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SYMPOSIUM 2022

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LARGE CAPACITY UREA LAUNCH[®] FINISH[™] GRANULATION DESIGN

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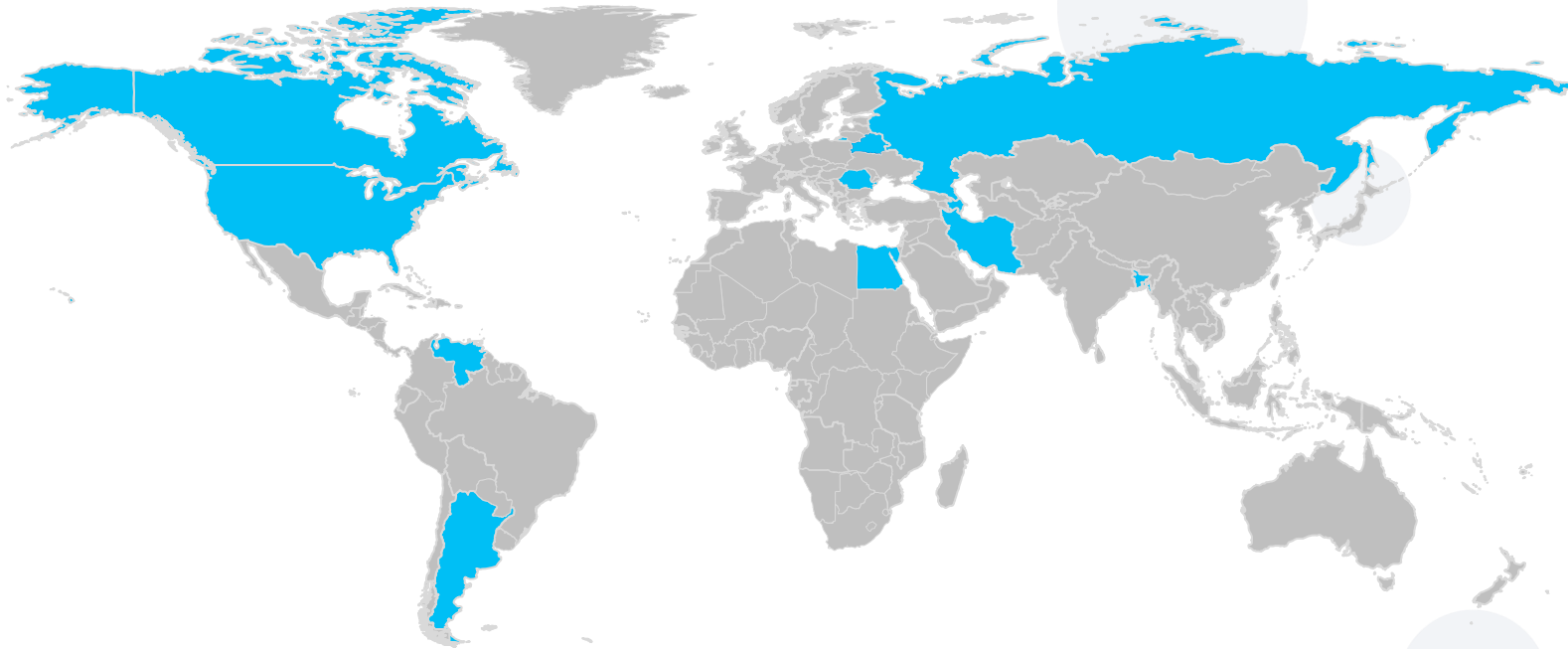
Jaarbeurs, Utrecht



Agenda

- Stamicarbon LAUNCH[®] FINISH[™] Granulation experience
- Challenges in designing a 5000 MTPD plant
- Single- or double-line configuration?
- Experiences from 4000 MTPD granulation project
- Conclusions

