Process Phase Separation Pitfalls
&
Screening out the Worst

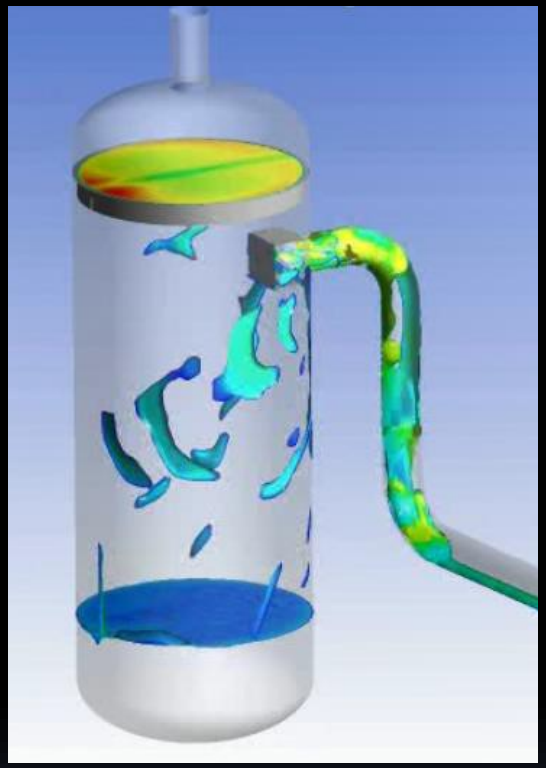
30th June 2021

Outline

- Undesirable internals selections
- Scrubber remediation demo
- Inlet Pipework
- Good design practice demo
- Research & Validation
- Digital Twin demo
- Summary
- Q & A

What affects separation effectiveness ?

Flow distribution



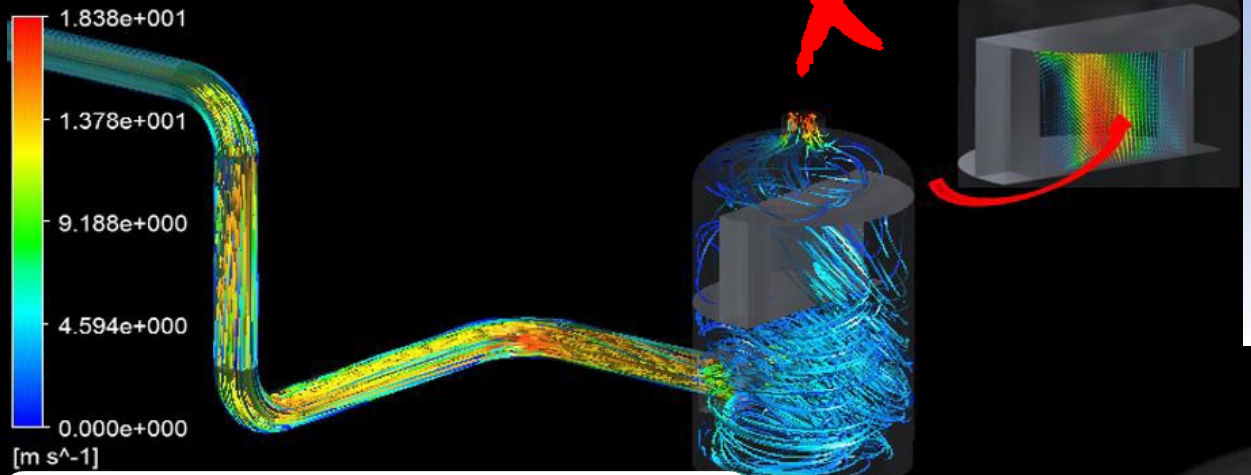
Uneven distribution means:

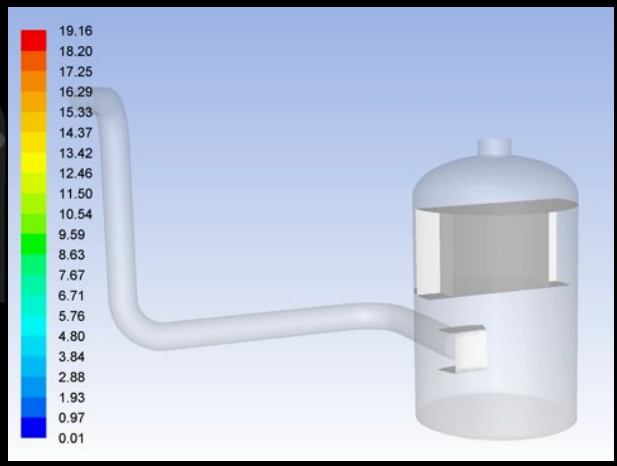
- high local velocities
- thus, poor droplet gravity capture
- and poor conditioning for:
  - *demisting*
  - *liquid-liquid settling*

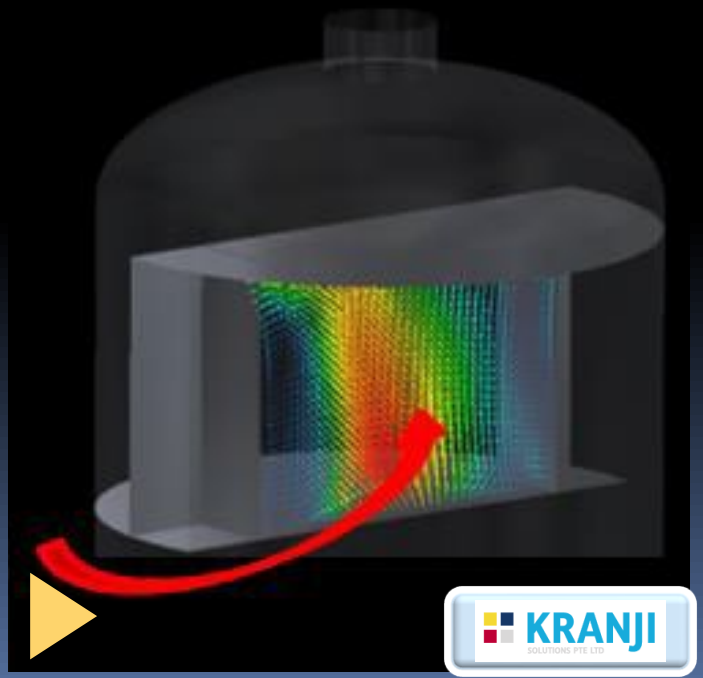
Spreadsheets usually size separators on ***mean*** velocities !

Mandate good practice -***strive for an even distribution*** !

Internals selection and Flow Distribution

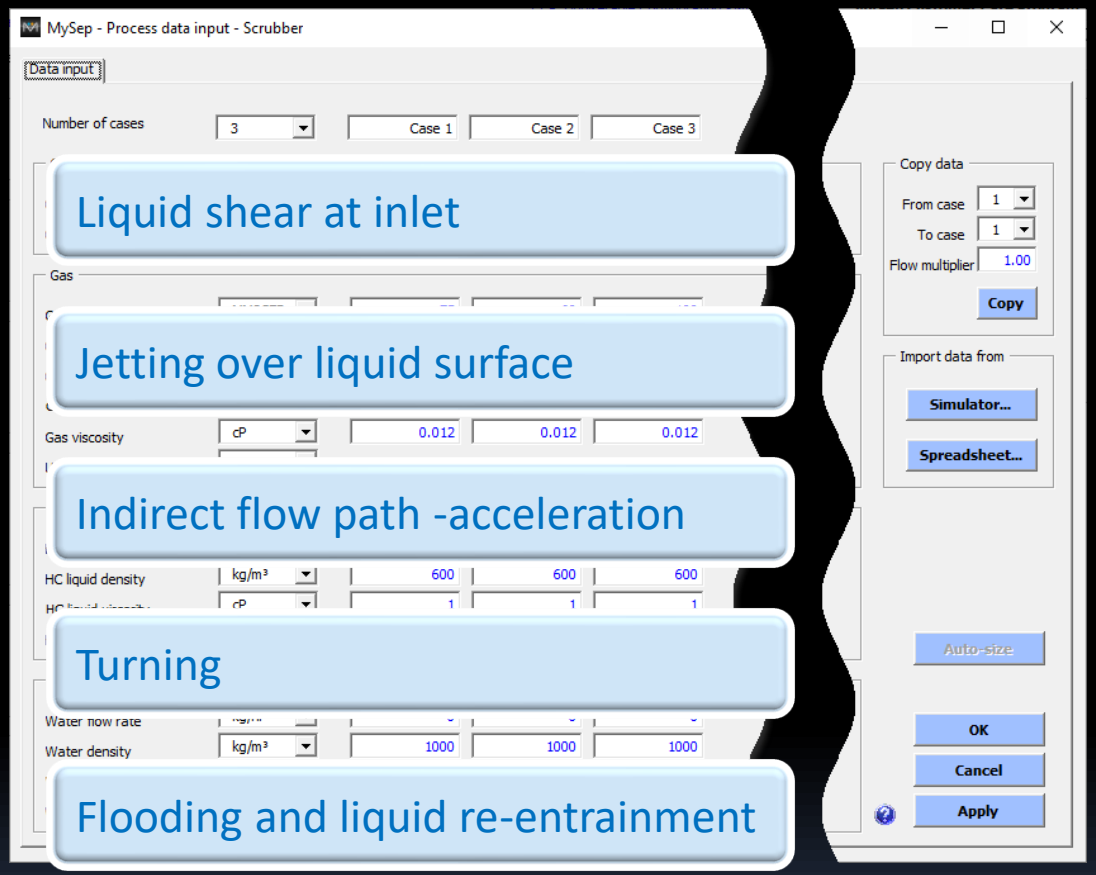






- Liquid shear at inlet
- High velocities over liquid surface
- Acceleration & turning
- Poor distribution over demister

