

CFD in Industrial Processes

ADVANCED MODELLING & SIMULATION – AMS –

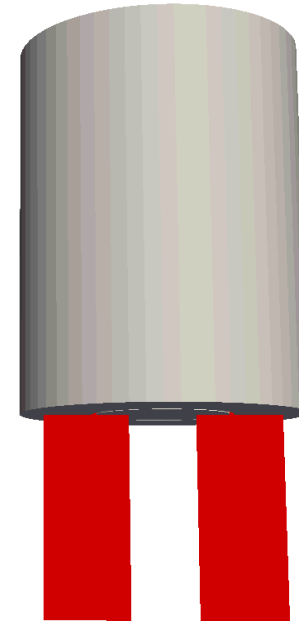
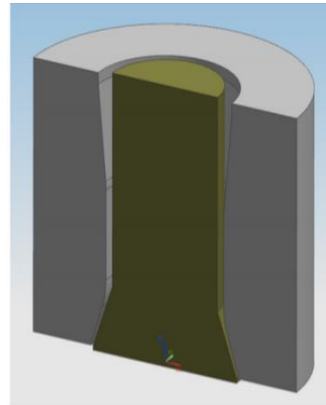
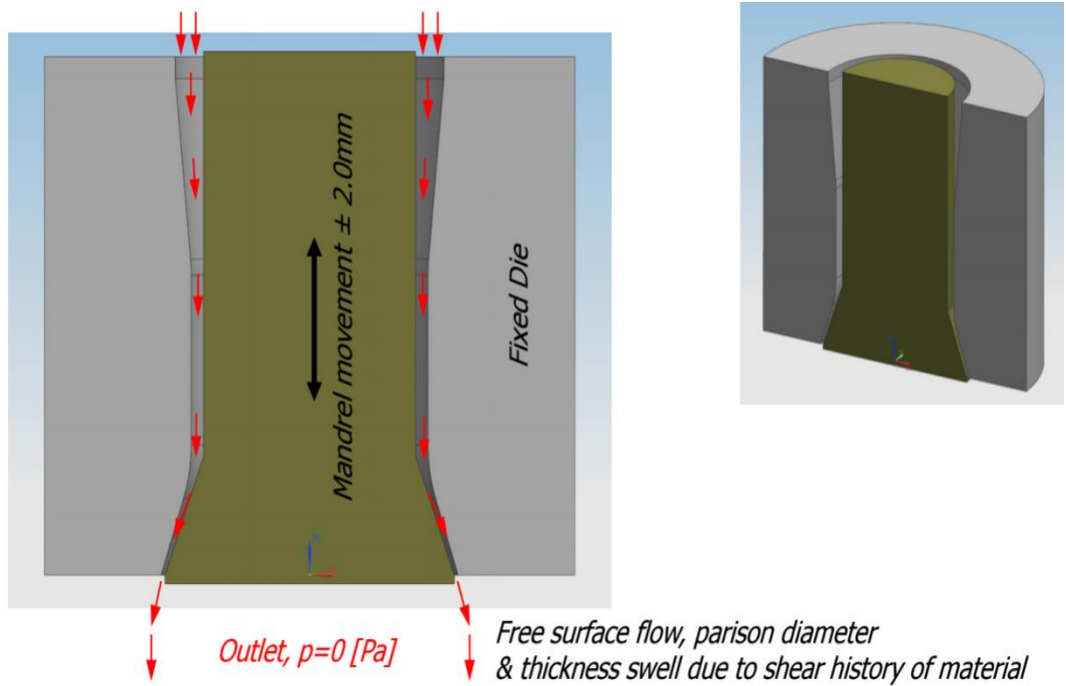
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JUNE 2020

Industrial Processes

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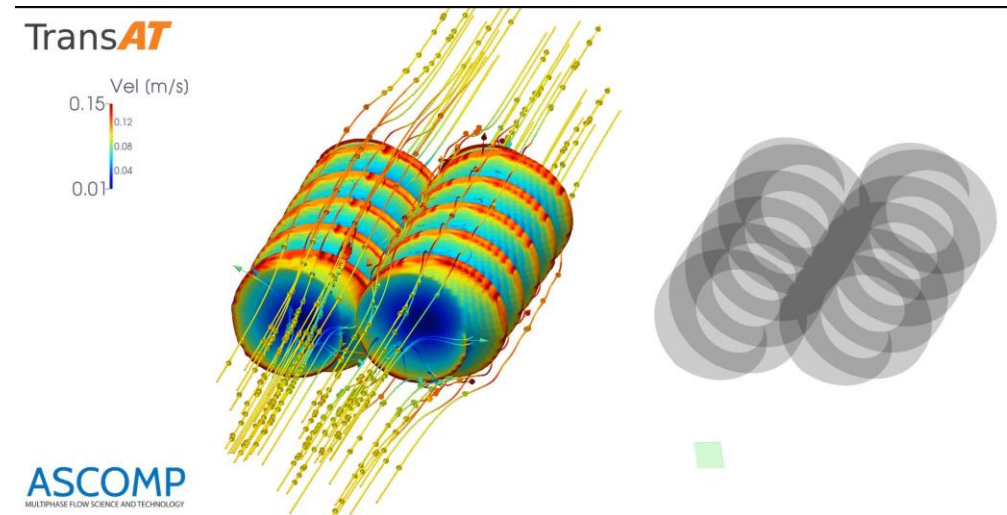
Plastic blow moulding