More than 20 years of Stamicarbon LAUNCH® FINISH™ Granulation experience

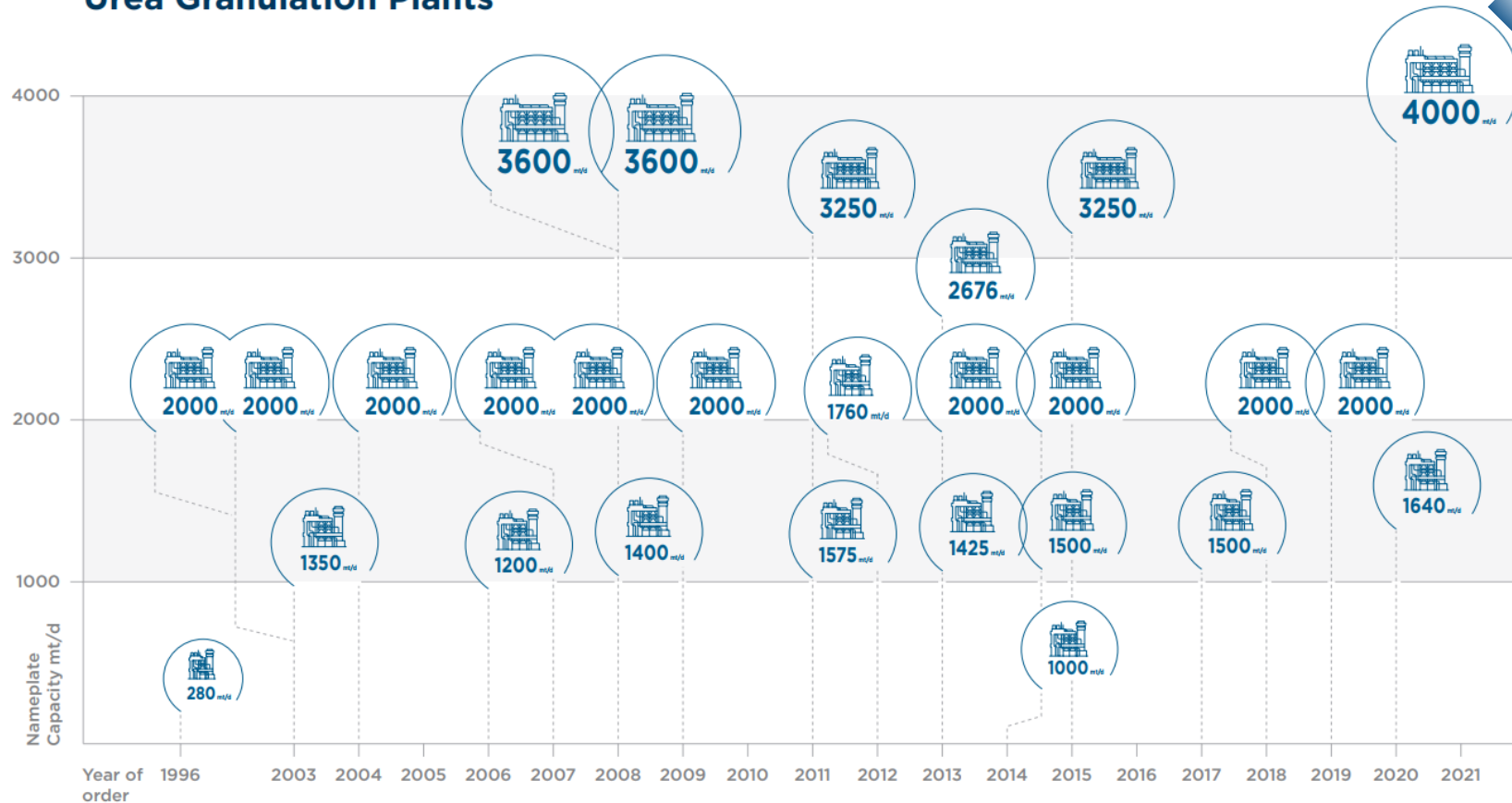


25+ licenses sold worldwide
60% market share in last 5 years