Rating Example – Typical Scrubber arrangement



Liquid shear at inlet

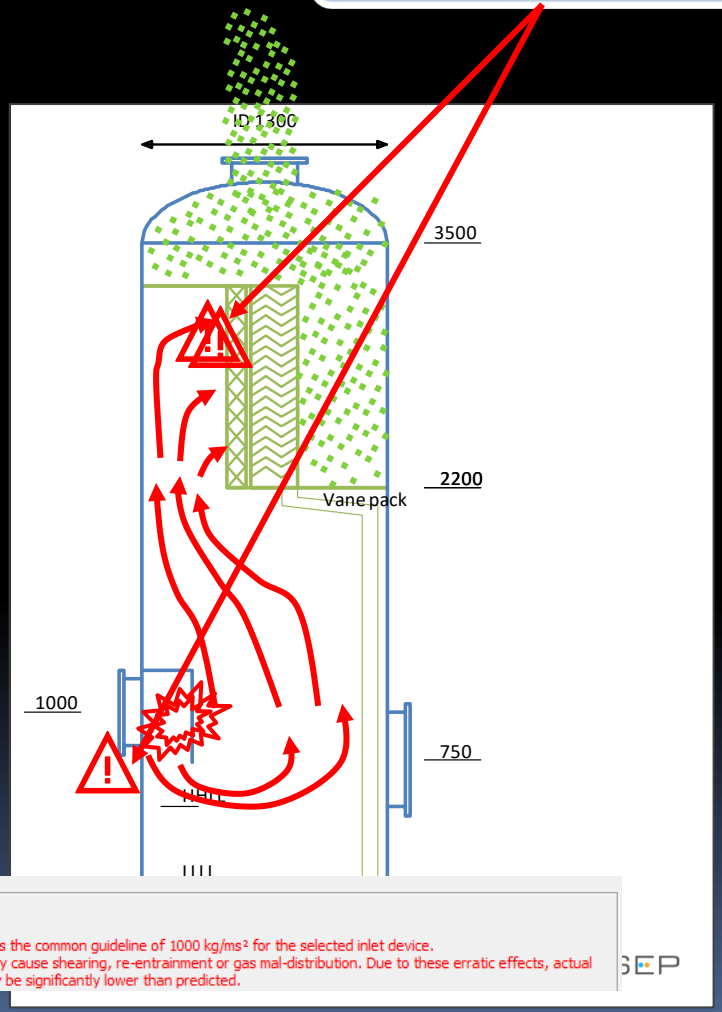
Jetting over liquid surface

Indirect flow path -acceleration

Turning

Flooding and liquid re-entrainment

MySep Warnings



Retrofit Demo ...

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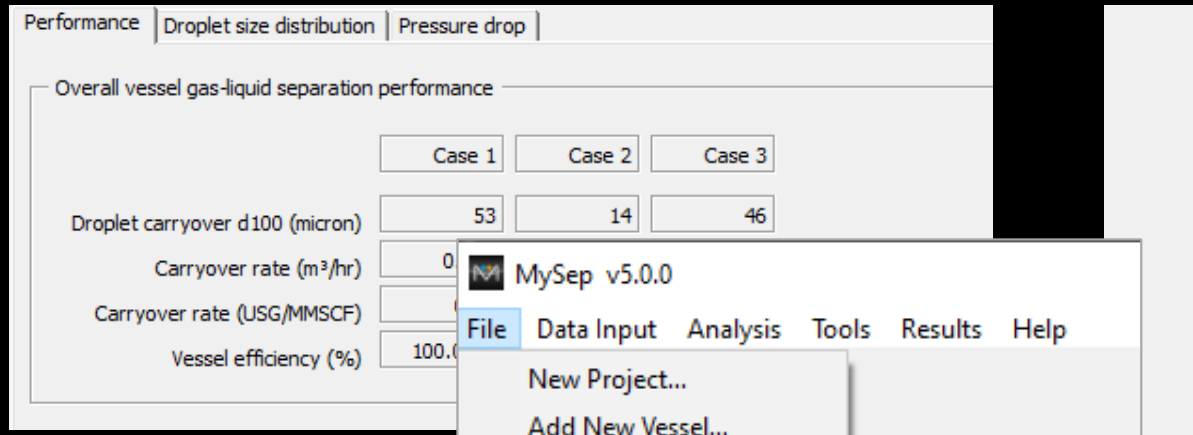
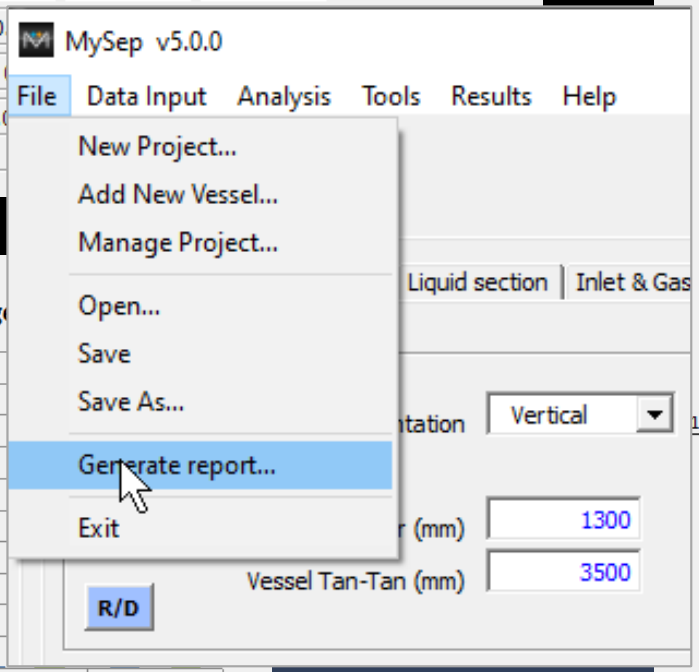
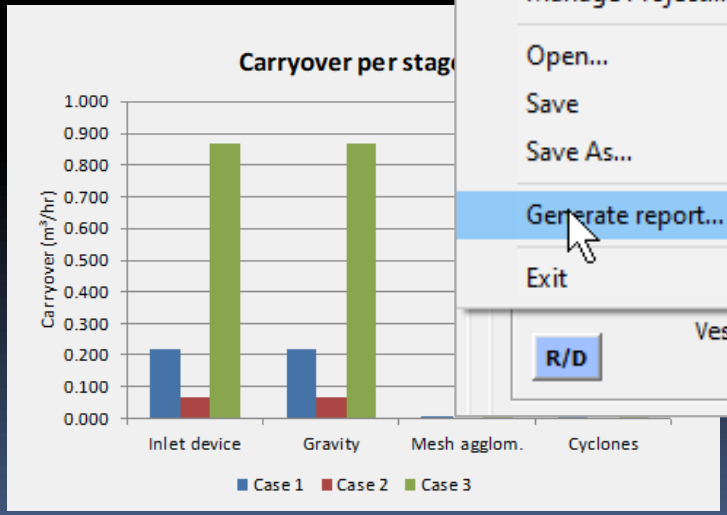
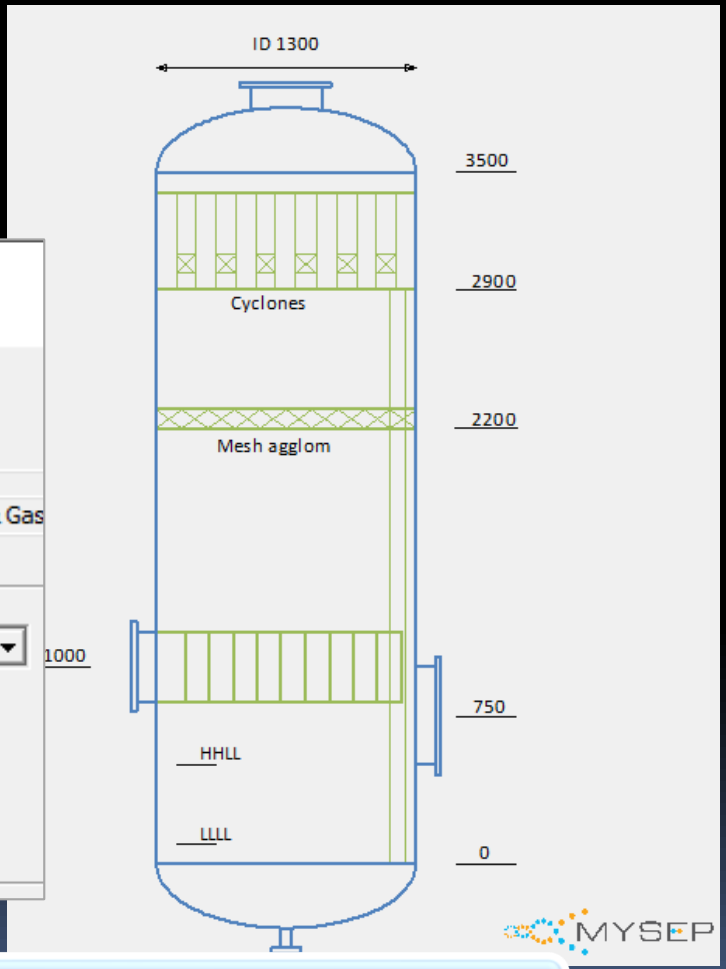
Retrofit Scrubber



