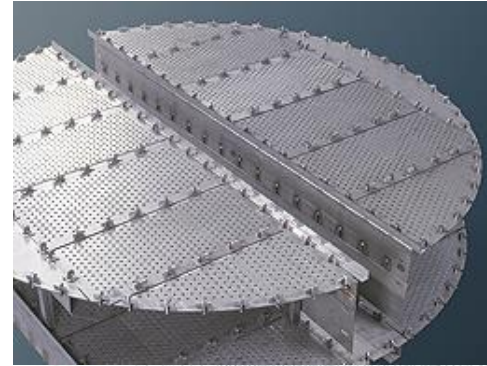
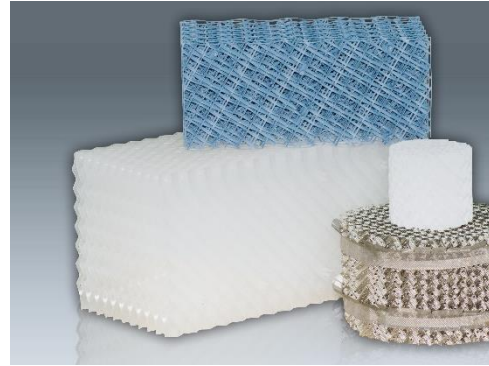
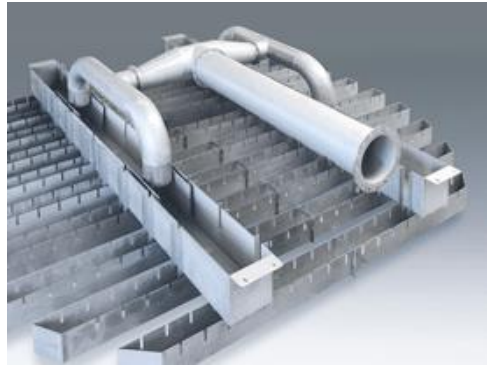




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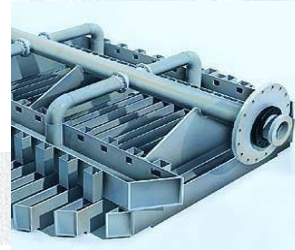
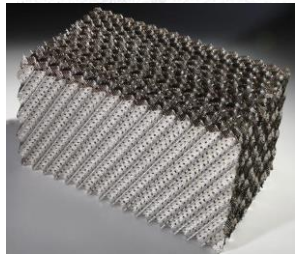
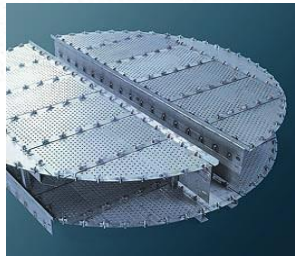
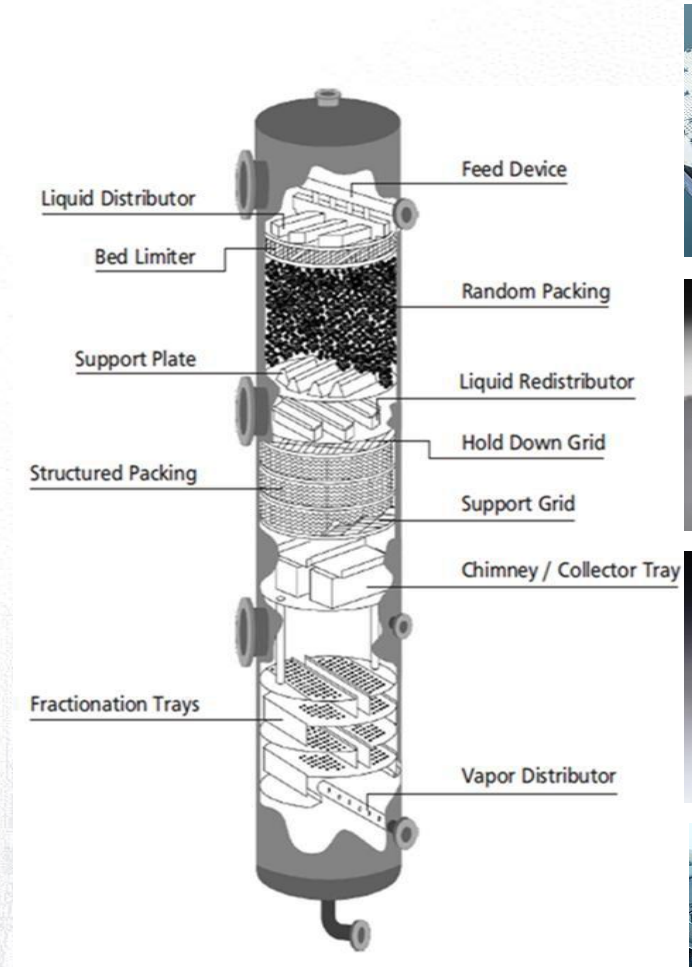
Optimization of an Ethlybenzene/Styrene Splitter with RMP SP-type Structured Packings – A Case Study

Introduction to RVT Process Equipment



RVT Process Equipment GmbH

- Company founded in 1976 in northern Bavaria, Germany
- A global supplier of mass transfer & separation internals and package units with five decades of experience
- Manufacturing facilities located in Europe, Asia and Americas.
- In-house R & D and Pilot Plant facilities for in-house product development and customer R & D projects
- Scope of supply:
 - complete portfolio of tower internals and mass transfer equipment
 - Turn-key units for combustion, waste gas scrubbing applications and ammonia recovery
- All key product performance is validated by independent organization such as Fractionation Research Inc. (Stillwater, OK) and SRP (Separation Research Program, University of Austin, Texas)



RVT Metal Structured Packings:

RMP N ---X/Y : conventional structured packing type
corrugation angle 45° (Y) or 60° (X)

RMP S --- : high capacity structured packing type
constant corrugation angle 45° in the middle
corrugation change at top and bottom ends

RMP SP --- : New high capacity packing development

--- = spec.area
 m^2/m^3



RVT high capacity structured packing development

RMP SP-line

RVT development with optimized channel geometry

New shape:

- High inclination angle in transition sections
- Middle section with varying inclination angle
- Varying crimp size dimensions

Performance proven in FRI and SRP measurements:

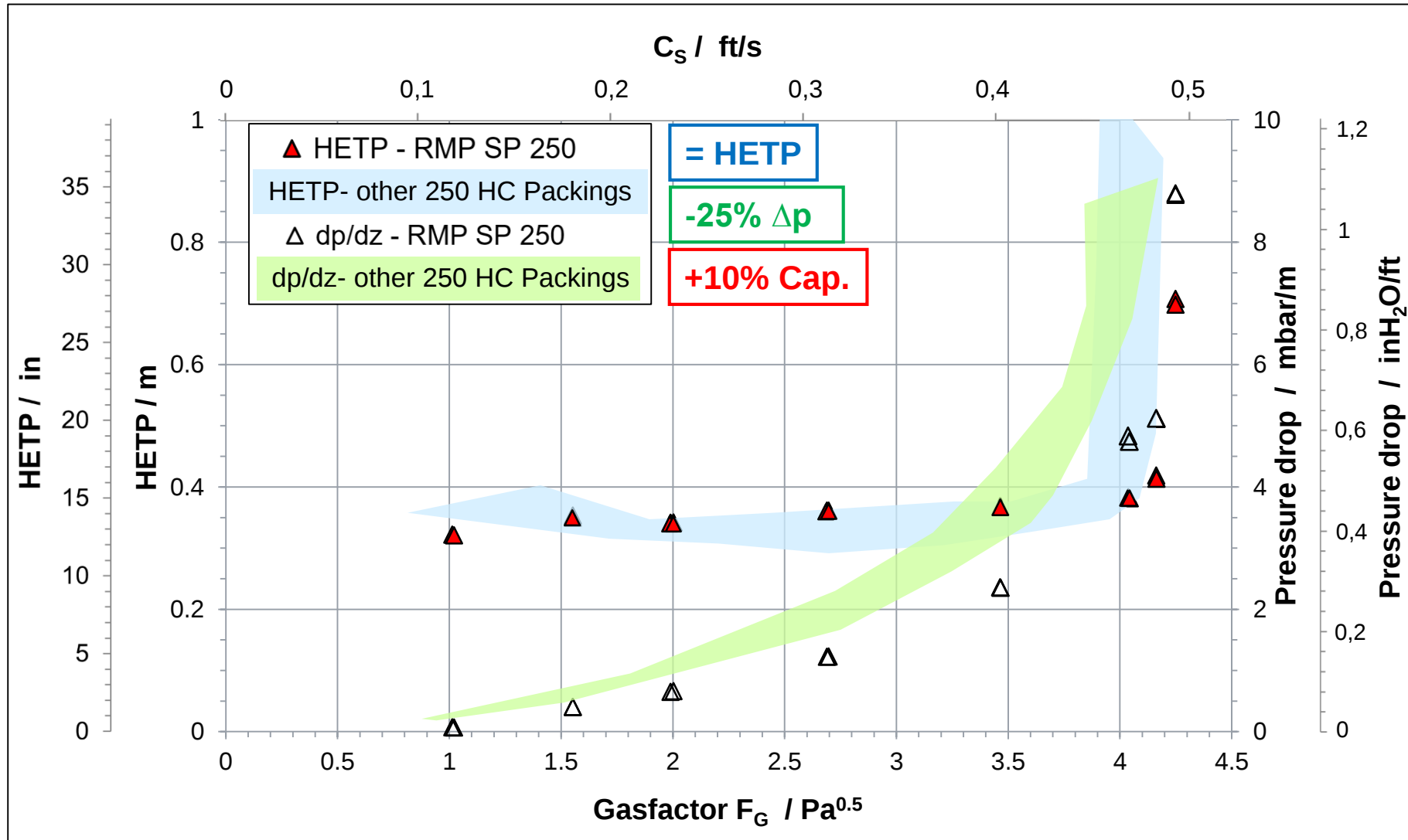
- Lower in pressure drop
- Higher capacity
- Equivalent efficiency

compared to 2nd generation structured packings with equivalent surface area



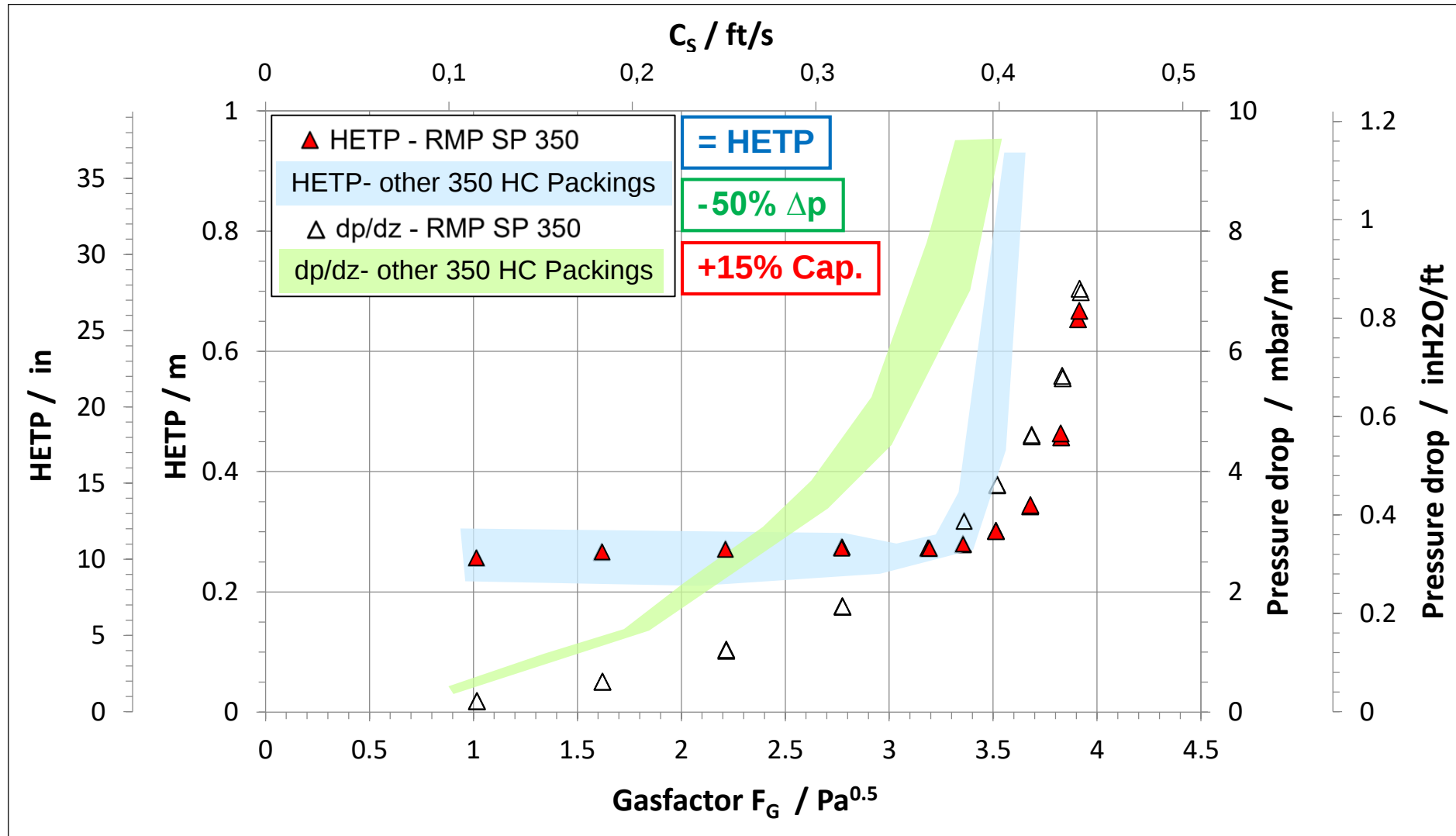
RMP SP 250 vs. other 250 m²/m³ HC-Packings

o/p-Xylene – p=0.1 bara



RMP SP 350 vs. other 350 m²/m³ HC-Packings

o/p-Xylene, p= 0.1 bara



The Next Generation Structured Packing: *The RMP SP packing*

- FRI (Category 1 Test) and SRP Tested
- Successfully proven in commercial columns since 2015
- Available in 250 and 350 m²/m³
- same efficiency level compared to other high-capacity packings
- 25% - 50% reduction in pressure drop compared to other high-capacity packings
- 10% - 25% increase in capacity compared to other high-capacity packings