Timeline of LAUNCH[®] FINISH[™] Granulation licences sold

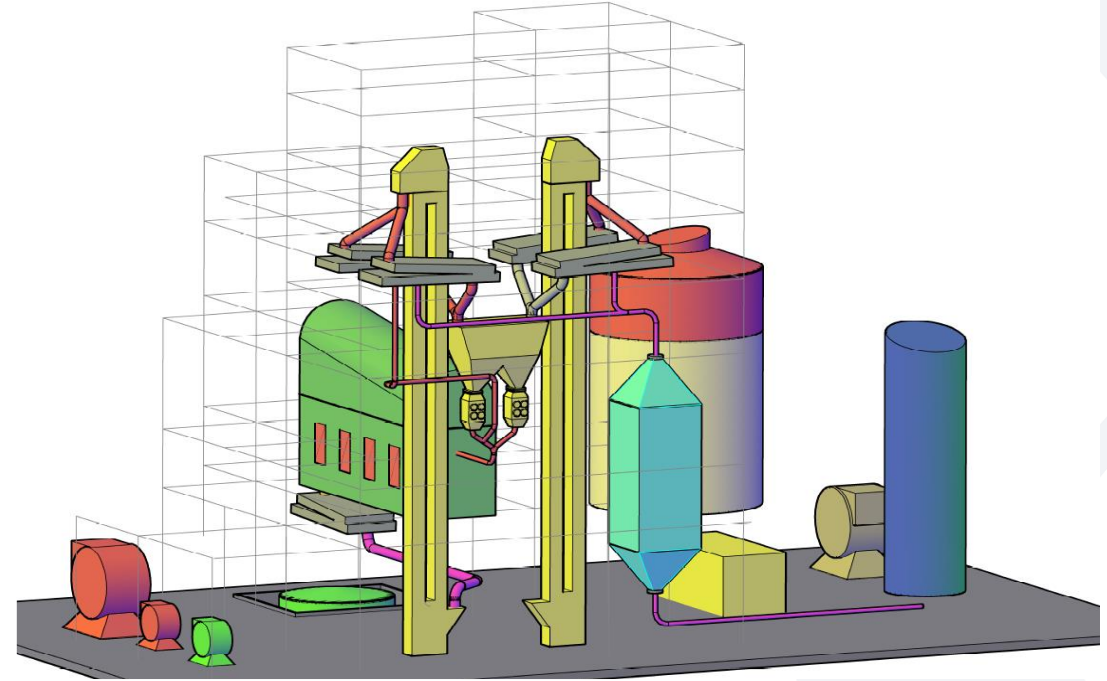
?

Urea Granulation Plants



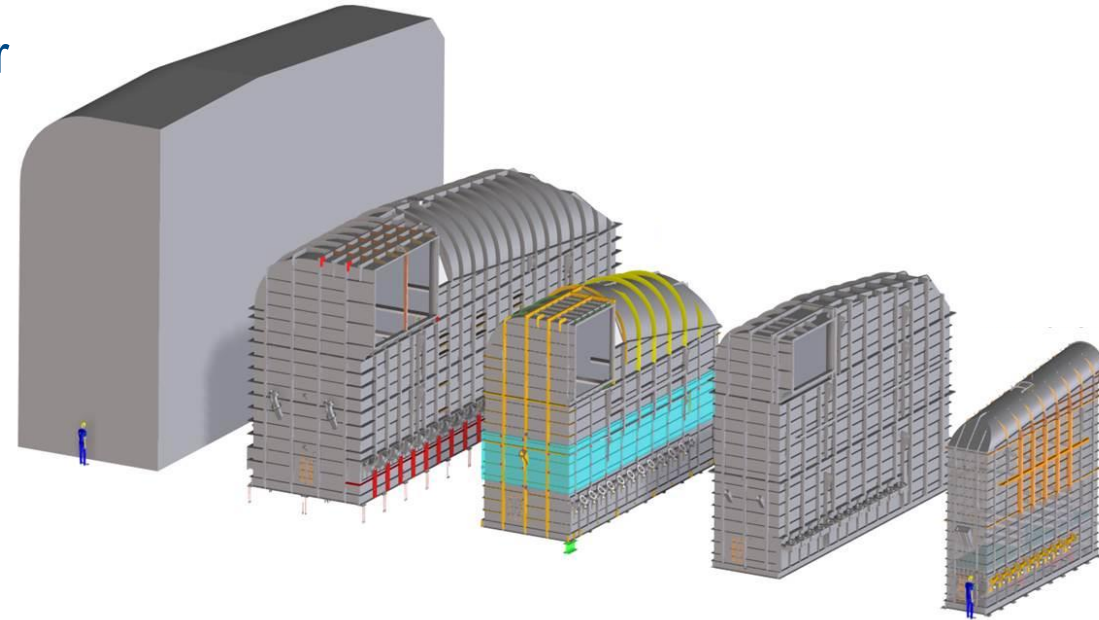
Challenges in designing a 5000 MTPD plant