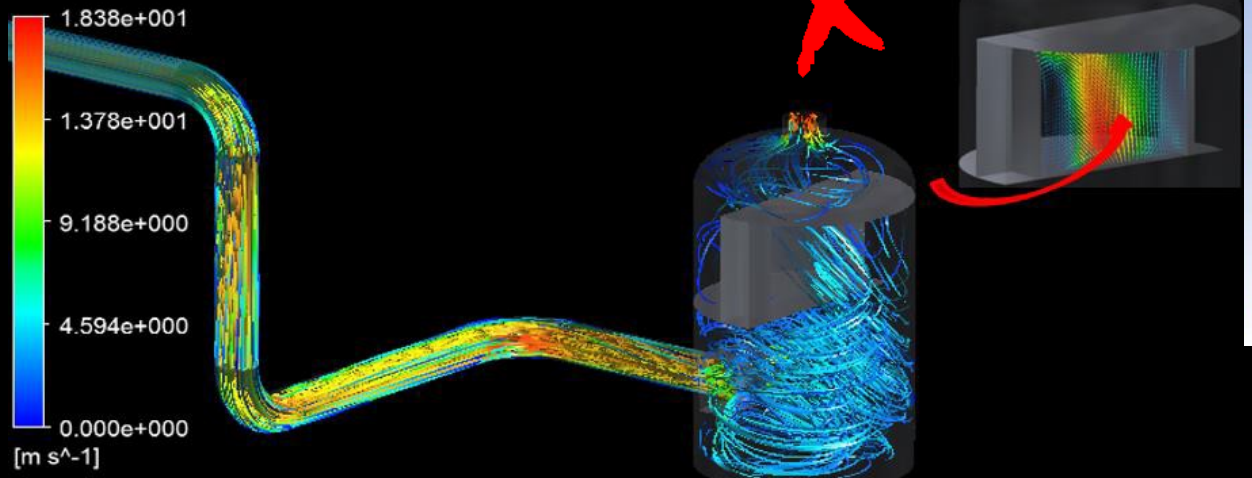


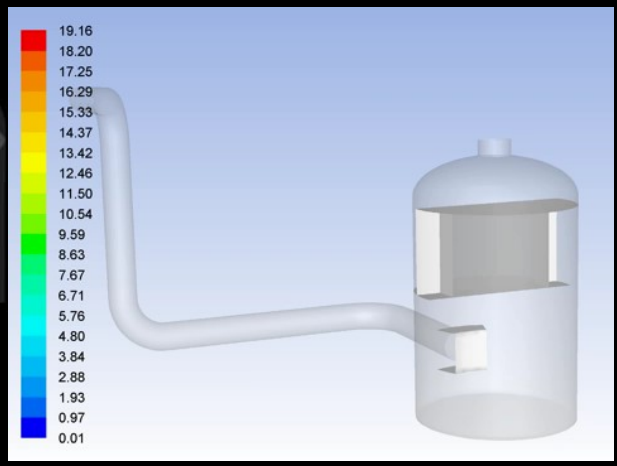


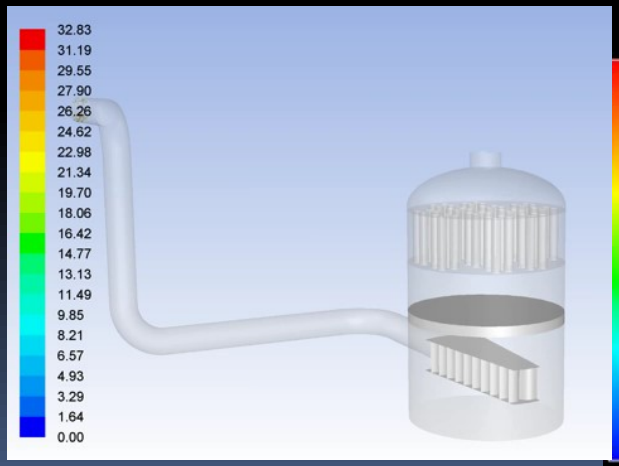


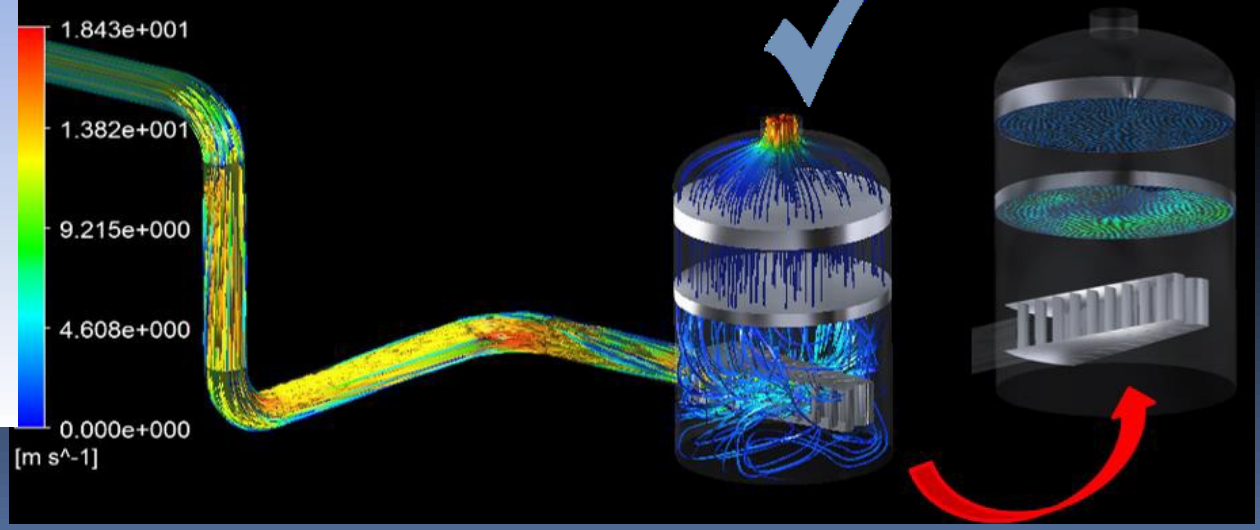
Full report available as pdf...

