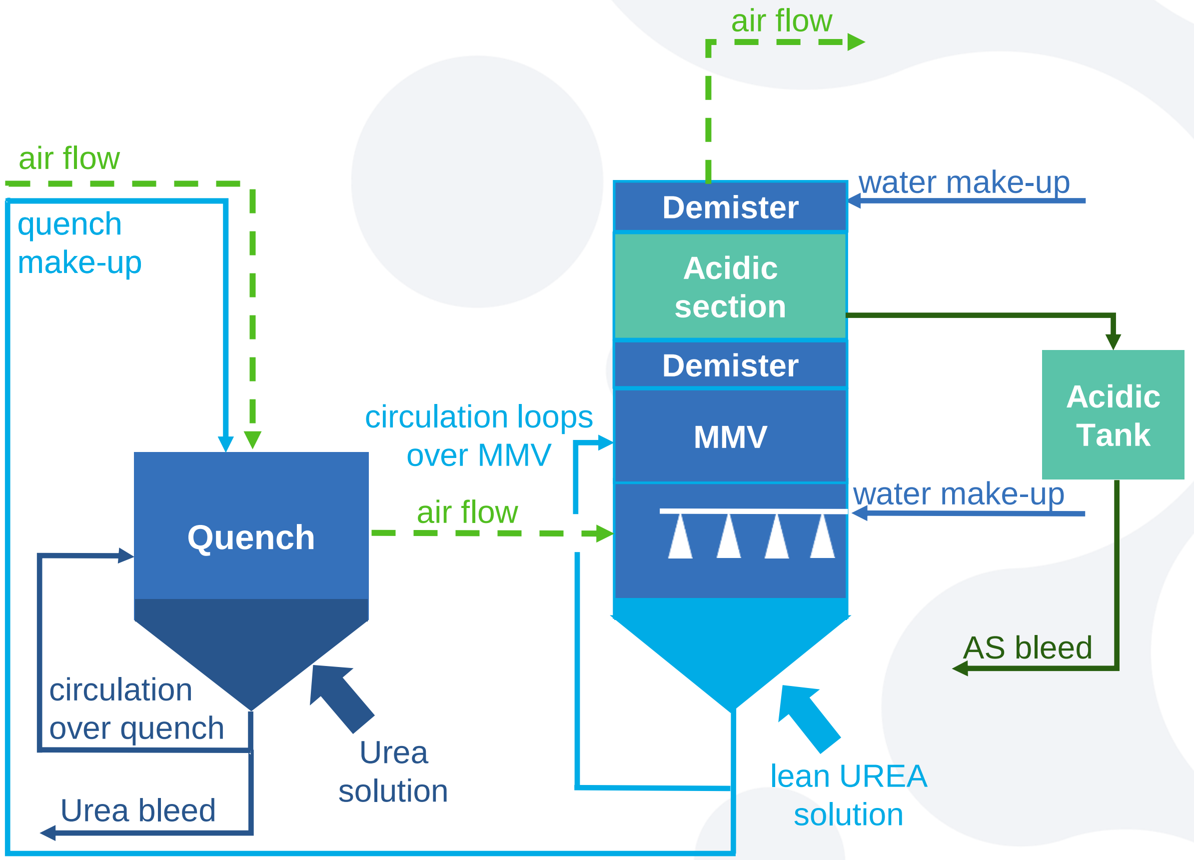
Second MMV reference

Design differences compared to the first MMV reference:

- Ammonium sulfate (AS) solution sent to battery limits
- Additional mist eliminator between MMV stage and acidic section
- No WESP stage due to less stringent dust emission requirement

Operational specifics:

- Quick and trouble-free start-up
- Liquid entrainment from quench vessel to MMV vessel