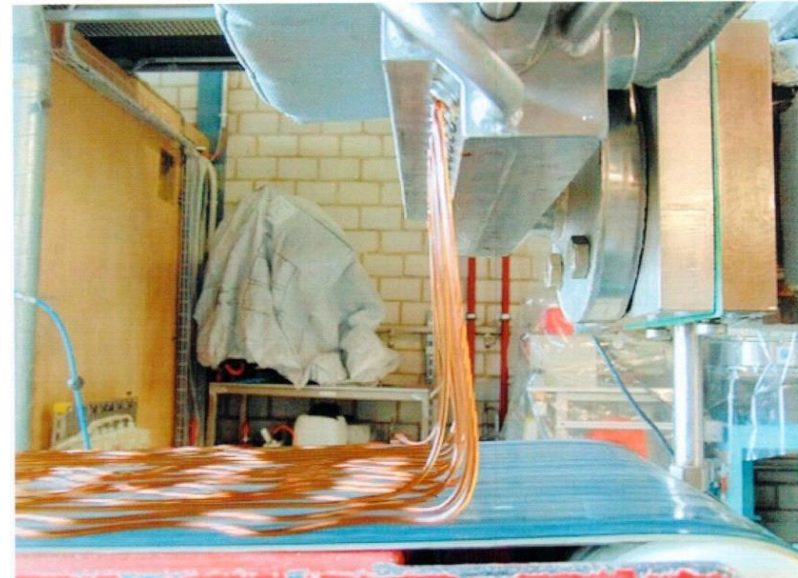
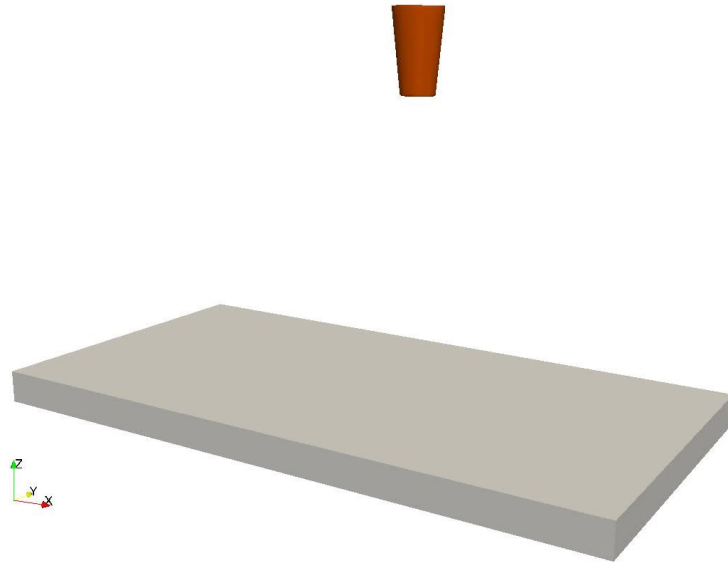
Trans**AT**