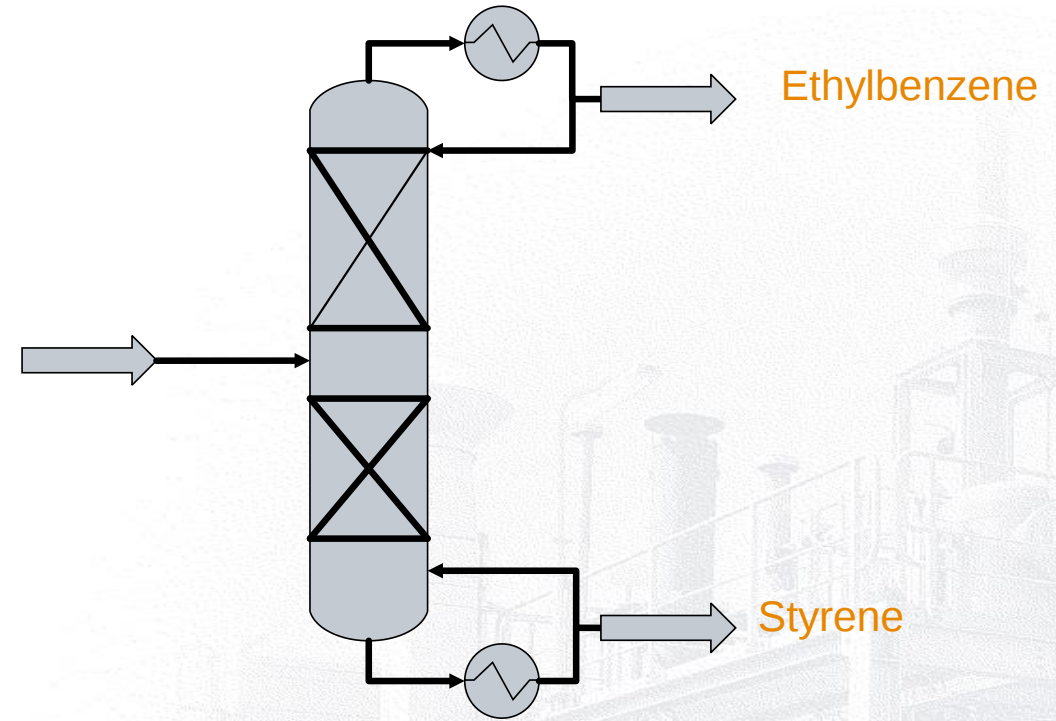
3800 mm Scrubber Column



Performance features of RMP SP-line offers a significant improvement potential for revamping columns equipped with structured packings

Ethylbenzene/Styrene Monomer (EB/SM) Splitter

- Styrene Monomer (SM) among the most extensively manufactured chemicals in the global chemical industry
- Vacuum distillation (< 400 mbara) due to SM-polymerization at elevated temperatures
- Sieve trays first choice as MTE in the 50s, then replaced by conventional- 1st generation & high capacity- 2nd generation structured packings



Trays



1st Gen. Str. Pack.



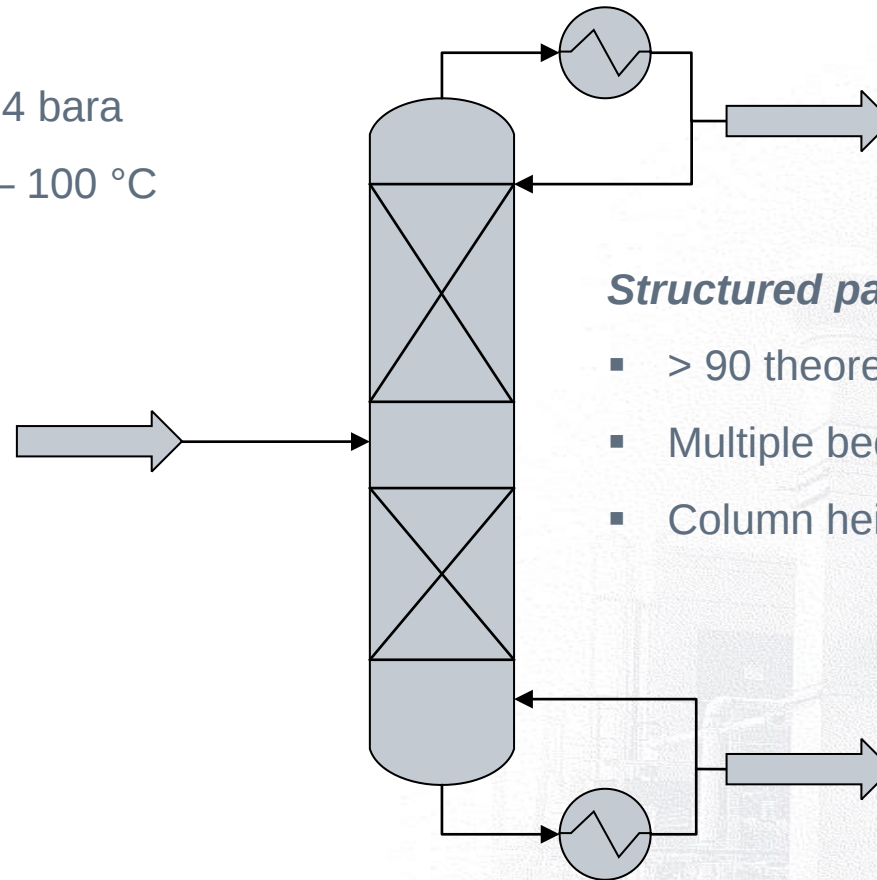
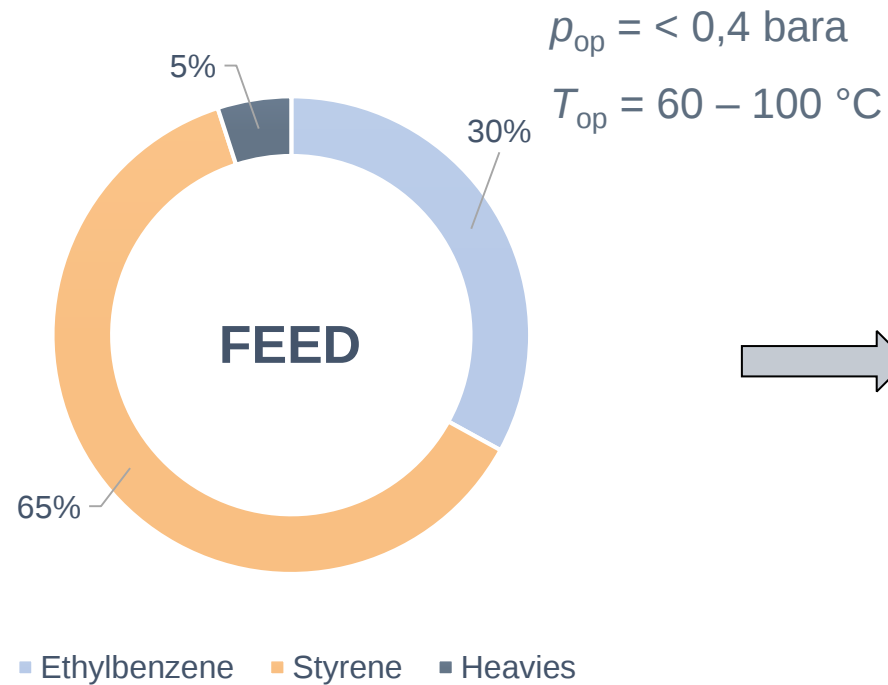
2nd Gen. Str. Pack.