CFD Confirms Good Distribution

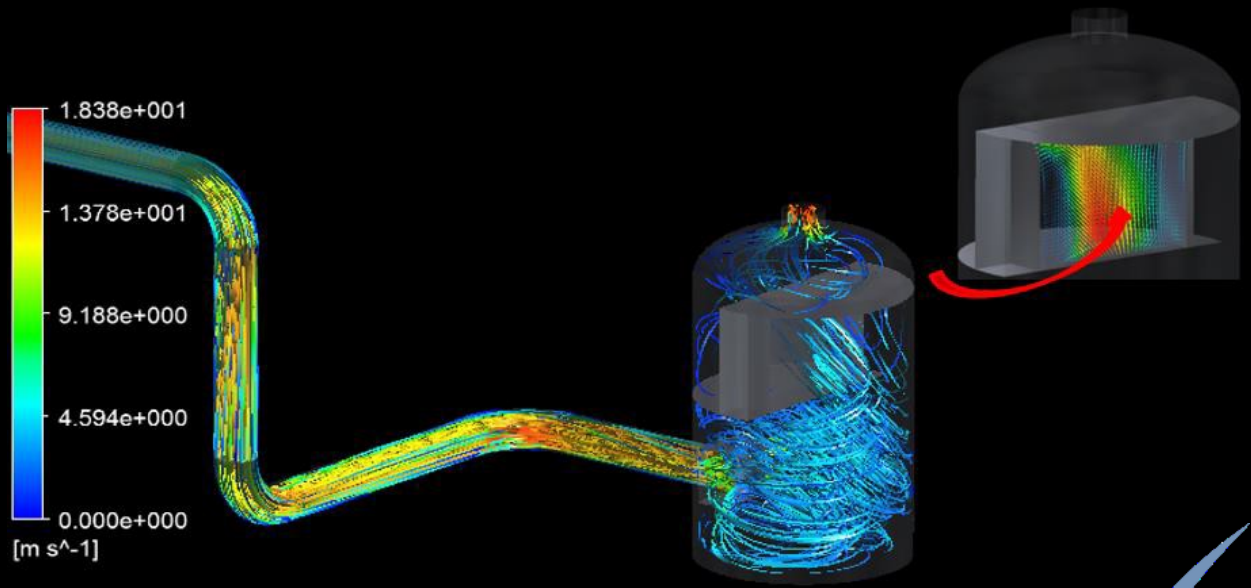


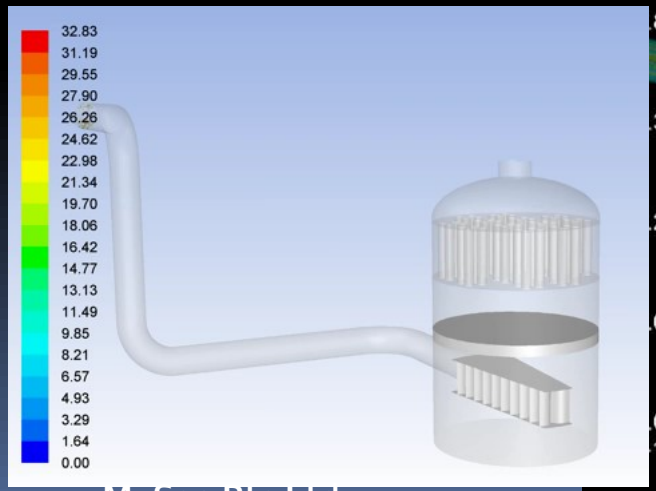


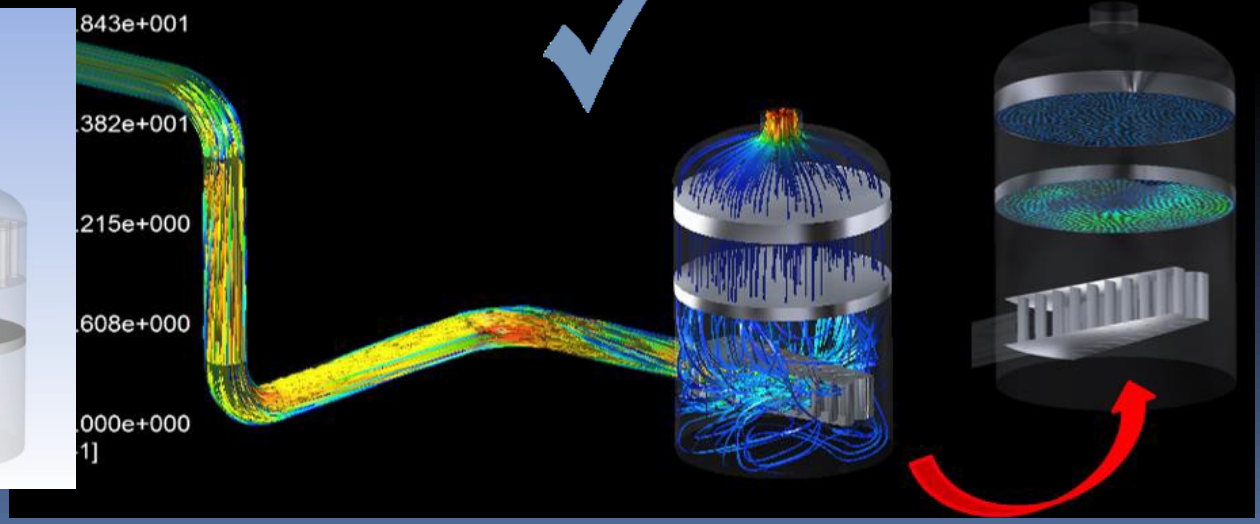




CFD Confirms Good Distribution



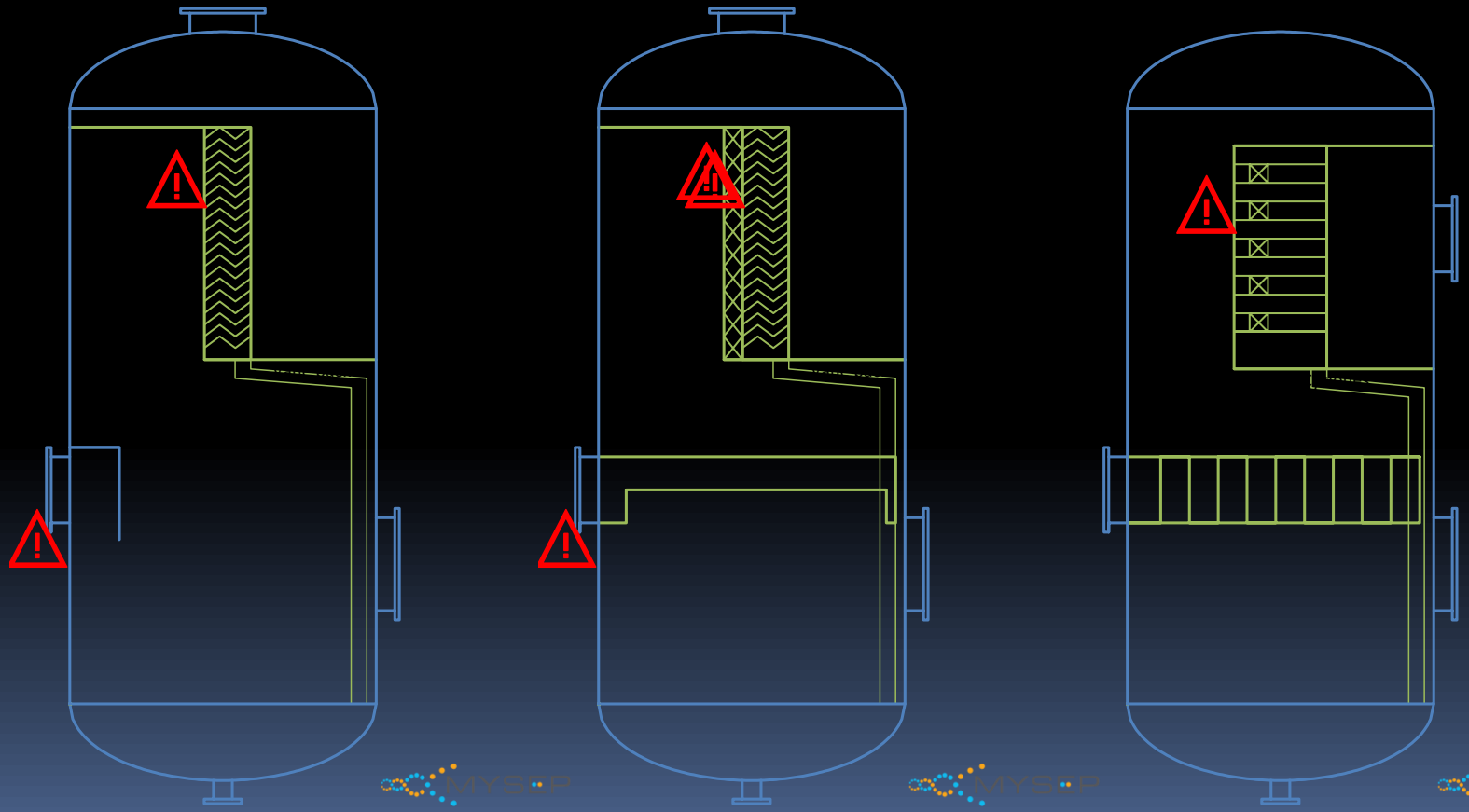




Some “Undesirable” internals configurations

Vertical Separators

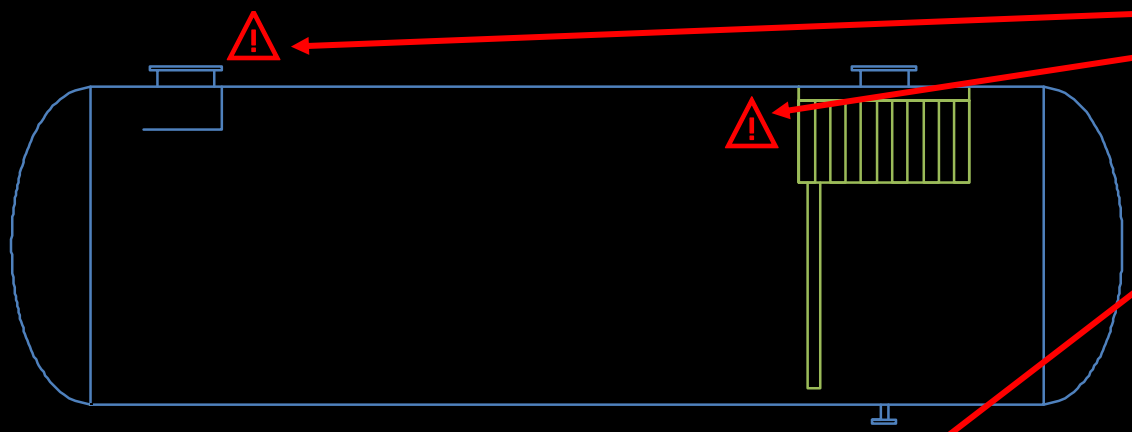
Examples of the many undesirable configurations you can specify



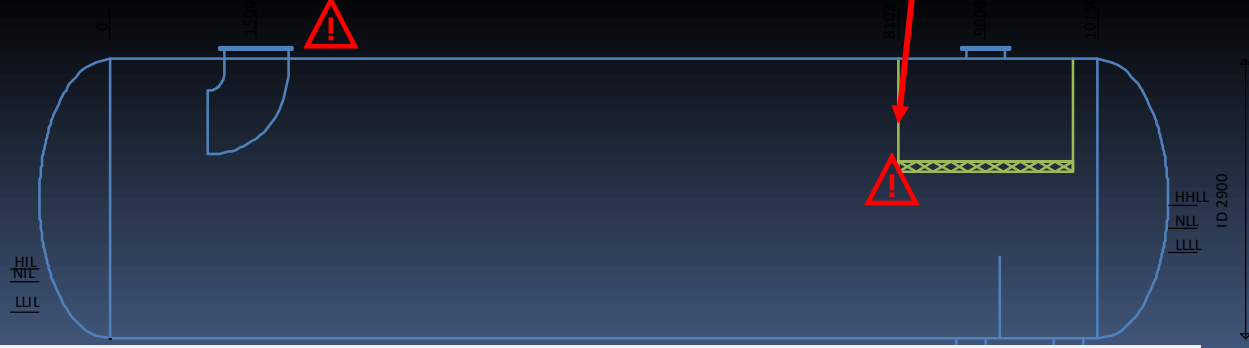
Some more “Undesirable” internals configurations

Horizontal Separators

MySep Warnings

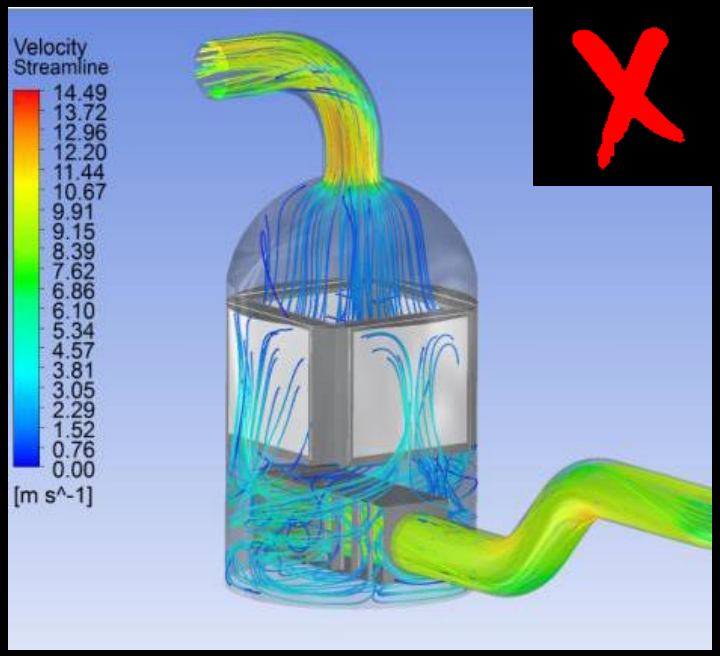


Examples of other “undesirable” configurations you may specify in **Rating** mode



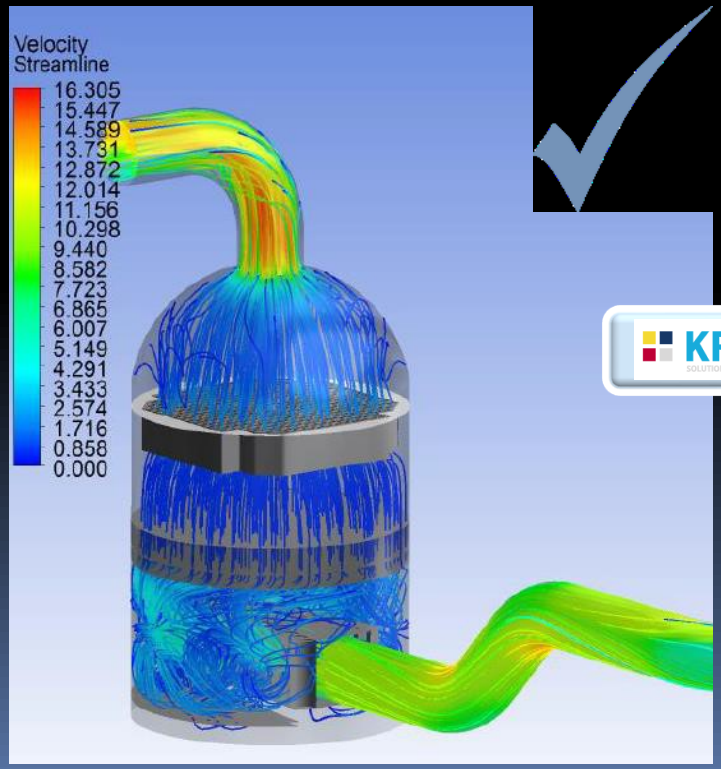
INFO: The selected orientation of demisting device #1 typically results in gas maldistribution. Local overloading of this device may occur and performance may be lower than predicted. CFD verification is recommended.

Another poor demister arrangement



LNG process – carry-over at 35% capacity

Rapid degradation of molecular sieves



"Use designs that positively affect flow distribution"

What affects the separation ?

Even before the inlet flange !