Twin screw mixer: Demonstration

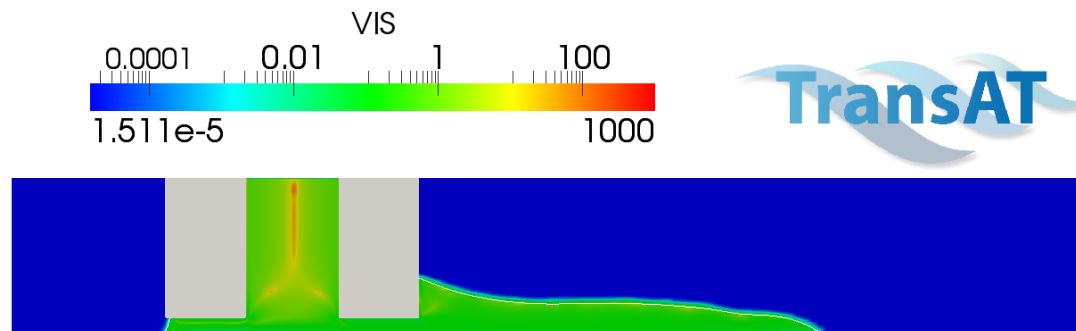
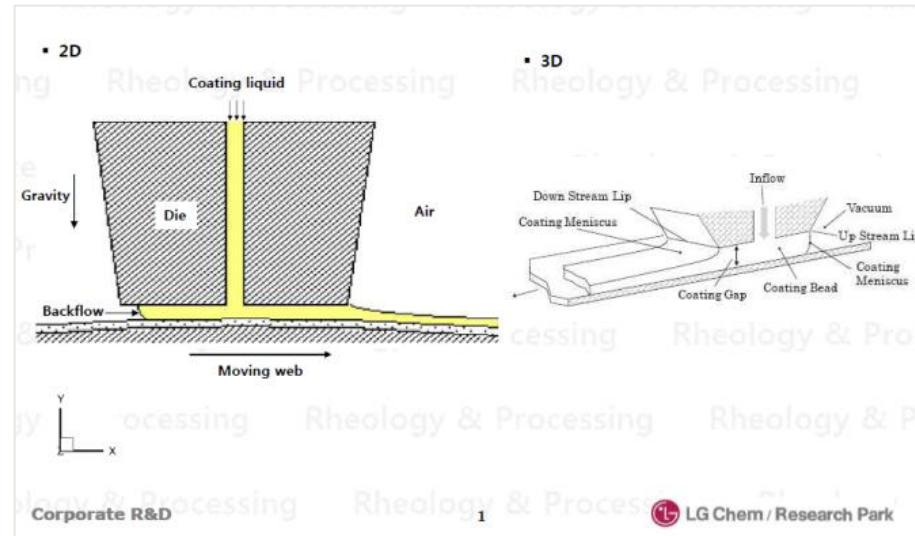
- Single phase
 - Highly viscous liquid
 - Inflow-outflow problem
 - Short screw for demonstration
-
- TransAT: Moving objects feature only available for consulting
 - Available end of 2018 in product



Strand conveyor



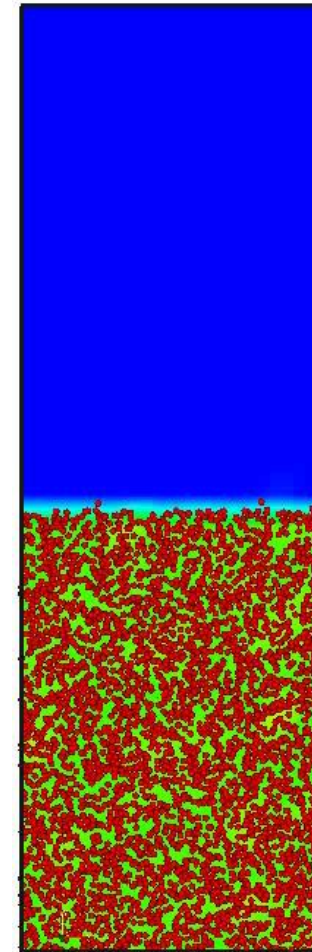
Die coating



Shear thinning is observed in the liquid only

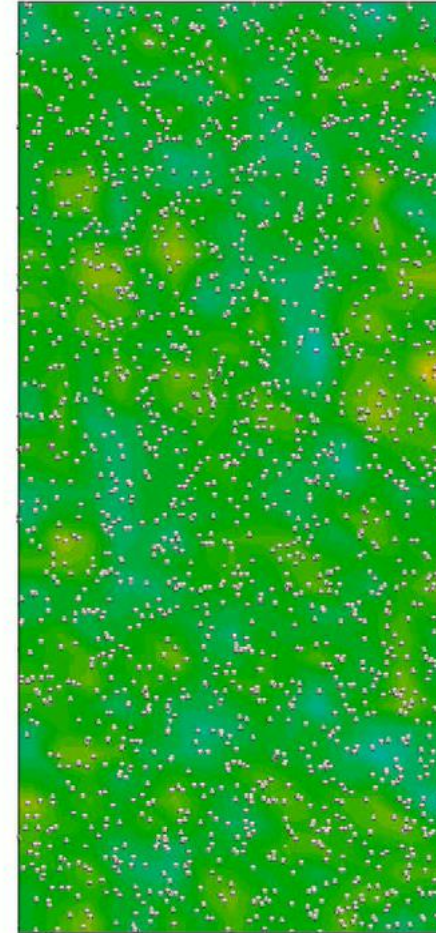
Fluidized beds

- Variable class of particles
- Four-way coupling momentum
- Accounts for particle packing