- Granulator design
- Dry recycle loop
- Other solid handling equipment



Challenges in granulator design

- Design and sizing of the granulator are directly dictated by the plant capacity and ambient conditions.
- Stamicarbon's preference is to fabricate and deliver the granulator in one piece in horizontal orientation in order to:
 - ✓ Ease transportation and installation
(both in-shop and on-site)
 - ✓ Minimize potential damage to the equipment
 - ✓ Lower packaging costs



Challenges in granulator design

- Challenges to focus on while designing large capacity granulators:

Sizing limitations
(length & width)

Maldistribution of
granules

Increase in melt
header length

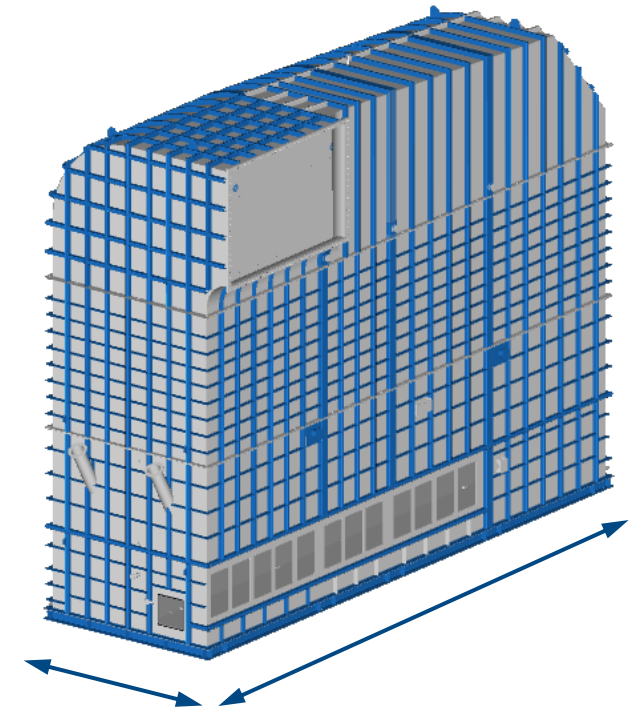
High
off-gas load

Monitoring &
controlling the
granulation
operation

Mechanical integrity
of the granulator

Challenges in granulator design

- Sizing limitations (length & width):
 - Max. width of the granulator has a limit due to manufacturing limitations
 - This results in a L/W ratio that is higher than Stamicarbon's standard design value
 - A larger L/W ratio will influence the particle size distribution (PSD) inside the granulator



Challenges in granulator design

- Measures taken to overcome sizing limitations:
 - Potential change in PSD can be mitigated in terms of:
 - flexible design (“dry recycle” ratio)
 - configuration of solid handling equipment (e.g. mesh size of main screens)

Challenges in granulator design

- Maldistribution of granules over the fluidization plates:
 - Optimum flow pattern of the granules can be affected due to larger width
 - Risk of improper particle & melt spray coverage and consecutive cooling
- Measures taken to overcome maldistribution:
 - Re-design of the orientation of dry recycle inlet lines and (extra) baffles inside the granulator



Challenges in granulator design

- Increase in main melt header length:
 - Length of main melt header is increased in accordance with the length of the granulator.
 - This results in:
 - longer residence time for melt → higher biuret formation
 - higher pressure drop over the melt header
- Measures taken for longer melt headers:
 - New proprietary melt header design for min. biuret formation and pressure drop