Case Study to evaluate advantages when using RMP SP structured packings in EB/SM-Splitters

Ethylbenzene/Styrene Monomer (EB/SM) Splitter

General information



Structured packing:

- > 90 theoretical stages
- Multiple beds
- Column height > 50m

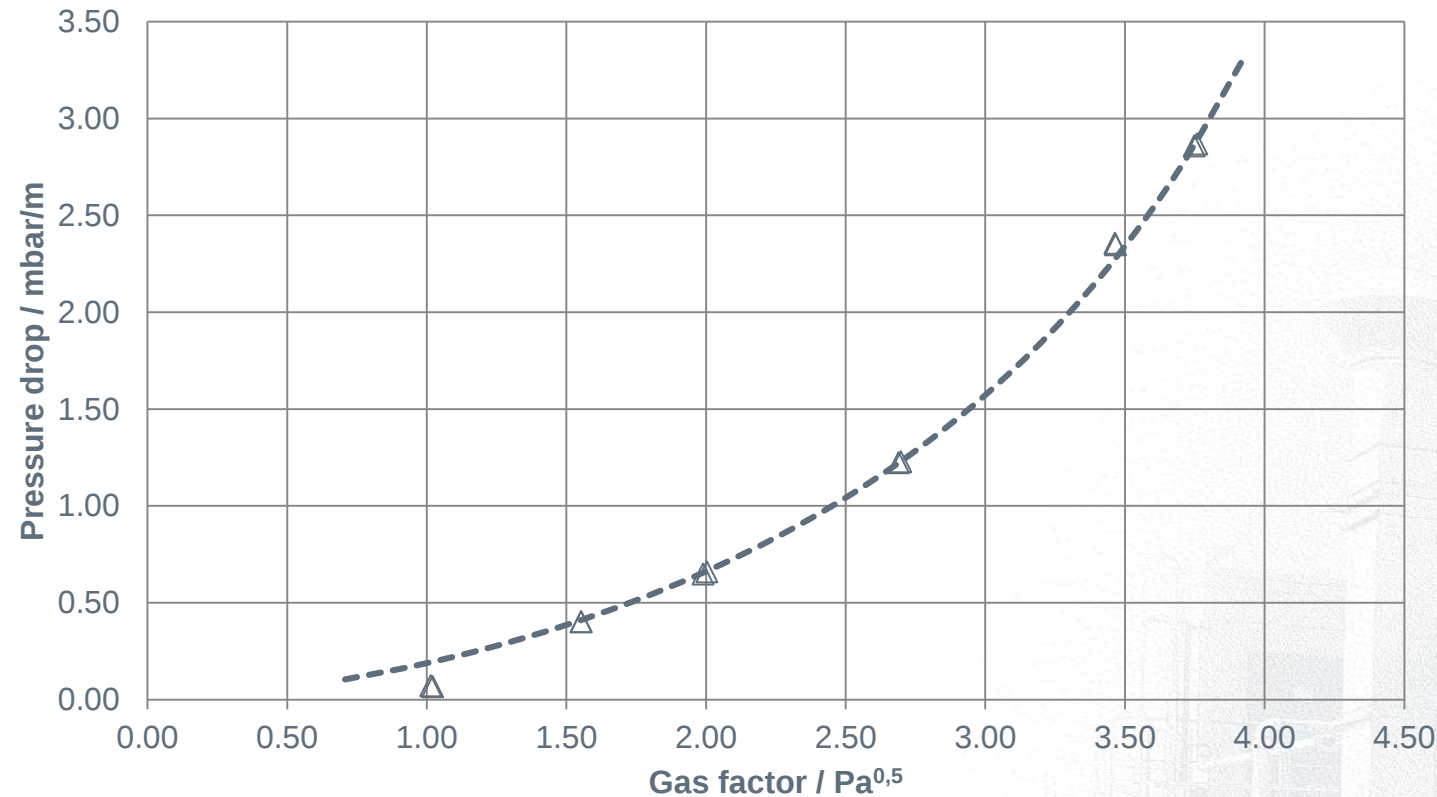
Top product	
x_{EB}	> 98 wt%
x_{SM}	< 2 wt%

Bottom product	
x_{SM}	> 92 wt%
x_{EB}	< 450 ppm
$x_{Heavies}$	7-8 wt%

Ethylbenzene/Styrene Monomer (EB/SM) Splitter

Hydraulic model

RMP SP 250 o/p-Xylene, Δp , $p = 0,1$ bara (FRI)



Δ FRI
--- Simulation



RVT random and structured packings are now available in Aspen Plus V15

Ethylbenzene/Styrene Monomer (EB/SM) Splitter

Scenario I - Replacement of 350 m²/m³ packing



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Replacement of 350 m²/m³ packing