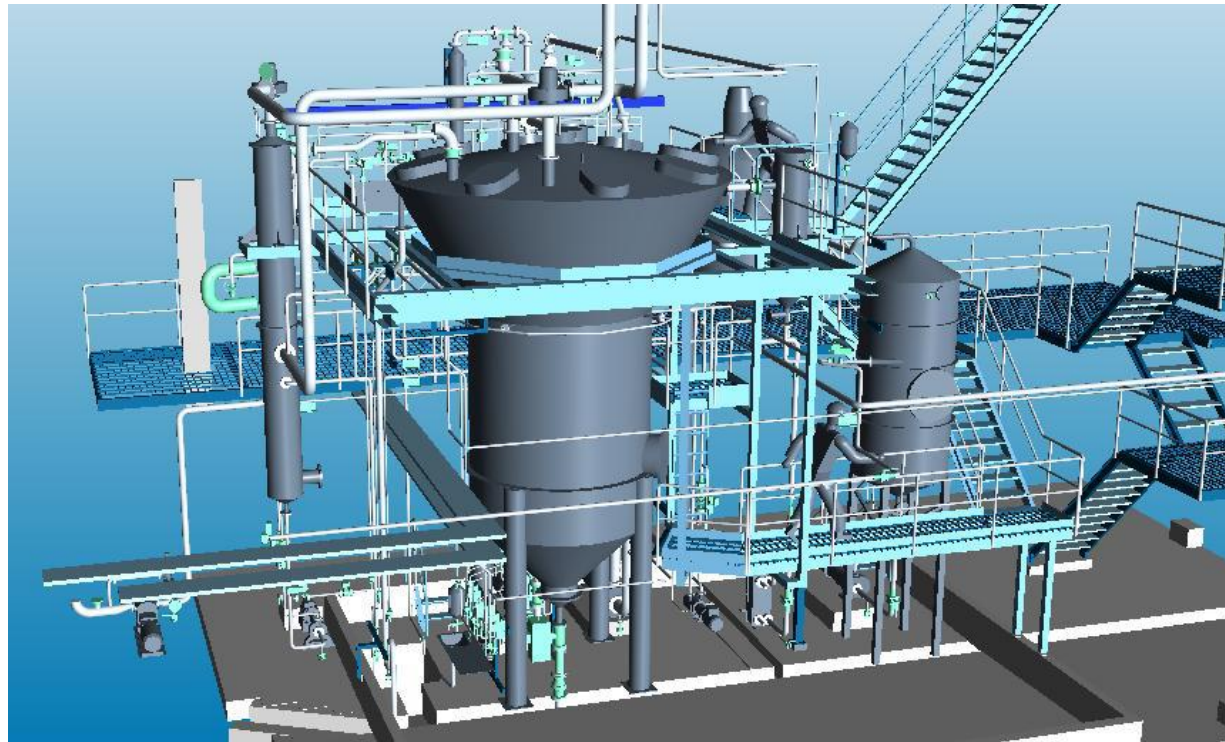


Packed beds

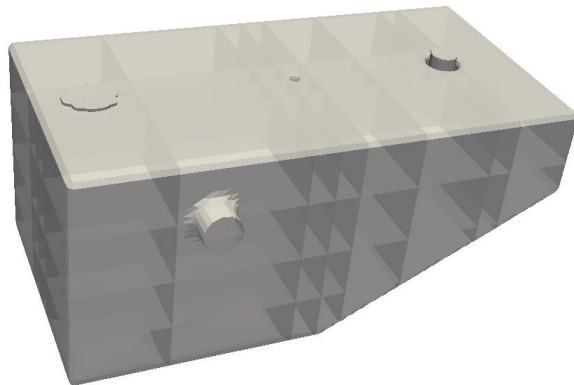
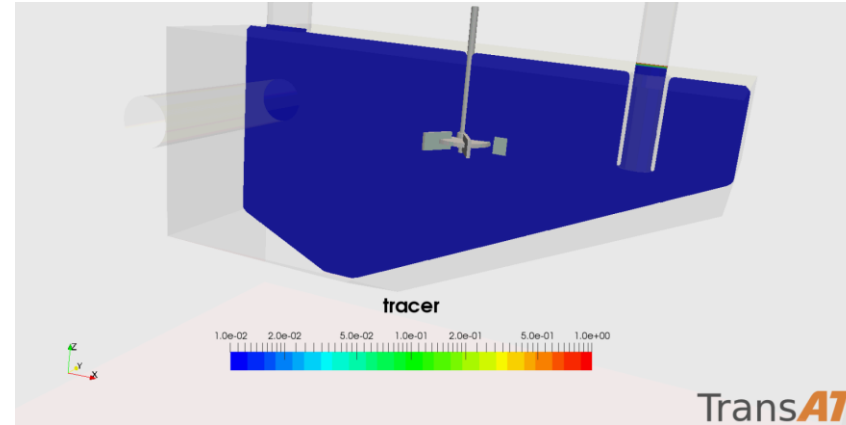
- Variable class of particles
- Four-way coupling momentum
- Accounts for particle packing