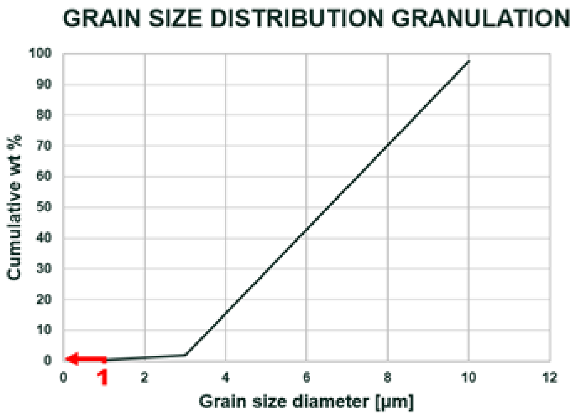
Second MMV reference

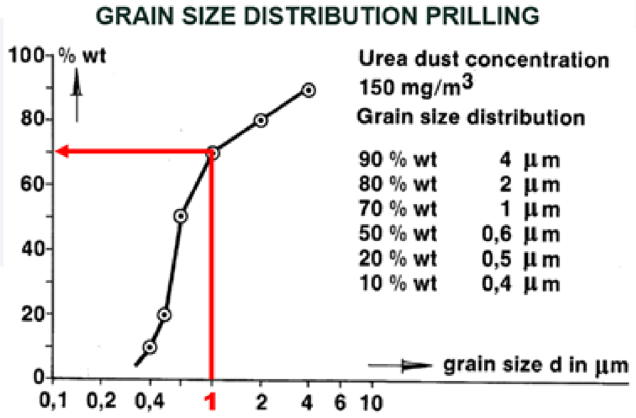
Official stack measurement:

- Measured particulate matter (PM) emission **below the expected 10 mg/Nm^3** ! This measuring both filterable (EPA Method 5) and condensable (EPA Method 202) PM
- Measured **opacity of 0%** (EPA Method 9)
- Achieved efficiency without any optimization or fine tuning of the scrubber operation

Dust scrubbing for Prilling Plants

Problem specific:



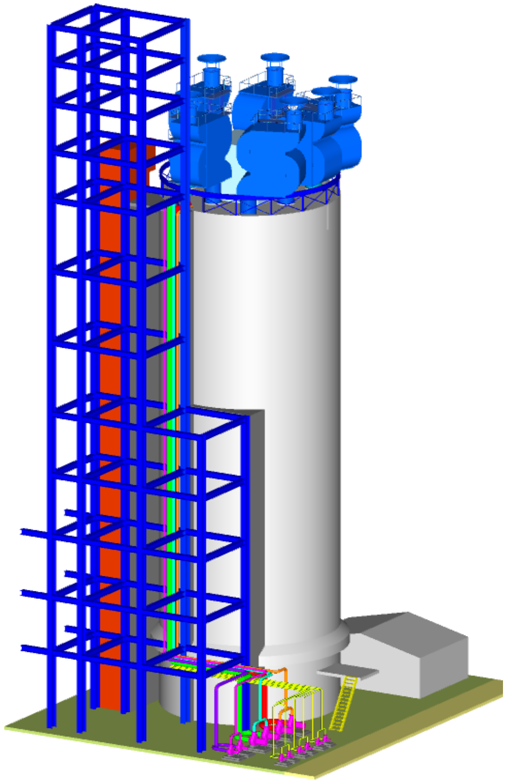


Jet Venturi Scrubber design specifics:

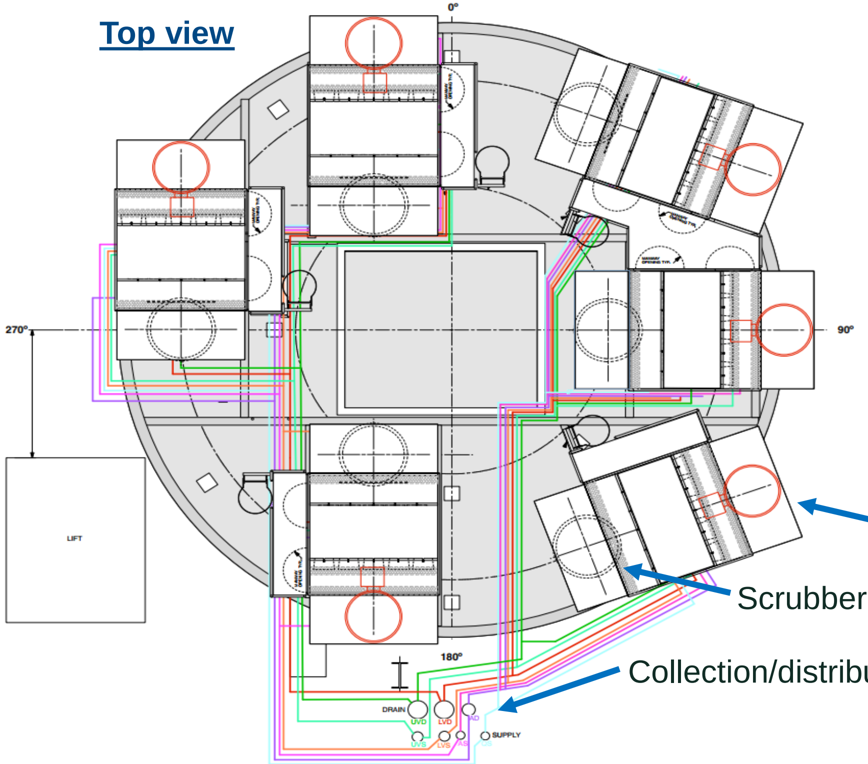
- High efficiency collection for sub-micron dust
- Applicable for forced and natural draft prilling towers
- Implementation at grass root and existing prilling towers
- Possibility to include ammonia abatement
- Installation at grade level and on top of the prilling tower
- Low pressure drop