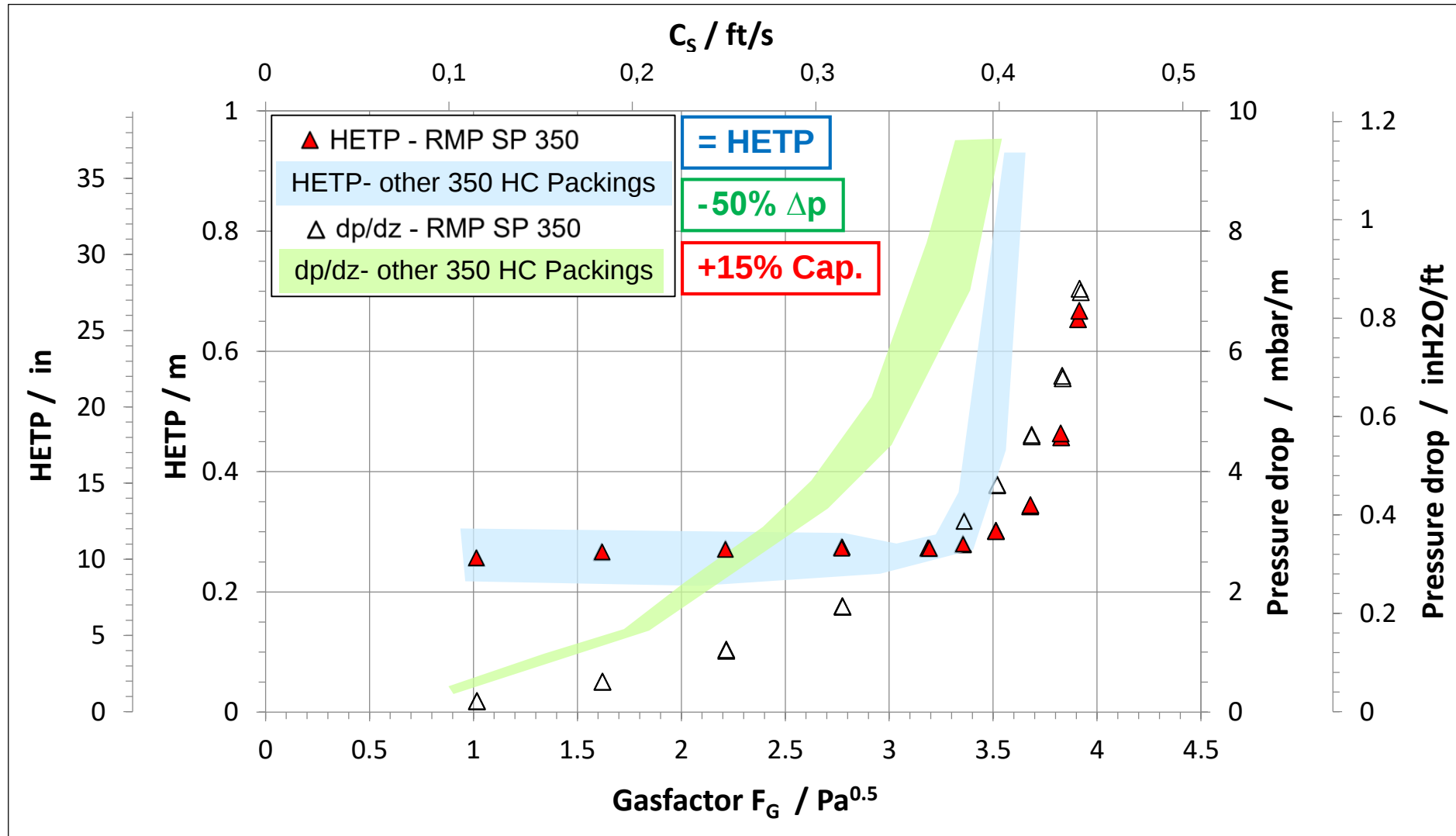
RMP S 350



RMP SP 350

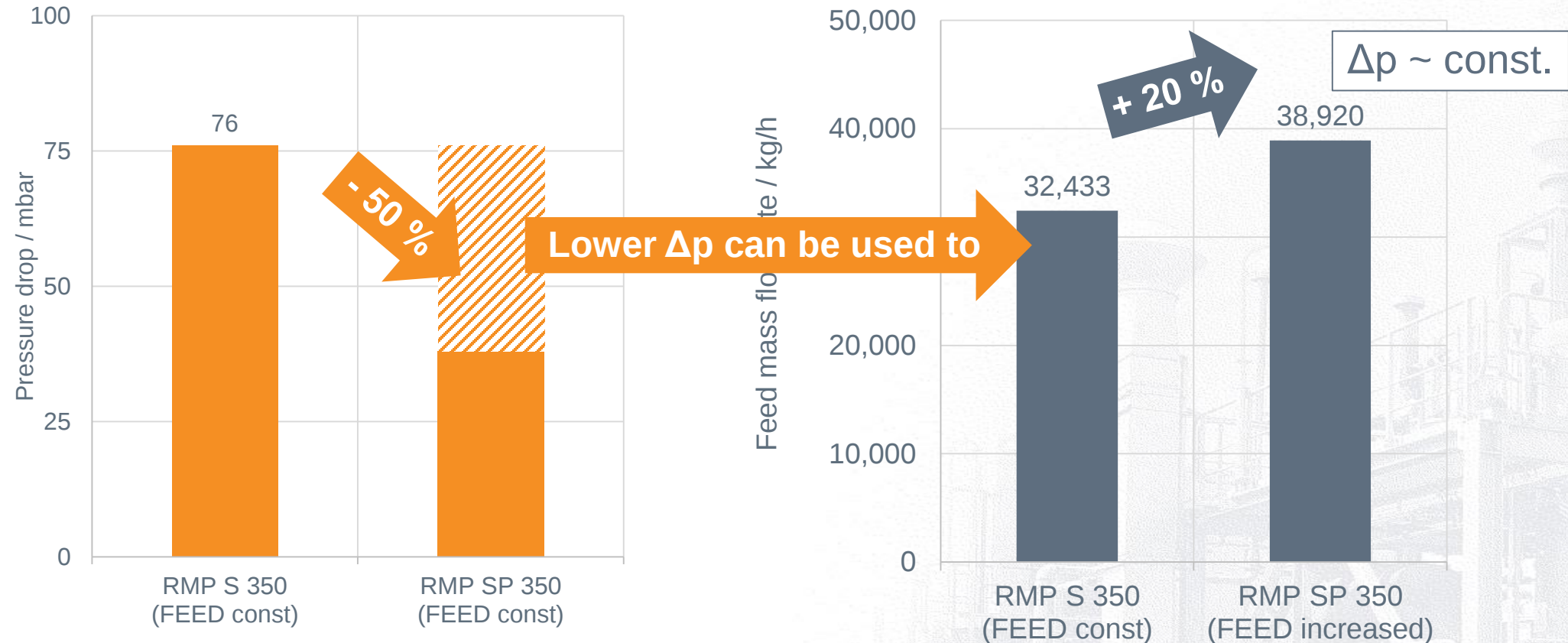
Ethylbenzene/Styrene Monomer (EB/SM) Splitter

Scenario I - Replacement of 350 m²/m³ packing



Ethylbenzene/Styrene Monomer (EB/SM) Splitter

Scenario I – Replacement of 350 m²/m³ packing



Lower specific pressure drop leads to lower sump temp. or higher hydraulic capacity

Ethylbenzene/Styrene Monomer (EB/SM) Splitter

Scenario II – Replacement of 250 m²/m³ packing



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Replacement of 250 m²/m³ packing