Pulp & paper: tall oil reactors

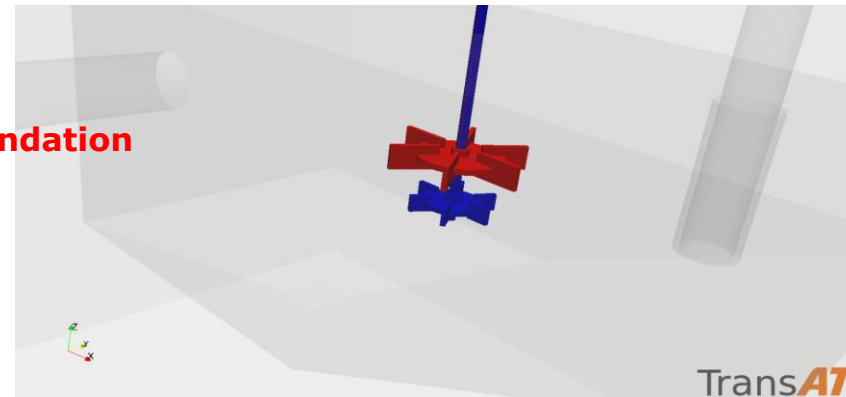


Tall-oil pre-reactor design



Recommendation

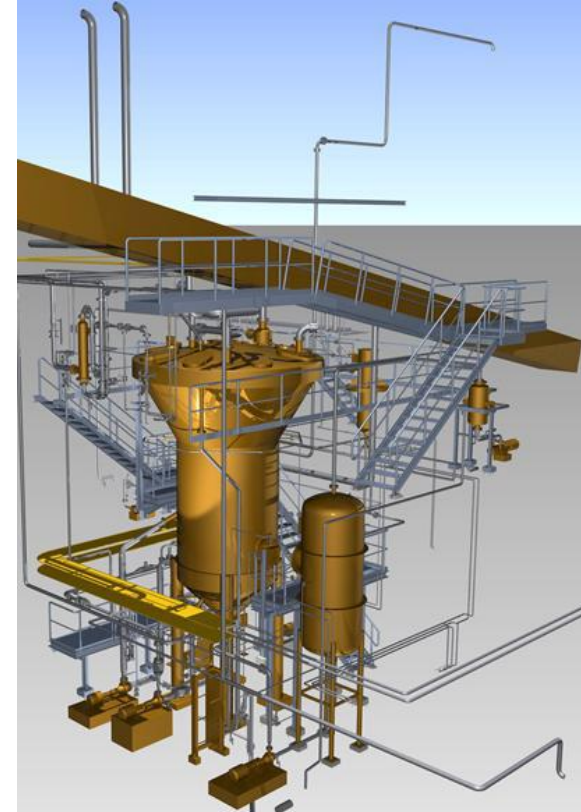
Original



HELP DESIGN OF THE SYSTEM, IN PARTICULAR WHEN MODIFIED

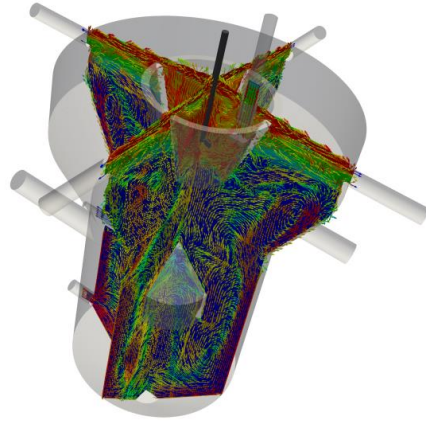
Tall-oil main reactor design

- **Objectives:**
 - Find the best configuration of the internal design.
- **Points of interest:**
 - To account for the presence of phases: (inflow) acid, soap; (ouflow): spent acid, tall oil, lignin and gas
 - Rection and separation to be accounted for
- **Solutions:**
 - Use TransAT with the N-phase model.

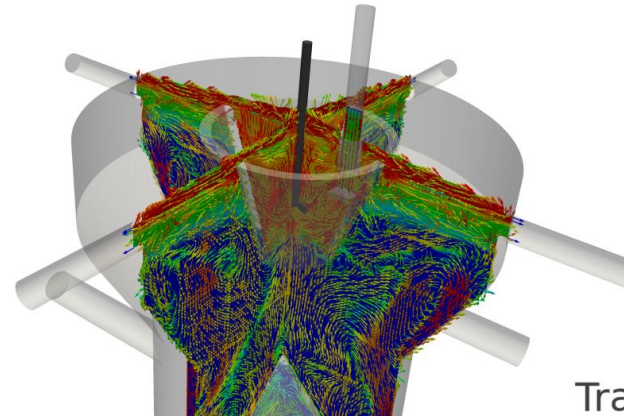


HELP DESIGN OF THE SYSTEM, IN PARTICULAR WHEN MODIFIED

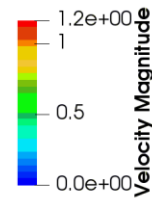
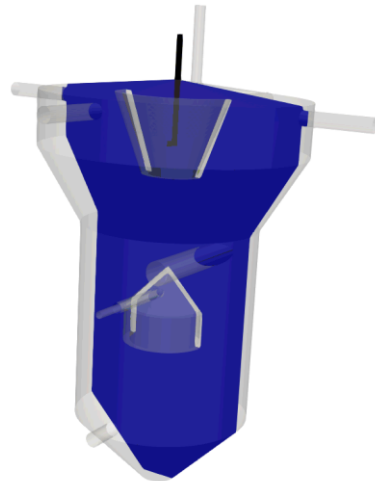
Tall-oil main reactor design