Overall scrubbing system design

Jet Venturi Scrubber on top of the prilling tower (Revamp Case Study)



Top view



Scrubber air exhaust

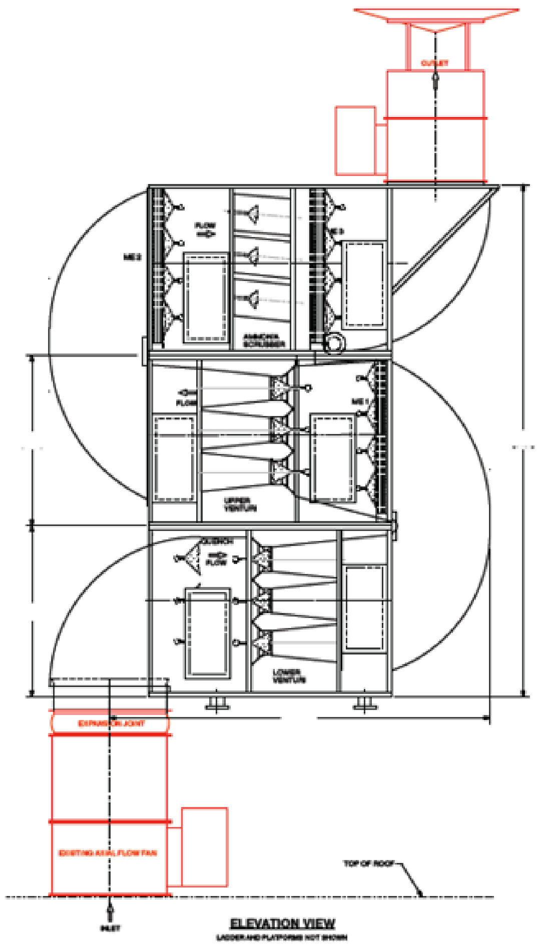
Scrubber air supply

Collection/distribution headers

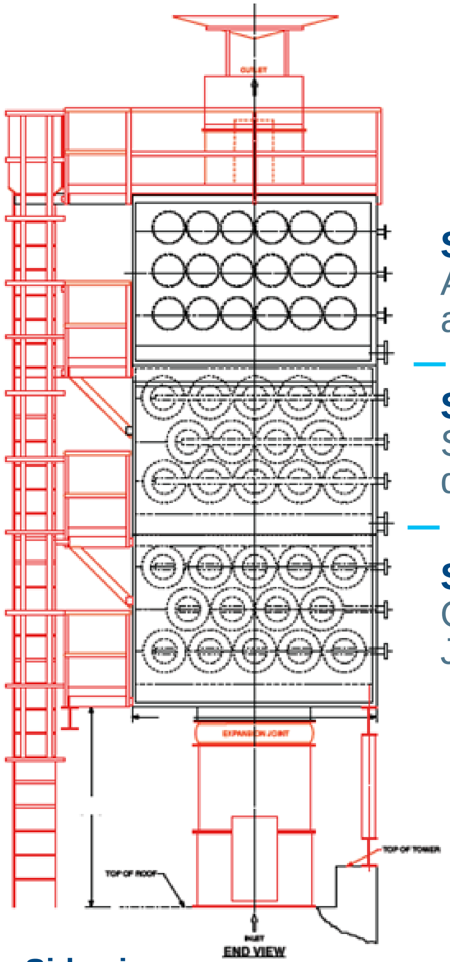
Design optimizations:

- Weight reduction (pumps, hold-up volumes)
- Common pumps
- Power consumption

Jet Venturi Scrubber Design



Side view

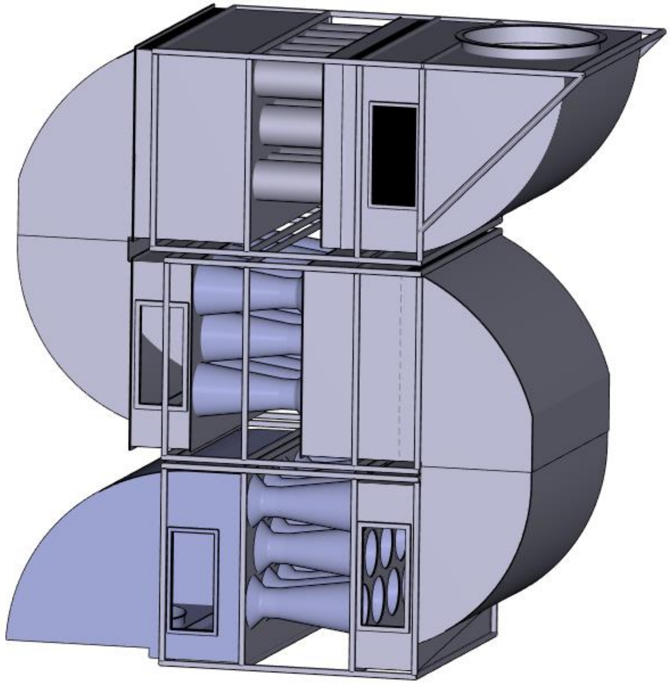


Side view

Stage 3:
Acidic scrubbing for ammonia capture

Stage 2:
Secondary Jet Venturi dust scrubbing

Stage 1:
Quench and Primary Jet Venturi dust scrubbing



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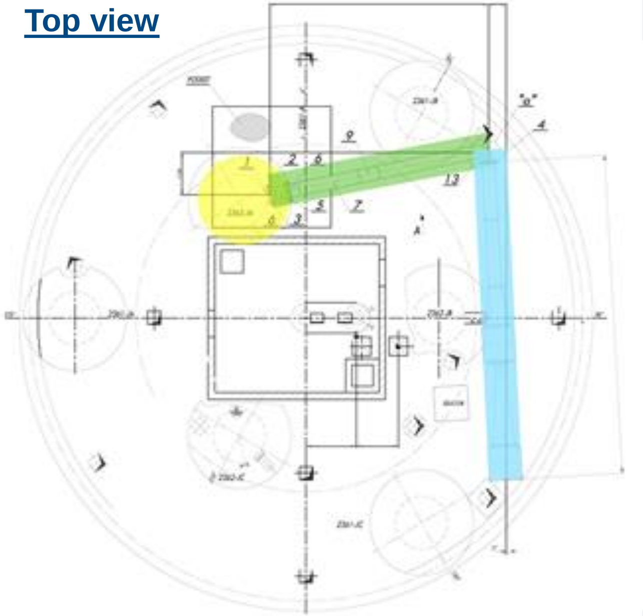
Jet Venturi pilot unit

Single Jet Venturi layout (two venturi elements in series):

- Primary jet venturi (between boxes 1 and 2)
- Secondary jet venturi (between boxes 3 and 4)

Pilot unit tests



Analysis of conducted tests resulted in determining:

- Venturi design (size and nozzle)
- Operating conditions
- Dust scrubbing capability (< 15 mg/Nm^3)

Conclusions

MicroMistTM Venturi Scrubber for granulation plants:

- Dust less than the expected amount of 5 mg/Nm^3
- Optimization of the quench sump in combination with CAPEX reduction
- Scrubber package incorporated in the Stamicarbon Operator Training Simulator

Jet Venturi Scrubber for prilling plants:

- Pilot testing for determining scrubbing capabilities and optimal operating conditions
- Reducing dust emission below 15 mg/Nm^3
- For forced and natural draft, existing and grass-root prilling plants
- Top (preferred) and grade level solutions

Thank you!

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