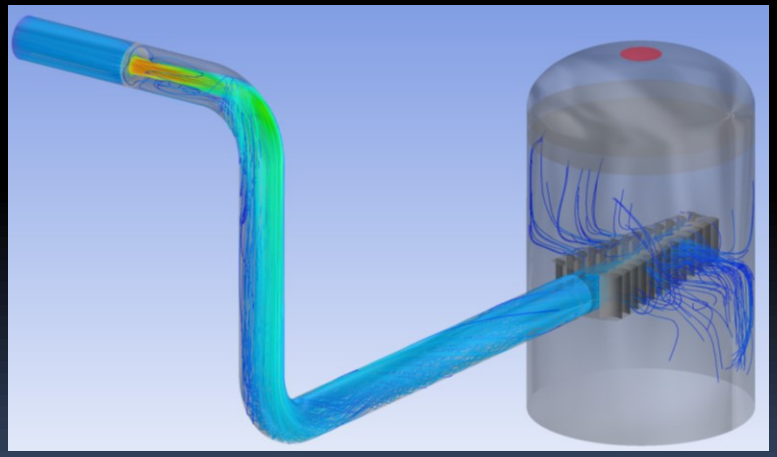
Piping layout

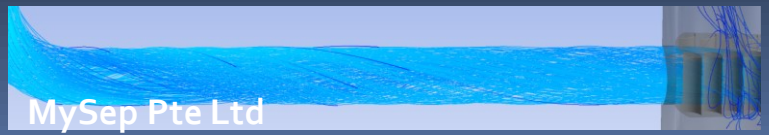
Flow characteristics

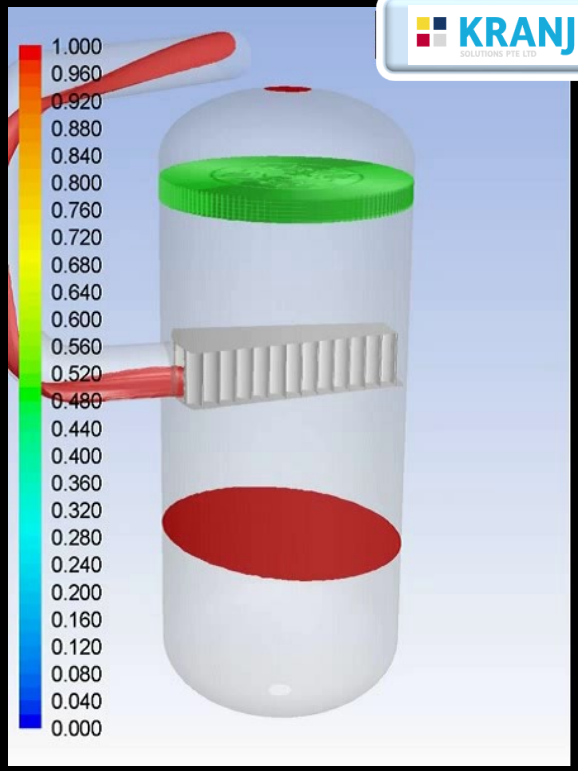
Valves, fittings etc…

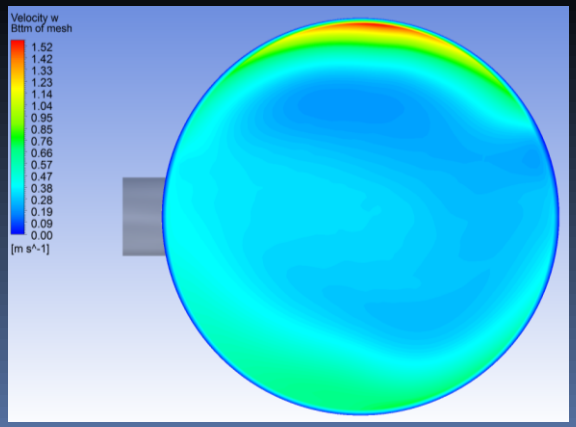
Impact of piping layout

- Combinations of bends
- Promote swirl
- Bias liquid and vapour flows

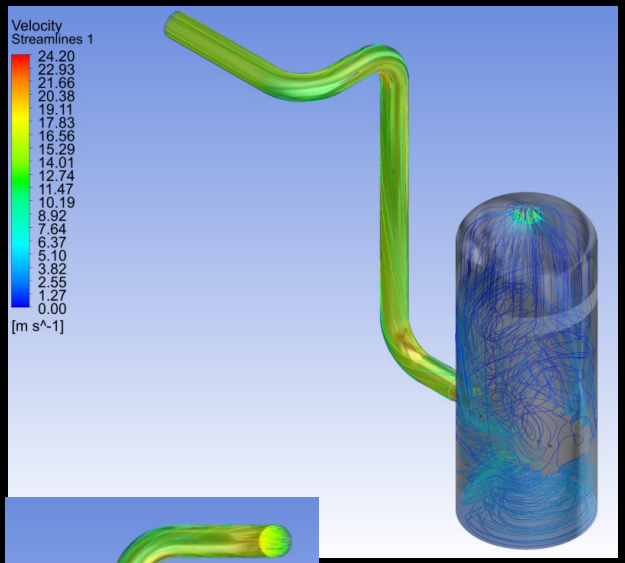




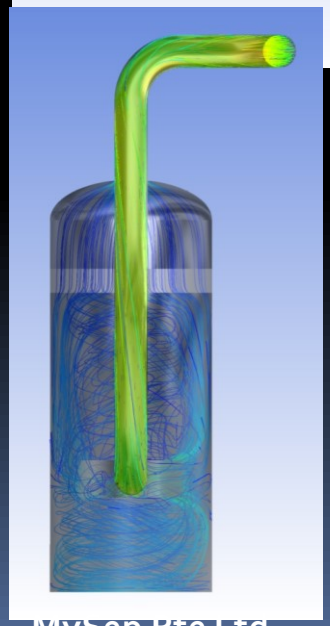


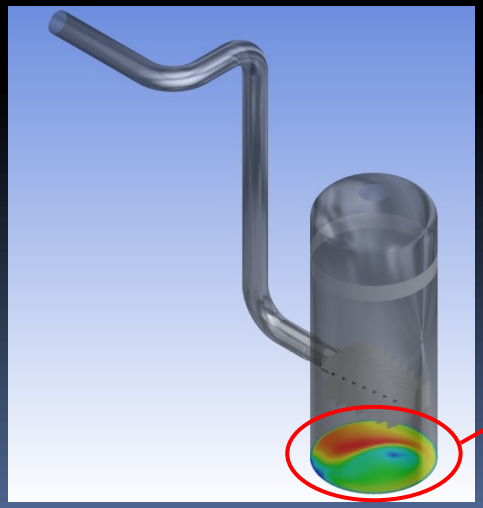


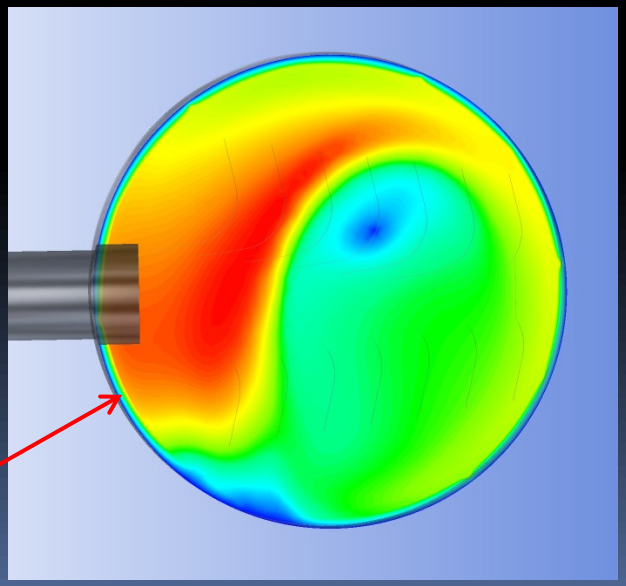
Impact of piping layout



- Possible high vapour velocities
- Liquid surface interaction
- Re-entrainment potential







Flow Characteristics - condition of fluids entering

Consider a 3-phase production separator

How does the inlet pipe diameter….

Affect inlet mist and hence performance

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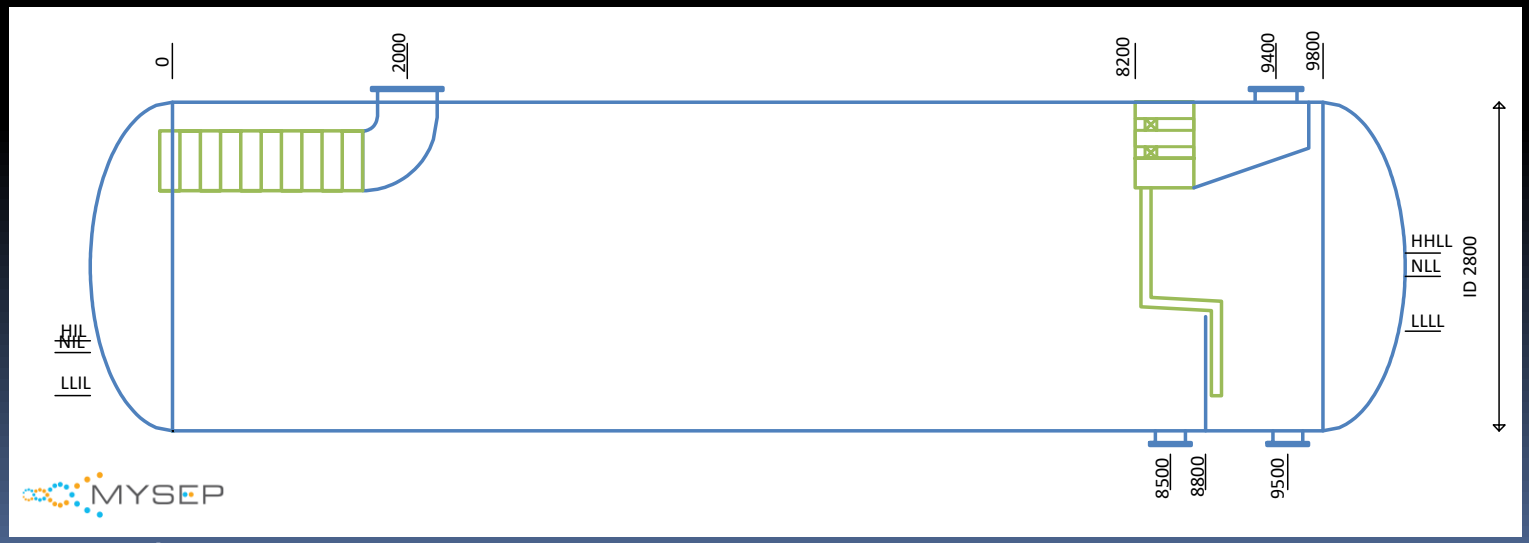