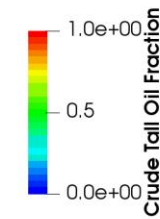
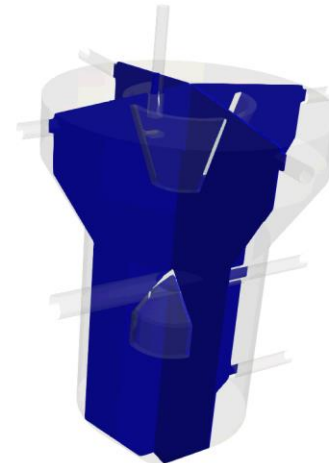
TransAT



TransAT

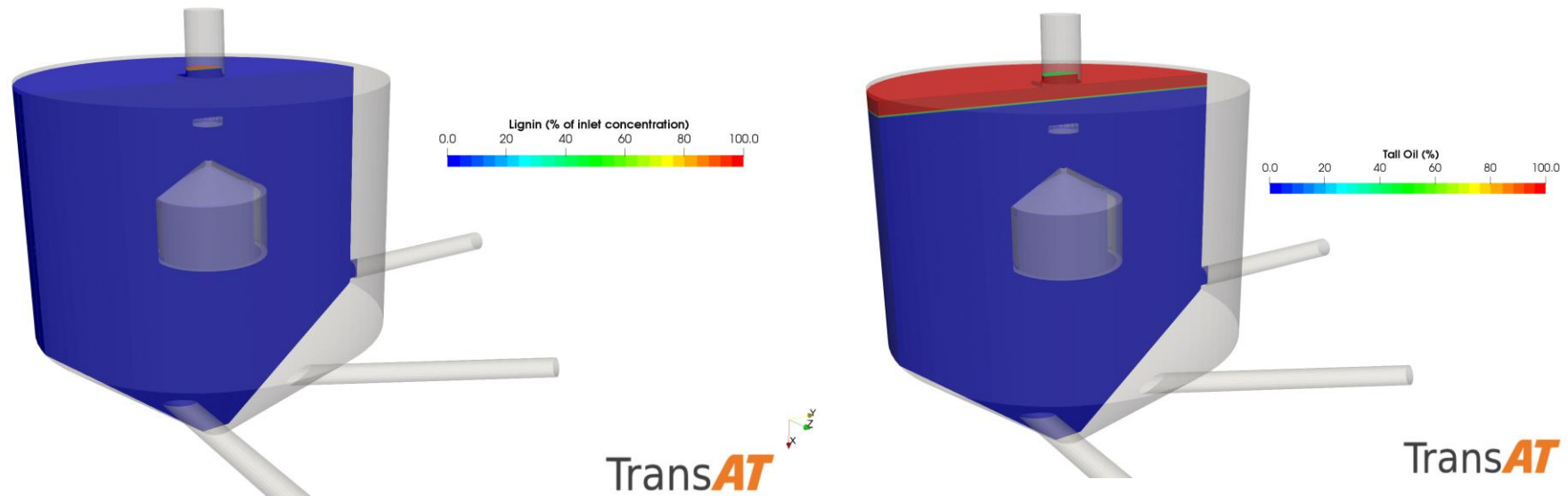


TransAT

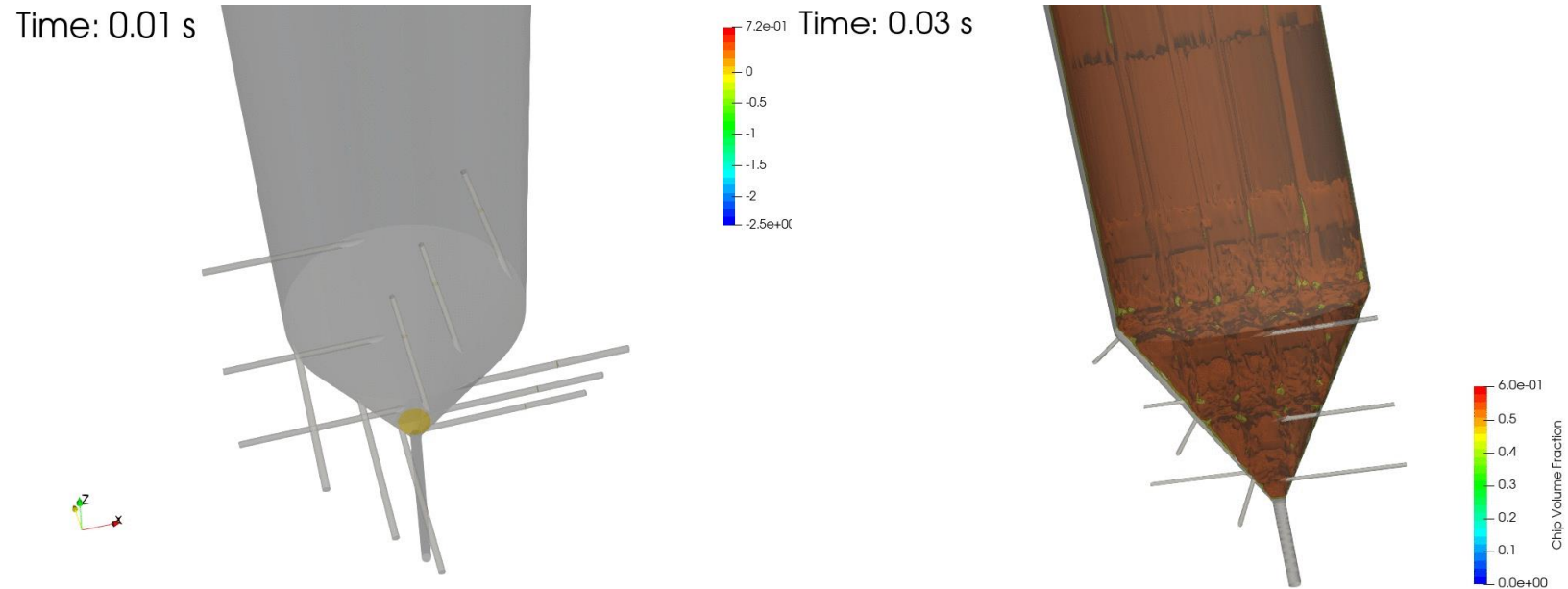


TransAT

Tall-oil main reactor, new design

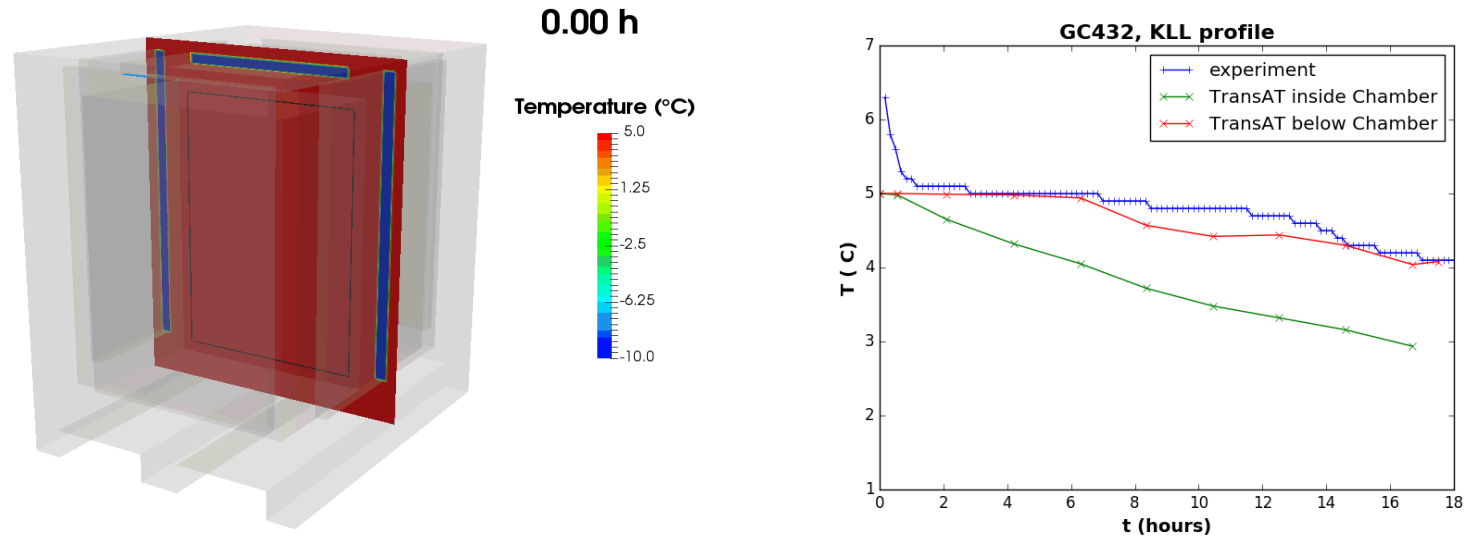


Tall-oil lignin unloading, confidential design



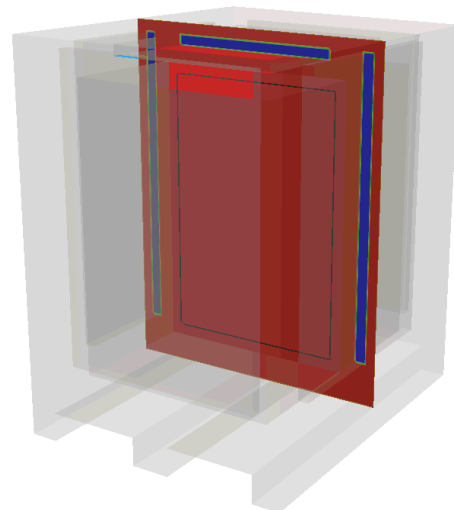