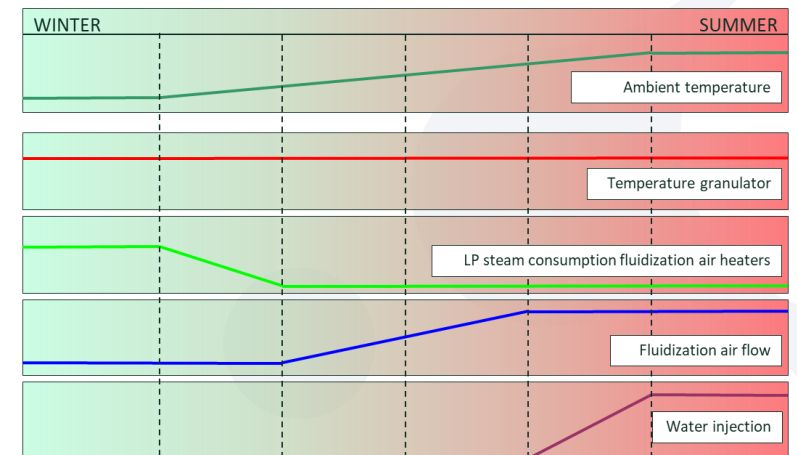
Challenges in granulator design

- High off-gas load:
 - Load to the scrubbing system is increased in proportion to the capacity
 - Higher amount of off-gas air leaving the granulator will result in a larger nozzle size
 - Traditional square ducting yields a further increase of the granulator height
- Measures taken to mitigate the effect of increased off-gas load:
 - Single scrubbing unit is confirmed to be still capable
 - Optimized shape of the off-gas nozzle and duct



Challenges in granulator design

- Challenges in monitoring & controlling the granulator operation:
 - Proper monitoring and controlling the granulation operation becomes more critical for larger sized compartments
 - Single source measurement may be misleading
- Measures taken to optimize the bed temperature control:
 - A new process control system that can be implemented in large scale granulators



Challenges in granulator design

- Mechanical integrity of the granulator:
 - Integrity of large size granulator design has been examined by the mechanical analysis
- Measures taken to reinforce the mechanical integrity of the granulator:
 - Implementation of extra supporting stiffeners are foreseen in order to prevent potential damage to the equipment
 - Design of the stiffeners is updated in order to minimize the fouling in this section

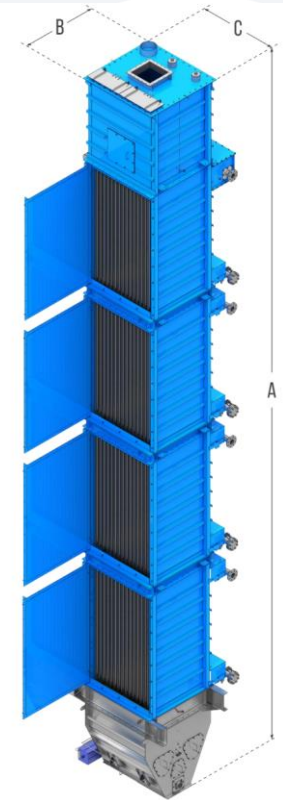


Challenges in the dry recycle loop

- For a 5000 MTPD granulation plant, the dry recycle flow can be considerably high.
- This high recycle rate becomes critical for determining the number of main screens and crushers required.
- In consultation with our preferred vendors, maximum capacity for each equipment was determined.
- 5000 MTPD granulation plant → min. 4 main screens and 3 crushers
- For better coupling with the equipment downstream, using 6 main screens becomes a better fit.