Flow Characteristics - condition of fluids entering

18” Inlet pipe

Inlet piping

Key liquid phase mode for G-L calcs: HC liquid

Pipe size (inch)	Actual ID (mm)	Roughness (mm)
18	457.20	0.0460

Override predicted droplet size ☐

Override predicted mist fraction ☐

R/D | Flow regime

	Case 1		
Max droplet size - predicted (micron)	863		
Mist fraction - predicted (%)	60.02%	33.07%	18.19%
Mist flow rate (m³/hr)	198.792	109.535	72.301

Performance

	Case 1	Case 2	Case 3
Carryover rate (m³/hr) :	0.800	0.242	0.116
Carryover rate (USG/MMSCF) :	20.28	7.69	4.91
Droplet carryover d100 (micron) :	42	43	43
Pressure drop (mbar) :	125	101	85
Oil residence time (min) :	3.62	4.14	4.83
Water removal d100 (micron) :	339	315	289
Water residence time (min) :	9.33	6.22	3.11
Oil removal d100 (micron) :	145	181	273

20” Inlet pipe

Inlet piping

Key liquid phase mode for G-L calcs: HC liquid

Pipe size (inch)	Actual ID (mm)	Roughness (mm)
20	508.00	0.0460

Override predicted droplet size ☐

Override predicted mist fraction ☐

R/D | Flow regime

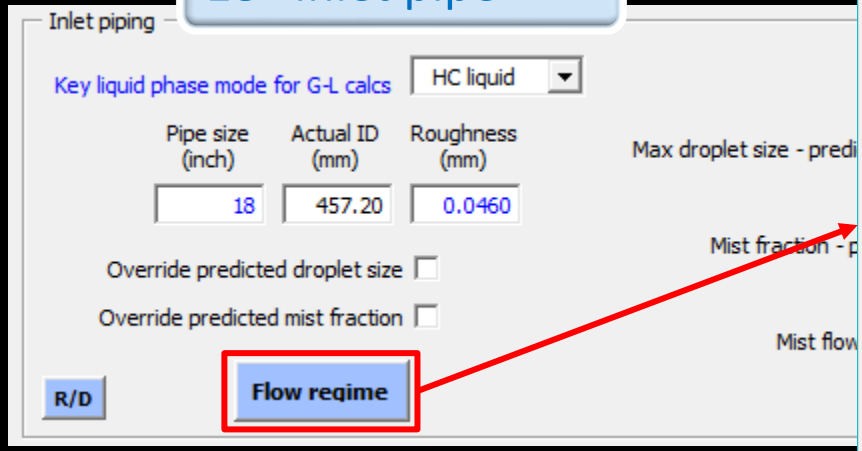
	Case 1		
Max droplet size - predicted (micron)	1159		
Mist fraction - predicted (%)	14.47%	7.38%	4.10%
Mist flow rate (m³/hr)	47.913	24.428	16.280

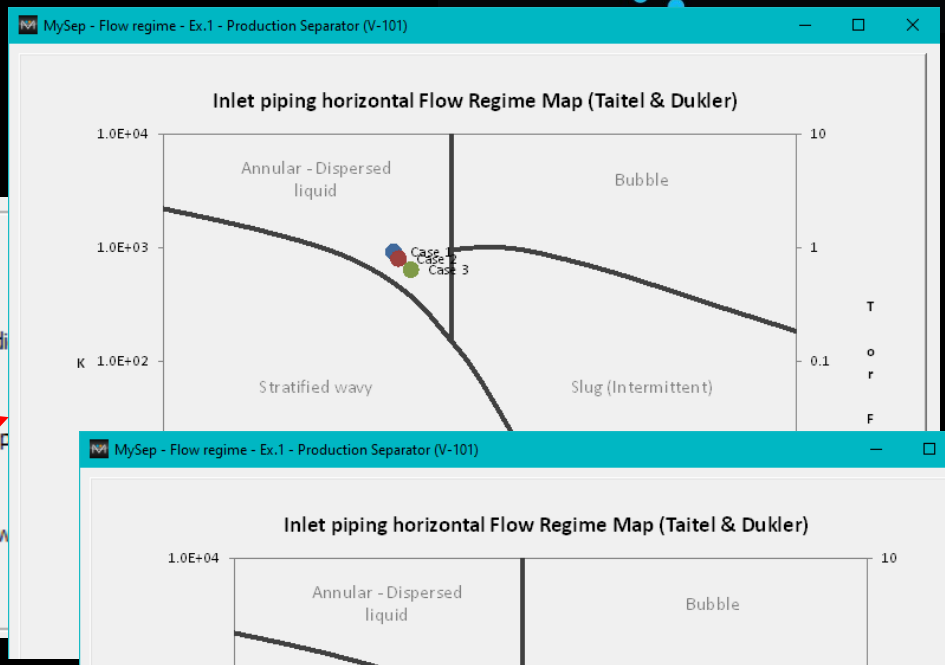
Performance

	Case 1	Case 2	Case 3
Carryover rate (m³/hr) :	0.047	0.018	0.009
Carryover rate (USG/MMSCF) :	1.20	0.58	0.39
Droplet carryover d100 (micron) :	42	43	43
Pressure drop (mbar) :	112	90	73
Oil residence time (min) :	3.62	4.14	4.83
Water removal d100 (micron) :	339	315	289
Water residence time (min) :	9.33	6.22	3.11
Oil removal d100 (micron) :	145	181	273

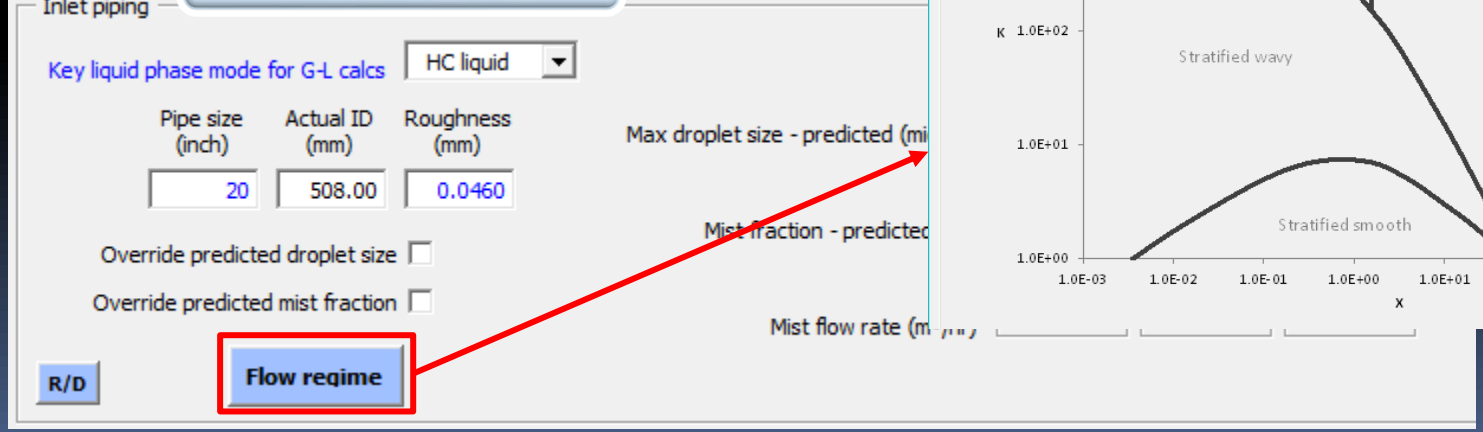
Flow Characteristics - condition of fluids entering