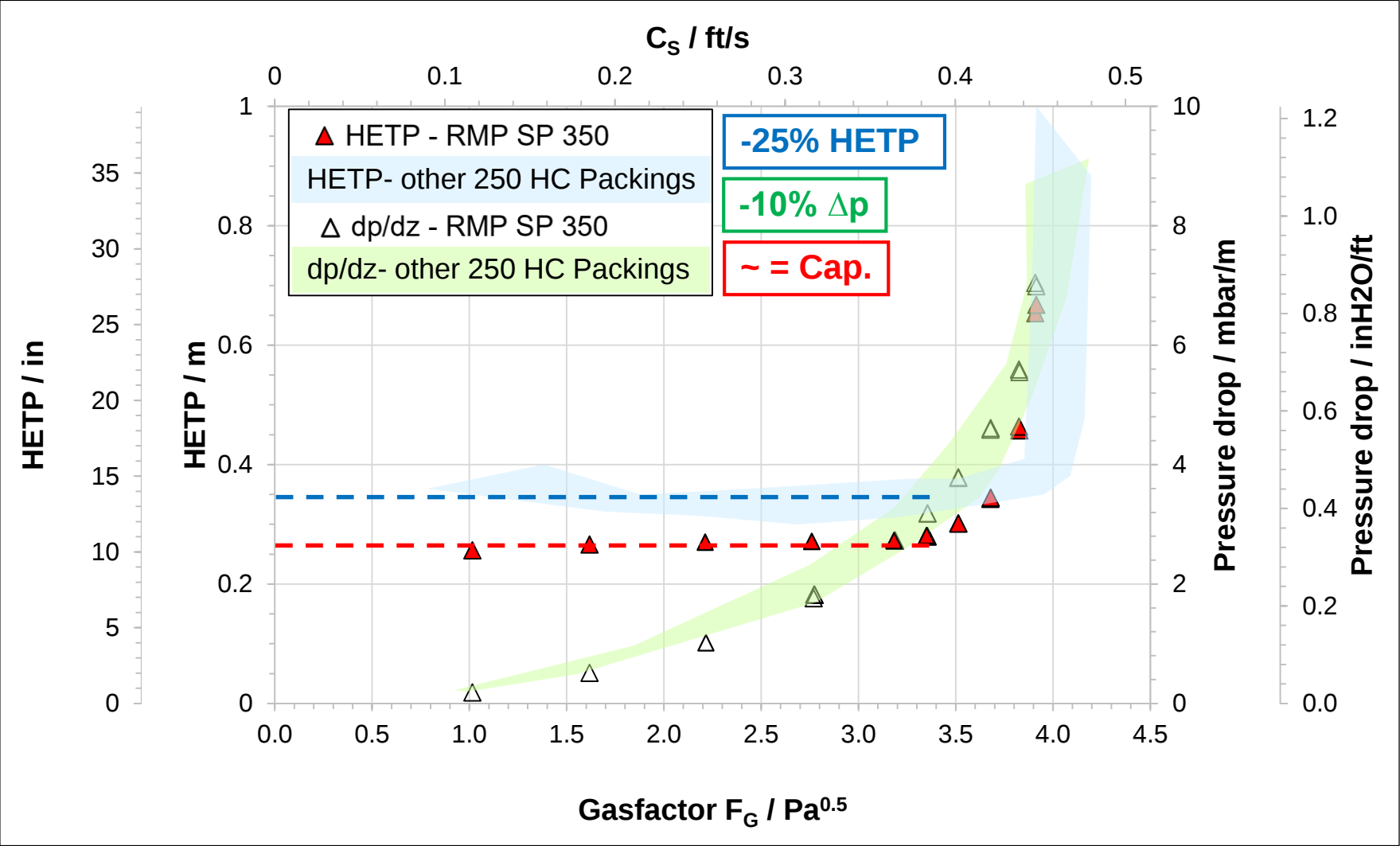
RMP S 250



RMP SP 350

Ethylbenzene/Styrene Monomer (EB/SM) Splitter

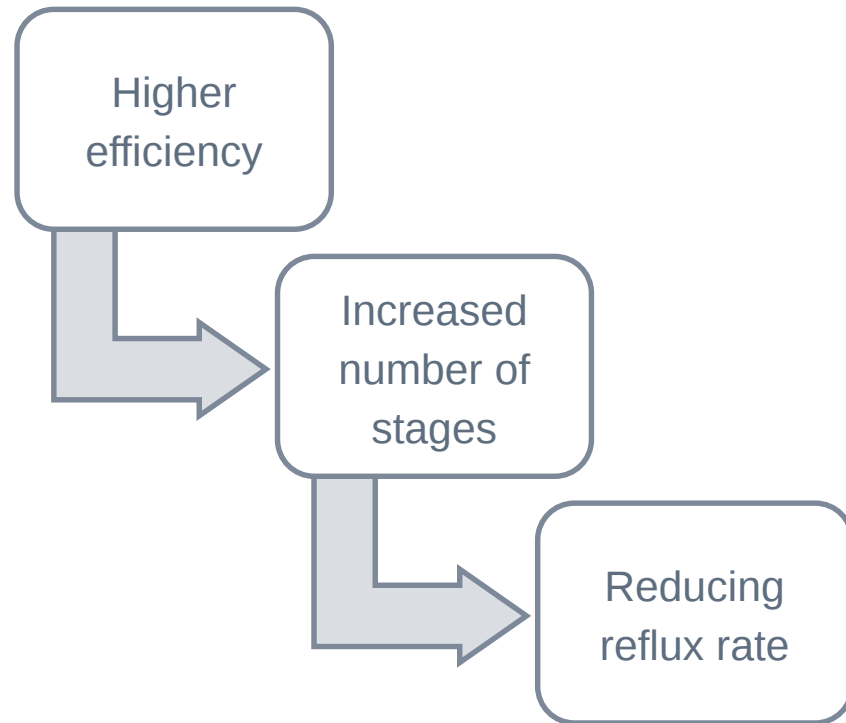
Scenario II – Replacement of 250 m²/m³ packing



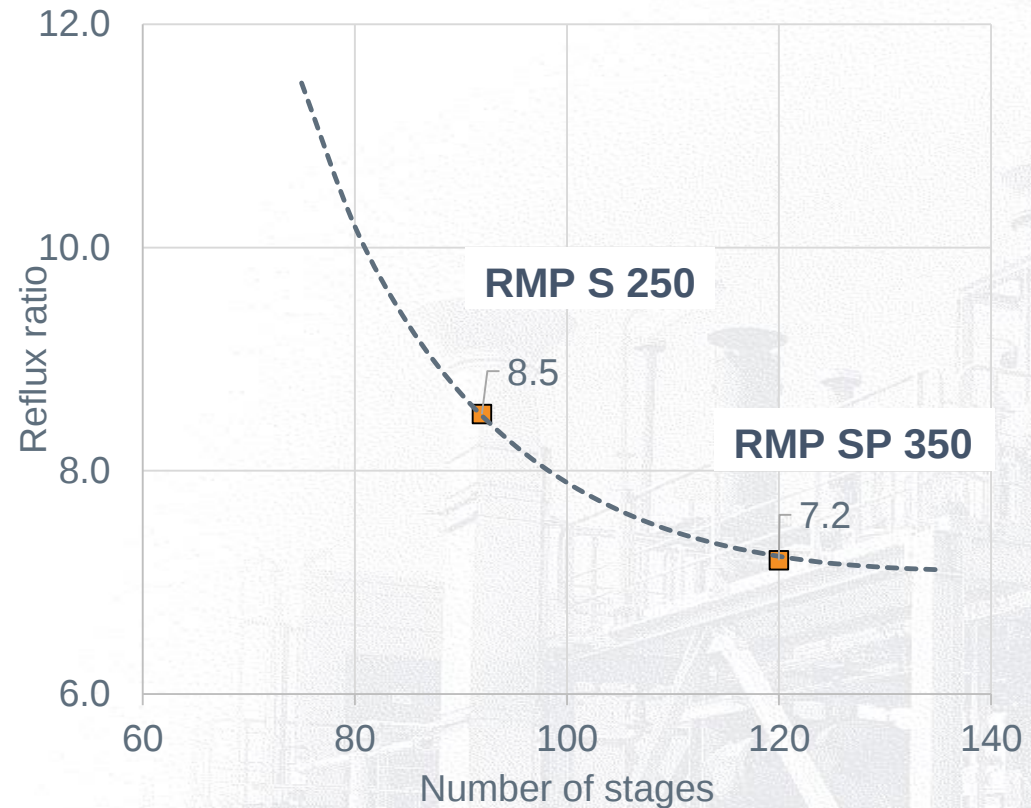
Ethylbenzene/Styrene Monomer (EB/SM) Splitter

Scenario II – Replacement of 250 m²/m³ packing

FEED = const.