Lignin unloading in a tall oil reactor

Pharma thermal packaging: for ROCHE Switzerland

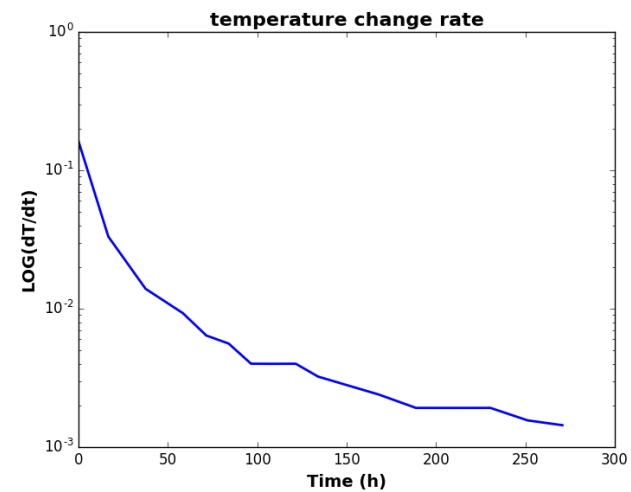
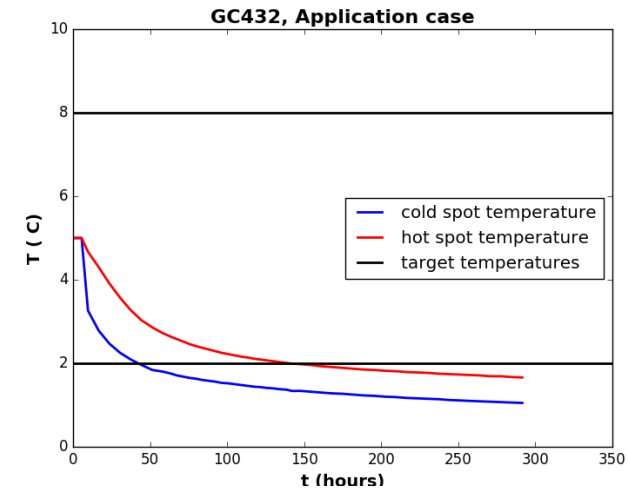
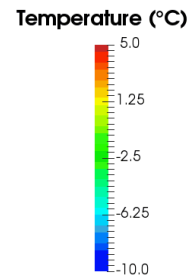


Using the conjugate heat transfer /PCM model

Pharma thermal packaging: for ROCHE Switzerland



0.00 h