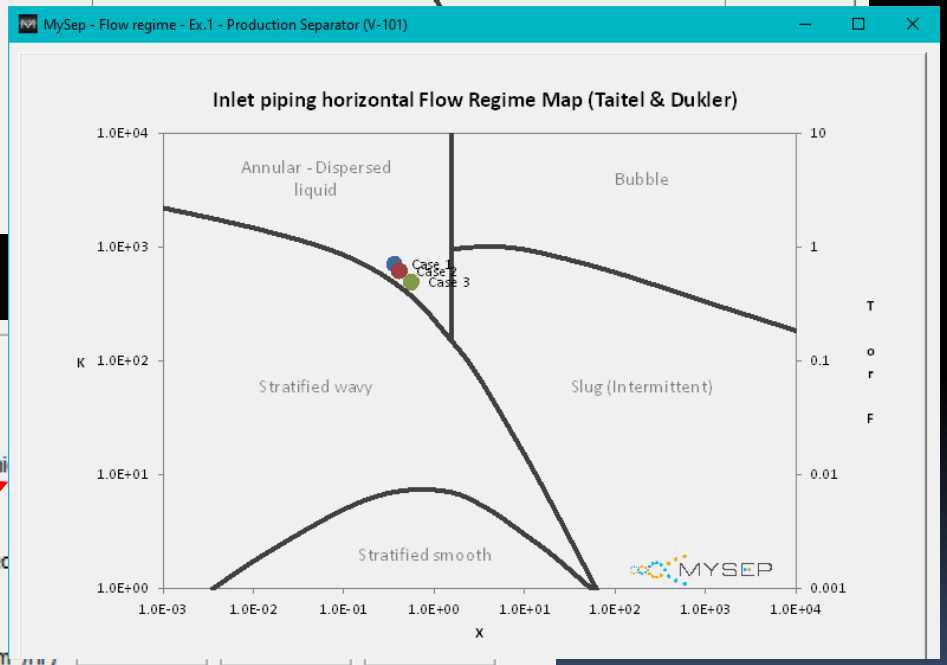
18” Inlet pipe



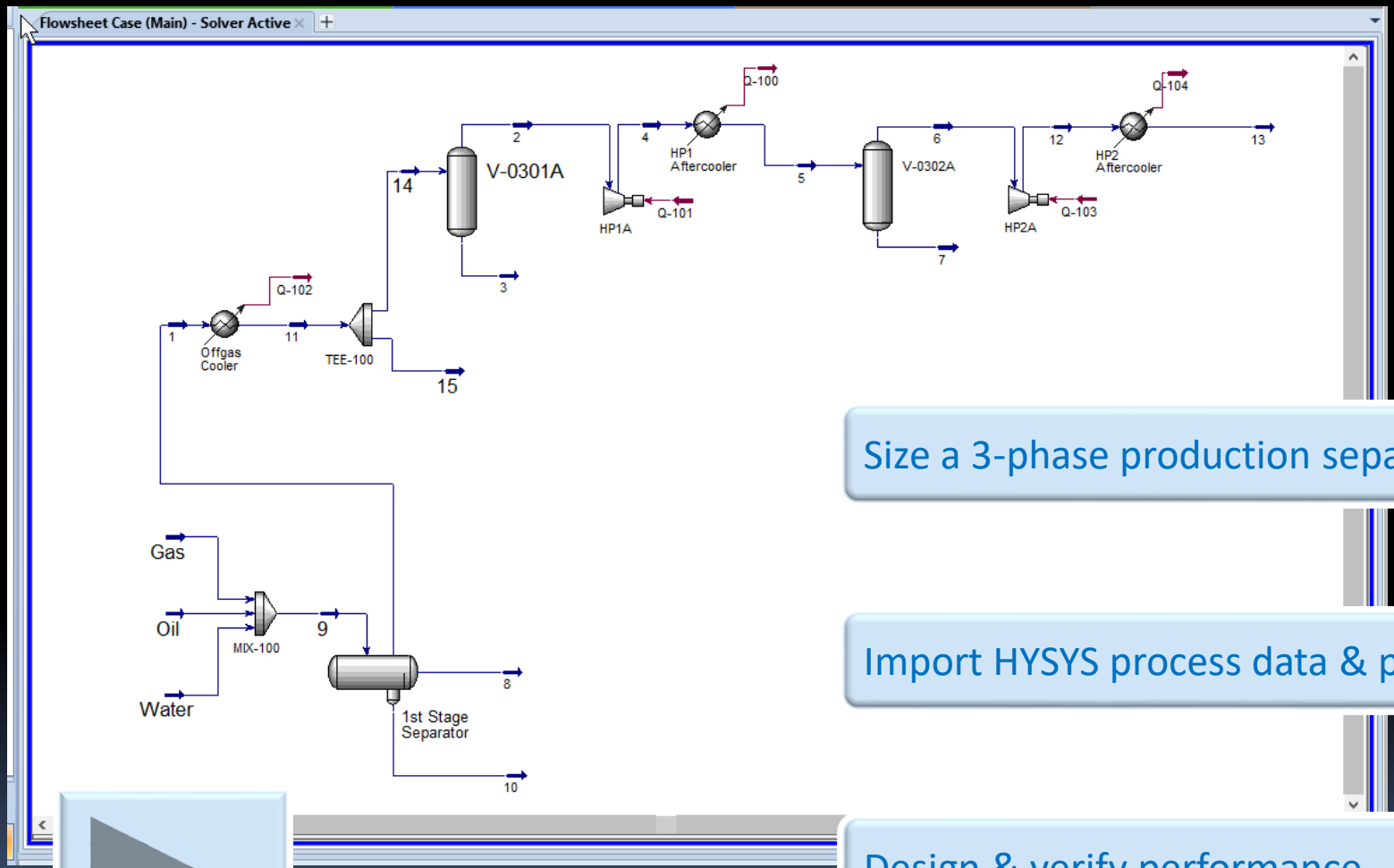


20” Inlet pipe





Designing with Good Practice



Size a 3-phase production separator

Import HYSYS process data & properties

Design & verify performance

MySep-Studio Design Demo ...

Design... Results Summary

MySep v5.0.0

File Data Input Analysis Tools Results Help

SONG_Pres_14Jan20 - MySep data.xls

Design Mode

MySep SONG Pres 14 Jan 2020

1st Stage Sep ()

Design | Overview

Project information

Project : MySep SONG Pres 14 Jan 2020
Vessel name : 1st Stage Sep
Vessel tag :

Vessel configuration

Vessel orientation : Horizontal
Separation type : 3-phase
Vessel inside diameter : 2680 mm
Vessel tan-tan length : 9380 mm

Piping & nozzles

Inlet piping : 26" (660.40 mm ID)
Inlet nozzle : 26" (660.40 mm ID)
Gas outlet nozzle : 16" (406.40 mm ID)
HC liquid outlet : 12" (304.80 mm ID)
Water outlet : 12" (304.80 mm ID)

Internals

Inlet device : Vane type
Agglomerator : -
Demisting device #1 : Vane pack
Demisting device #2 : -
Perforated Baffles : 2

Design notifi

<< No desig

Sized vessel & nozzles

Recommended flow conditioning baffles

Sized vane pack demister

MYSEP

Performance

	Case 1
Carryover rate (m³/hr) :	0.062
Carryover rate (USG/MMSCF) :	3.74
Droplet carryover d100 (micron) :	50
Pressure drop (mbar) :	53
Oil residence time (min) :	1.81
Water removal d100 (micron) :	195
Water residence time (min) :	1.50
Oil removal d100 (micron) :	82

Water residence time (min) : 1.50
Oil removal d100 (micron) : 82

Plate coalescer – improved Liquid/Liquid performance

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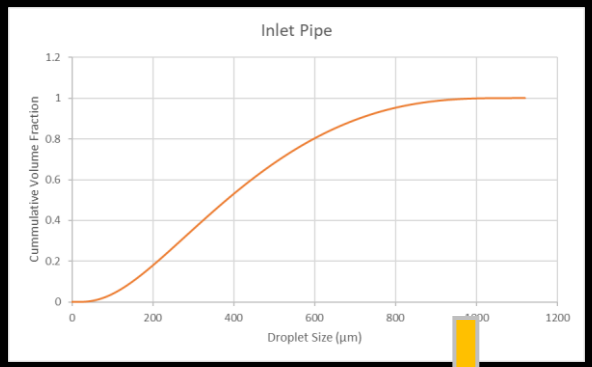
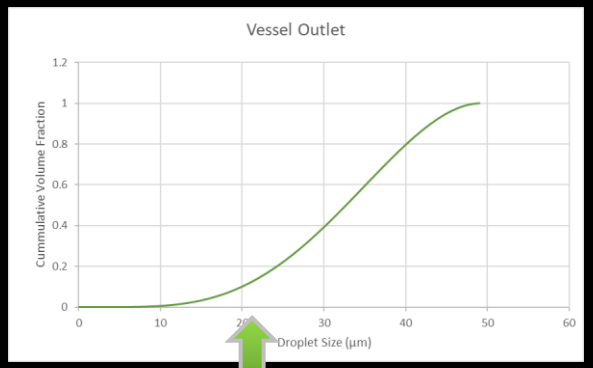
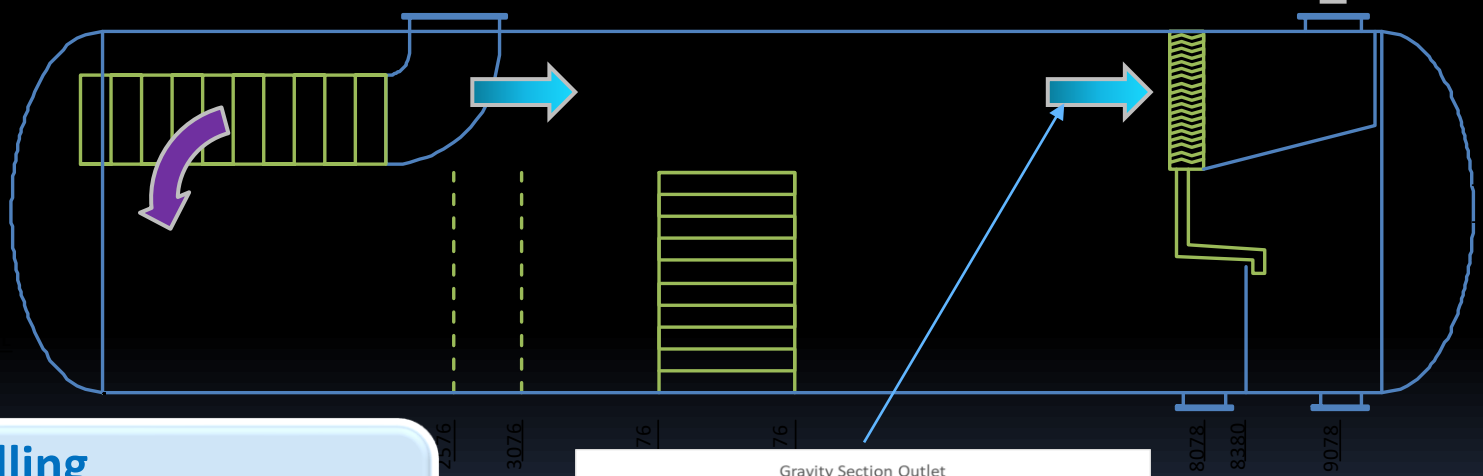
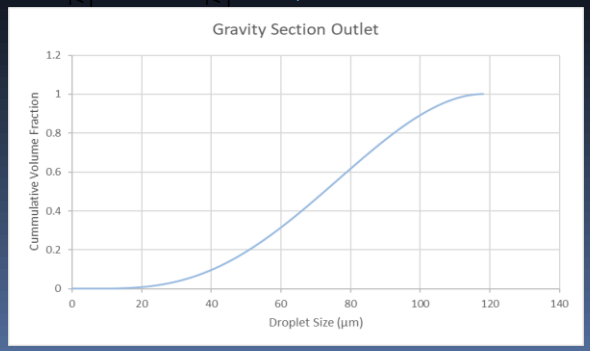
Design & Incremental Performance Analysis









Modelling

- MySep research-derived models & correlations
  - Separation efficiency
  - Droplet size distribution
- & selected published models