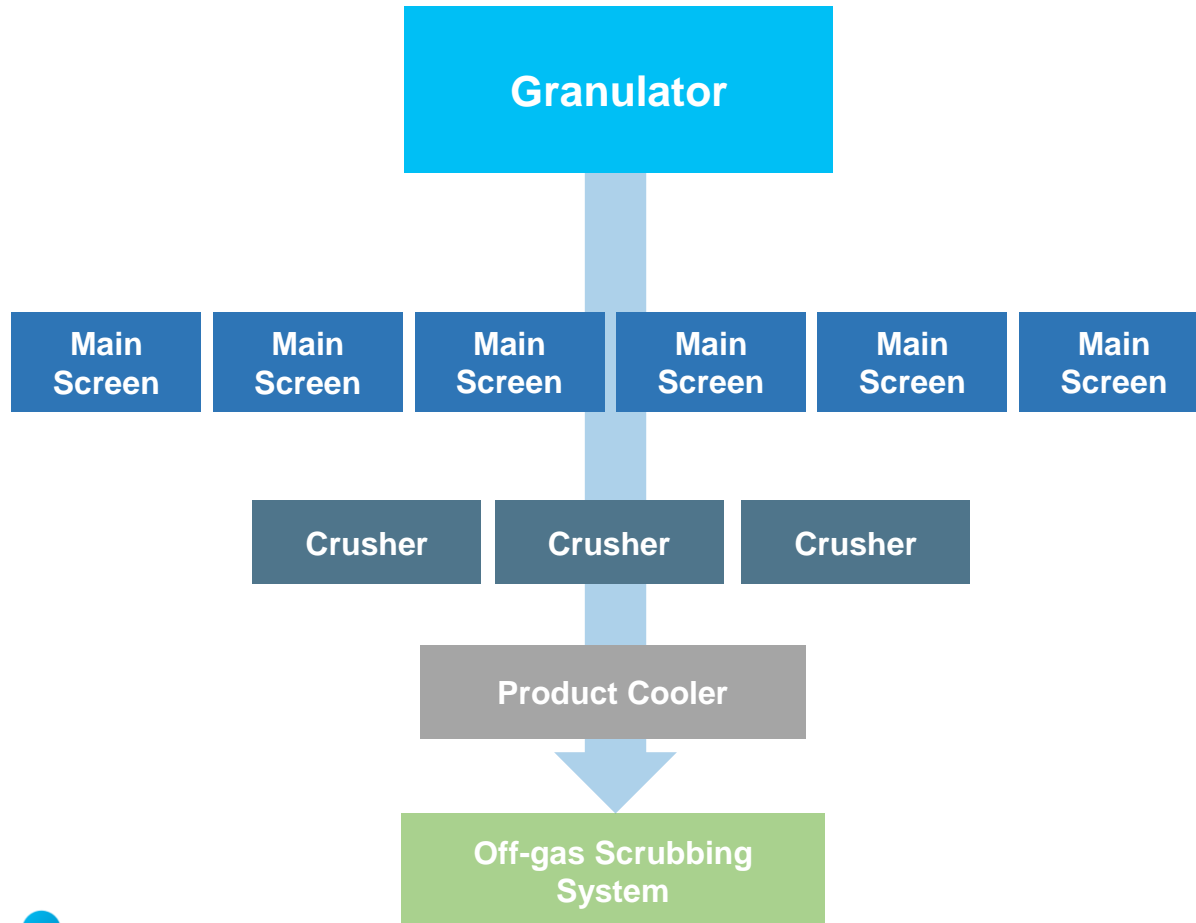
Challenges for other solid handling equipment

- Rest of the solid handling equipment in the loop has also been investigated for 5000 MTPD
- No issues related to capacity or configuration found
- A single solid flow type final cooler unit will be capable of handling 5000 MTPD production
- No significant impact on the overall plant height due to larger sized product cooler