Reflux ratio vs. Number of stages

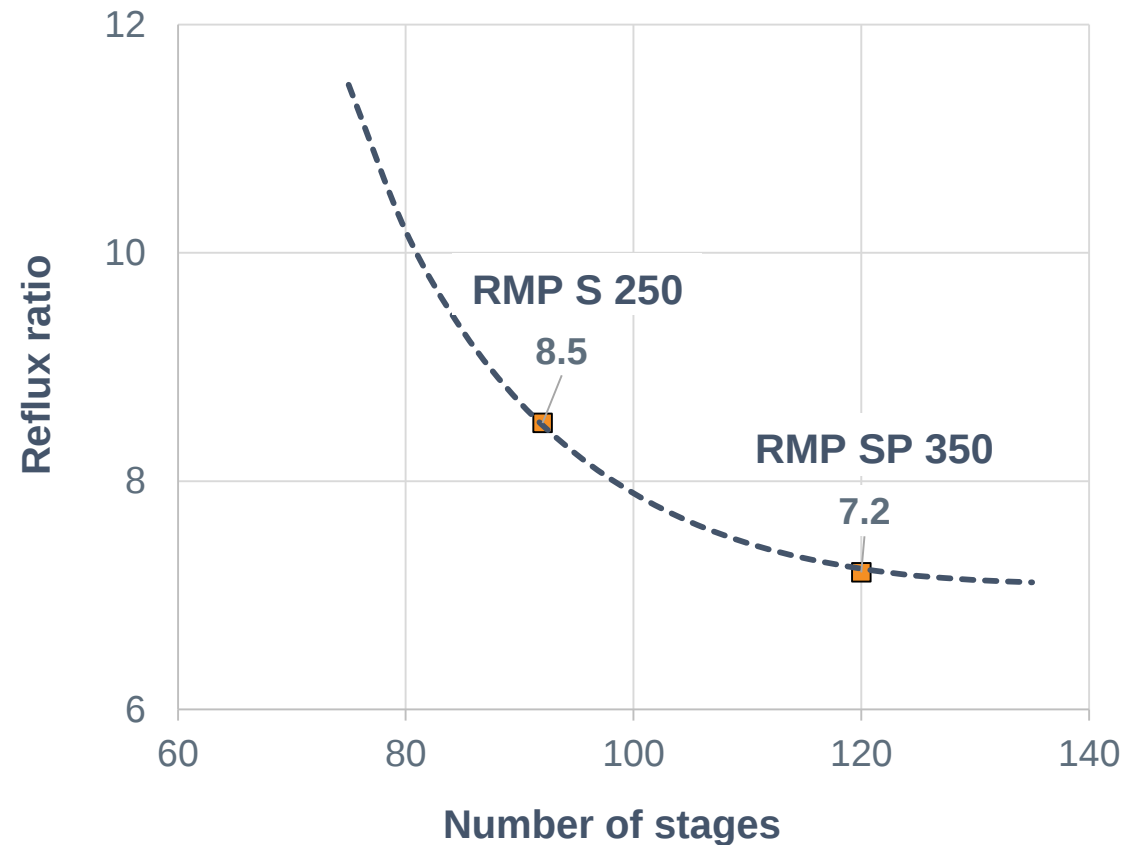


Packing replacement reduces the required reflux rate

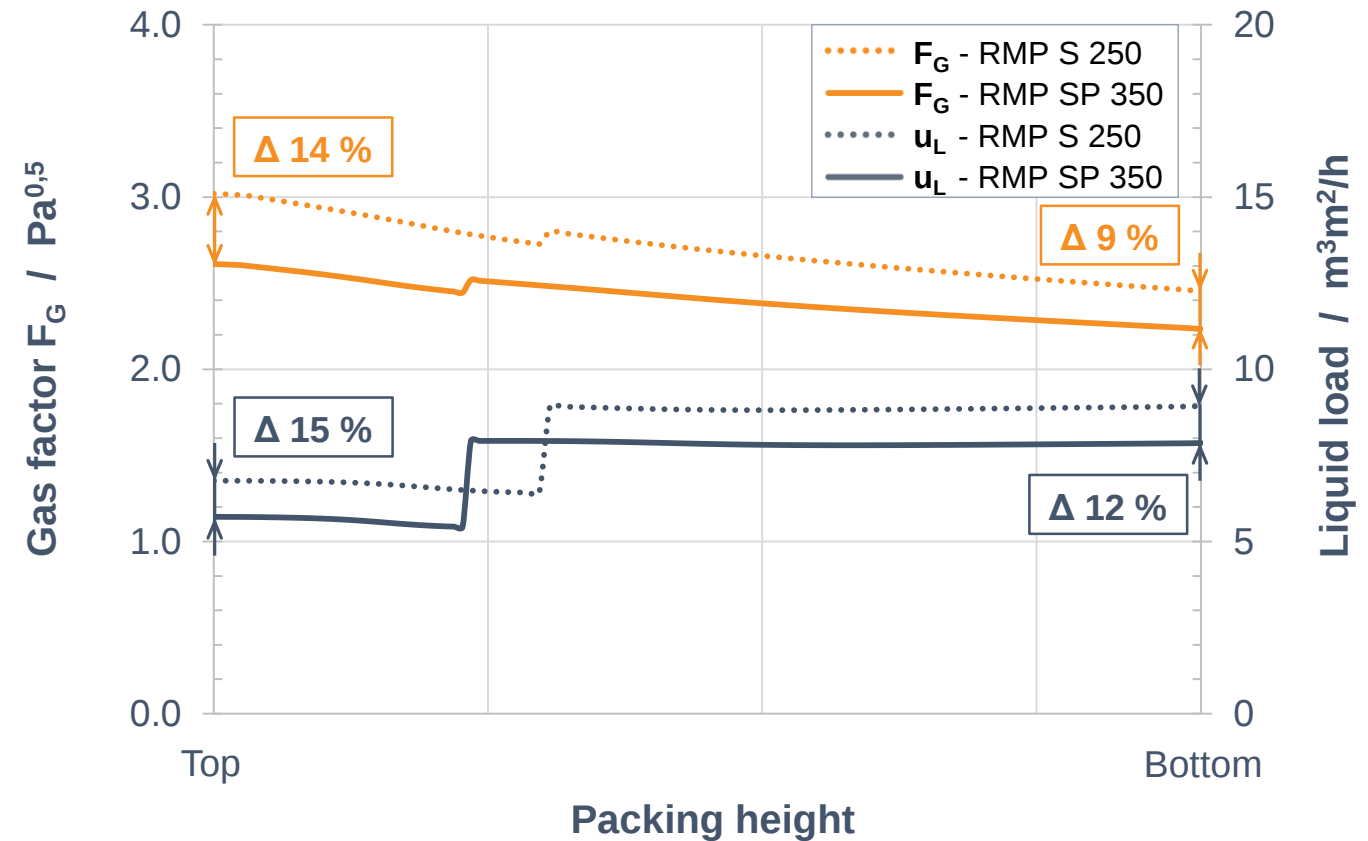
Ethylbenzene/Styrene Monomer (EB/SM) Splitter