Research & validation

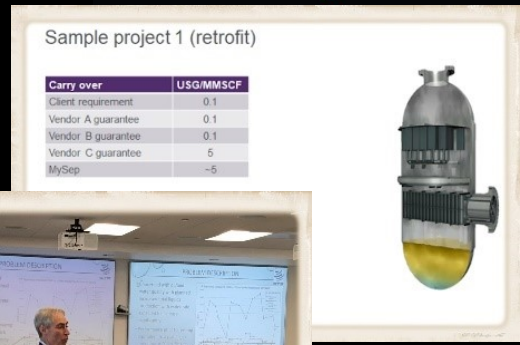
Validation

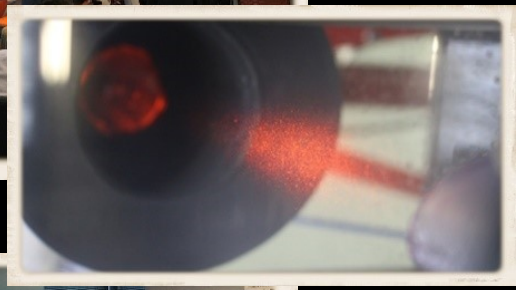
Used by operators, EPCs & suppliers with deep domain expertise

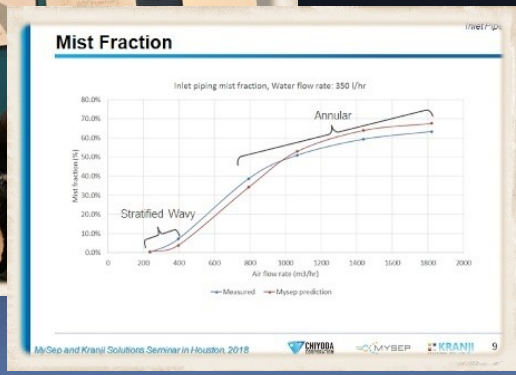
Validated by SMEs with in-house data & know how

Customer commissioned validation tests ….prior to licensing

MySep research - Kranji Solutions Pte Ltd (sister company)







Kranji video…

MySep Customers I

ExxonMobil

ConocoPhillips

bp

PTTEP

OXY

Chevron

PHILLIPS 66

TOTAL

North Oil Company

أدنوك
ADNOC

PETRONAS

CHRYSAOR

MEDCOENERGI

HIBISCUS Petroleum

Western Midstream

MARATHON Marathon Petroleum Corporation

MySep Customers II

MySep Customers III

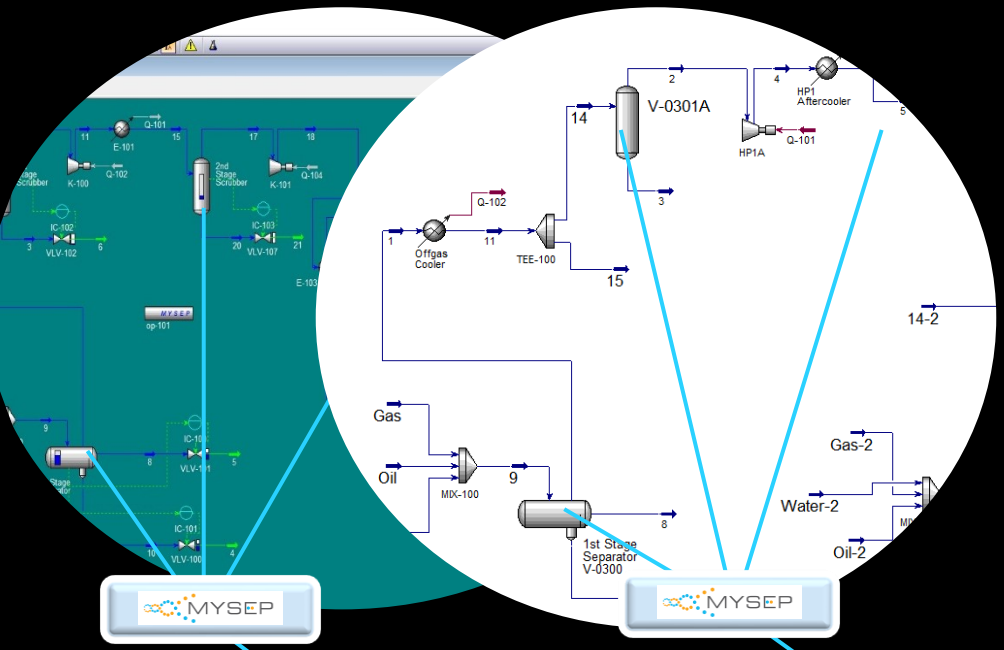
Rigorous Separation in Your Digital Twin

MySep Engine

In steady state simulation .....

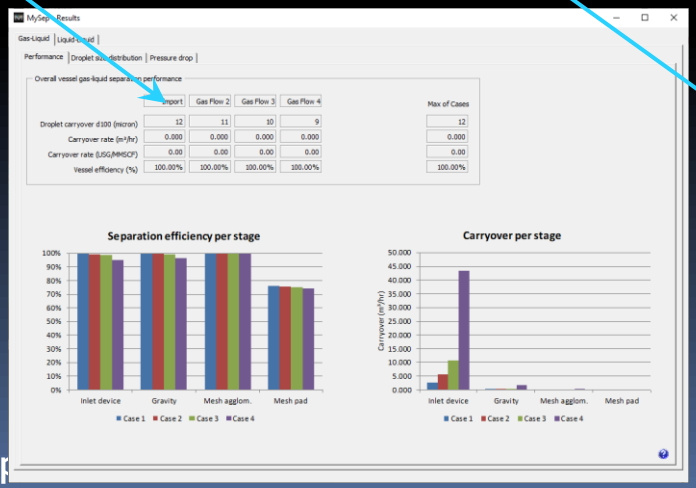
In dynamic simulation .....

MySep Products – Summary

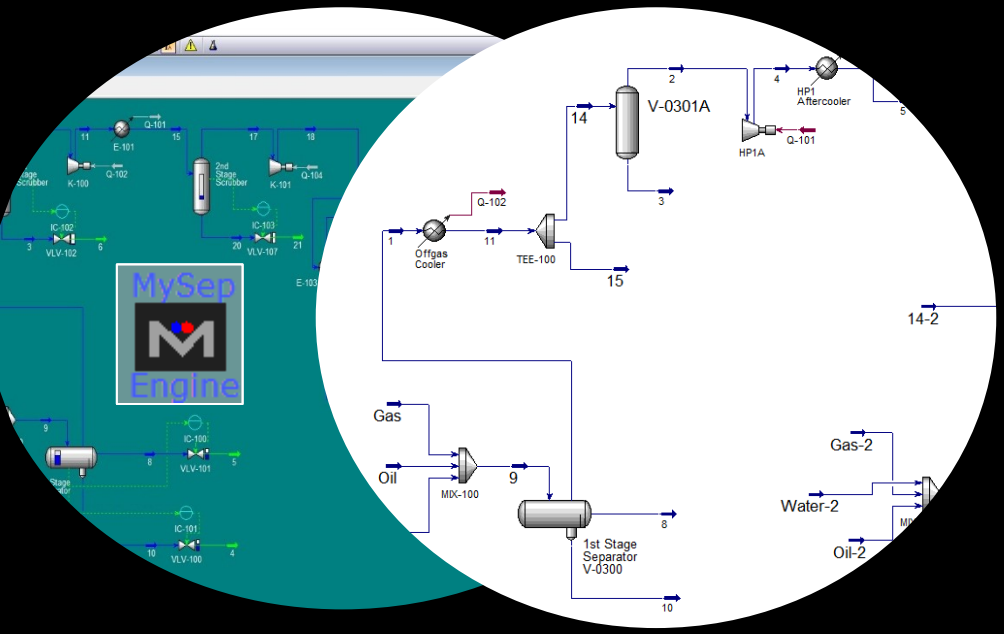


MySep Studio

- Design & Rating
  - *Desktop software*
  - *Linking to – HYSYS, UniSim, PRO/II, Petro-SIM, Symmetry*
- Detailed Performance Analysis



MySep Products – Summary



MySep Studio

- Design & Rating
  - *Desktop software*
  - *Linking to – HYSYS, UniSim, PRO/II, Petro-SIM, VMGSim…..*
- Detailed Performance Analysis

MySep Engine

- Simulates performance inside simulator
  - *Liquid carry-over*
  - *Pressure drop*
- Steady state and Dynamics
  - *HYSYS, UniSim, Dynsim, K-Spice, Symmetry, Petro-SIM …..*

Q & A


MySep Updates Newsletter

MYSEP

New Web Face for MySep

In June 2020 we launched our new web site at: https://www.mysep.com/

Here you will find lots of background on our heritage, our research foundations, and the value we bring to our expanding community of international customers.

We re-branded the former MySep product as MySep Studio and MySep-RunTime as MySep Engine.

Please visit our site and explore the case studies, videos, downloads, news and more.

More Value from MySep

Over the past year we embarked on a programme of awareness sessions for our customers. This Customer Care Programme (CCP) delivered web demonstrations, presentations, and user Q&A to many of our customers. Topics covered include:

- Rating & Design with MySep Studio
- Retro-fit to fix undesirable internals
- Links to process simulators
- Operational Envelope tool
- Sensitivity Analysis tool
- MySep Engine in Digital Twins

The CCP has so far offered 21 sessions for 15 companies with over 300 attendees. Sessions have been enthusiastically received by all attendees. We continue this initiative, with the objective of liberating more value for our customers' software investment.

If you think you and your colleagues could benefit from an awareness update, please request this at: https://www.mysep.com/contact

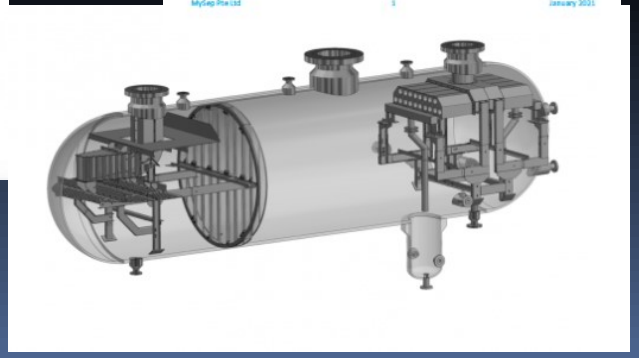
Digital Twins and MySep

Increasingly, leading Oil & Gas operators recognise the power of simulation-based digital twins, to drive greater production and avoid unplanned shutdowns.

Data from DCS and process historians are combined with process simulations of varying complexity. These digital twins generate performance indicators which are not measurable, providing insights to guide optimisation of the operation. "What-If" scenarios and case studies further enrich understanding.

A missing link in the modelling armoury, has been the ability to reliably predict the performance of process separators within simulations.

MySep Pte Ltd 1 January 2021



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THANK YOU !