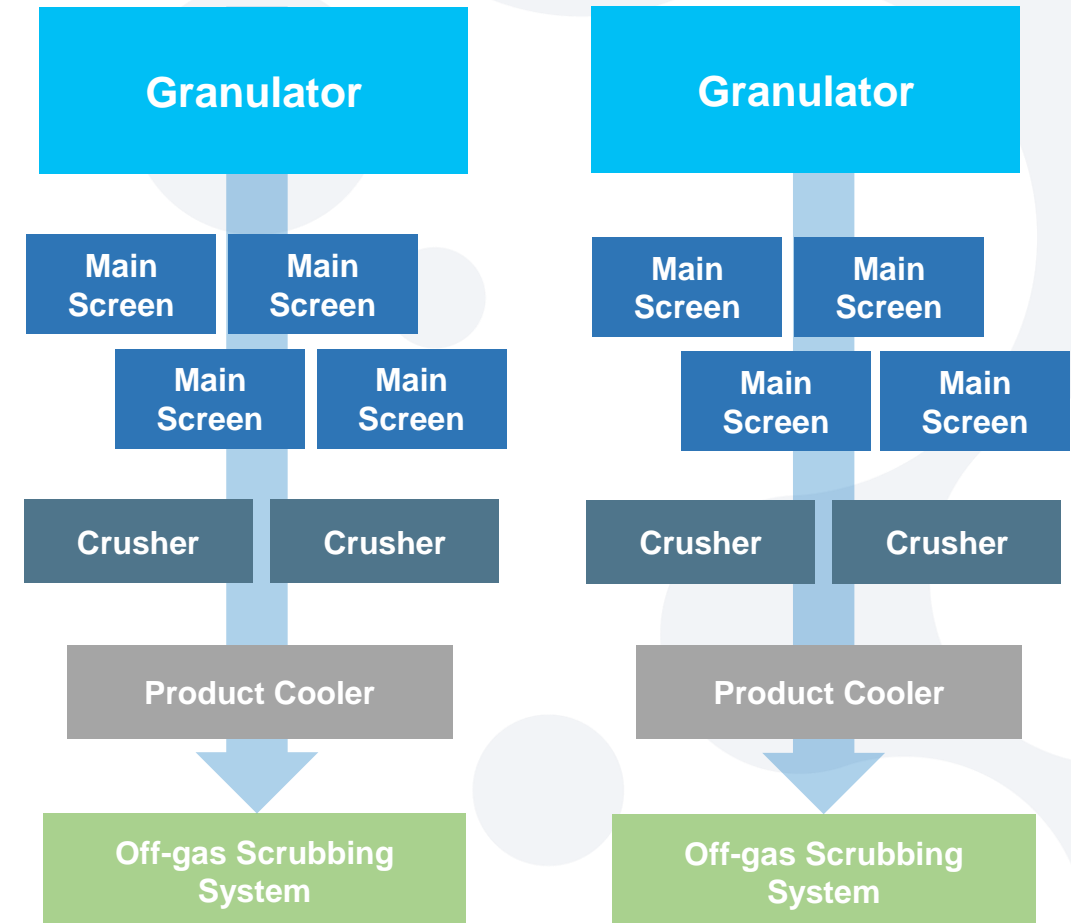


Single- or double-line configuration?

SINGLE LINE



DOUBLE LINE



Single- or double-line configuration?

- Economy of scale for single-line:

2500 MTPD vs. 5000 MTPD: + ~**USD 30/t**

- CAPEX comparison for single vs. double-line:

~**30% saving** on the investment cost for **single-line** configuration

- Operational benefits:

More operational flexibility for the double-line due to the possibility to operate each line independently

Experiences from 4000 MTPD granulation project

- Our recent 4000 MTPD licensing project showed the challenges in:
 - Minimizing the overall granulation plant height and the footprint
 - Satisfying standard piping design criteria such as length, slope, etc. for critical process lines also for the larger sized process equipment
 - Placing and inter-connecting the solid handling process equipment in the most optimum orientation in order to minimize breakage and loss of product
 - Designing a single off-gas scrubber unit with uniform distribution & efficient cleaning of the large off-gas flow

Conclusions

- Stamicarbon's experience with two reference plants running with capacities in the scale of 3000 MTPD have been positive.
- After an extensive technical & economical investigation, Stamicarbon developed and completed the design of a single line 5000 MTPD granulation plant.
- A single-line of 5000 MTPD is estimated to have a 30% less CAPEX as compared to two lines of 2500 MTPD each.
- In-house experience gained from our recent 4000 MTPD project will be valuable during the execution of larger scale projects in the future.

Thank you!