Scenario II – Replacement of 250 m²/m³ packing

Reflux ratio vs. Number of stages



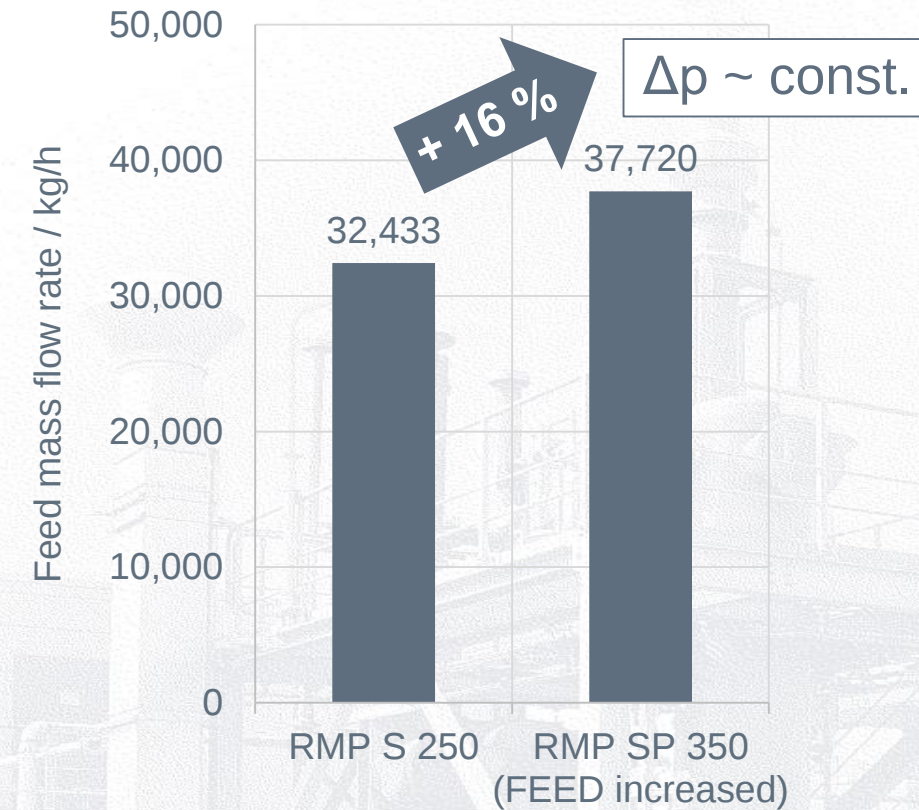
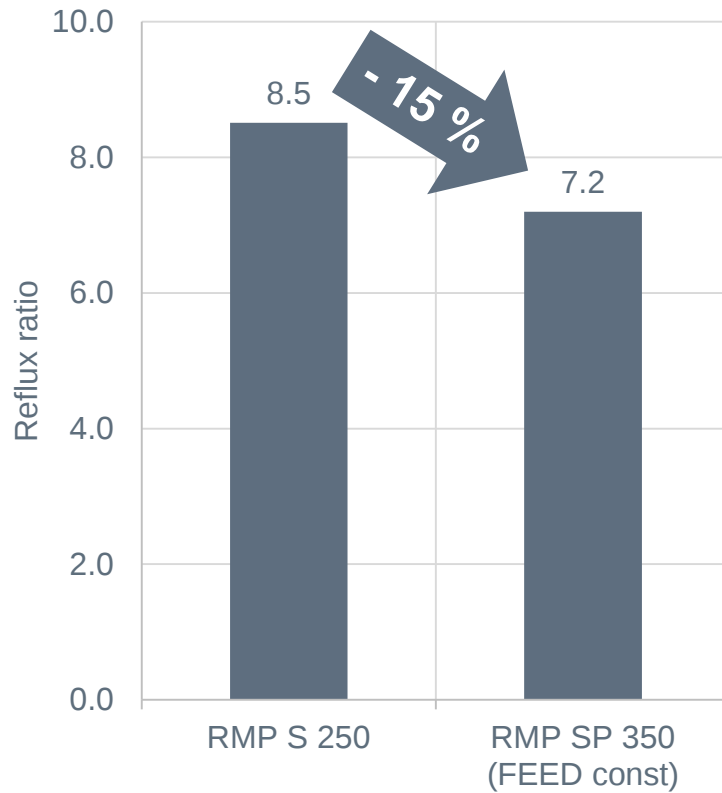
Column profile



Lower reflux rate leads to lower hydraulic loads

Ethylbenzene/Styrene Monomer (EB/SM) Splitter

Scenario II – Replacement of 250 m²/m³ packing



Increased Feed mass flow – same reboiler and condenser duty

Ethylbenzene/Styrene Monomer (EB/SM) Splitter

Summary

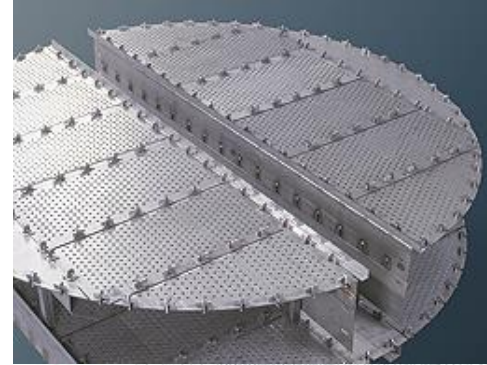
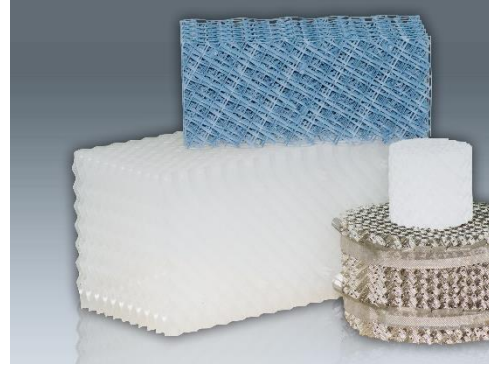
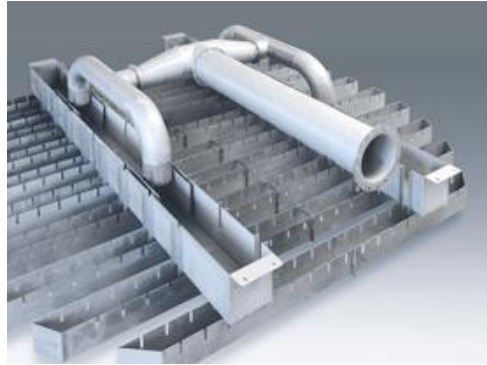


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- RMP SP- Packing offers significantly lower pressure drop at equivalent separation efficiency
- Especially for vacuum processes this benefits OPEX, capacity and polymerization behavior
- Case study of an EBSM-Splitter shows the benefits of having better efficiency at lower pressure drop level
- Replacement of 2nd generation RMP S 250 by RMP SP 350 leads to higher feed rate at constant reboiler and condenser duty
- Lower overall pressure drop and smaller ΔT leads to increase of COP for Vapor Recompression or heat pump



RMP SP 350 packing is an ideal solution for column revamp and optimization



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Thank you for your attention – Questions?