Droplet cooling: Droppo (for CIBA Switzerland)

- **Objectives:**

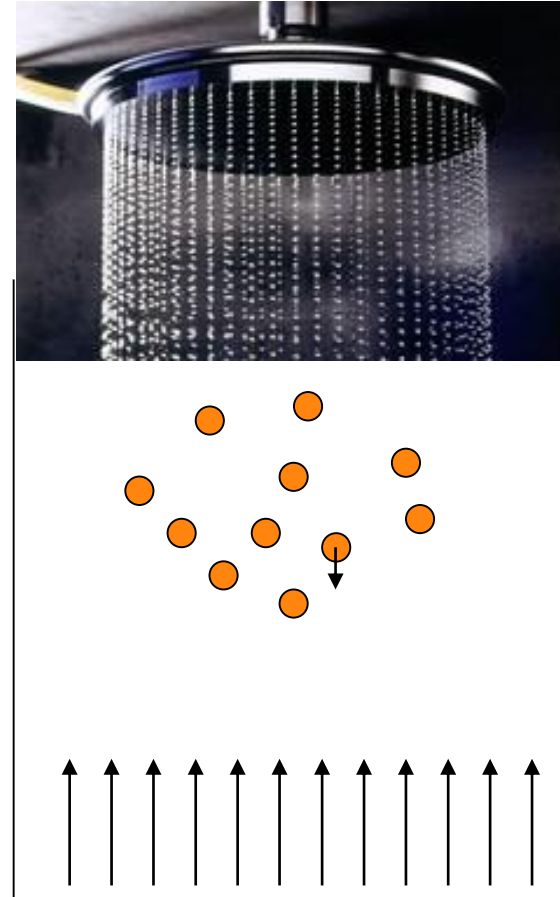
- The aim is to compare different injection orifices shapes and loading.

- **Points of interest:**

- Turbulent flow
- Particle affecting momentum
- Particle interacting with wall
- Particles exchanging heat
- Complex configuration
- Unsteady

- **Solutions:**

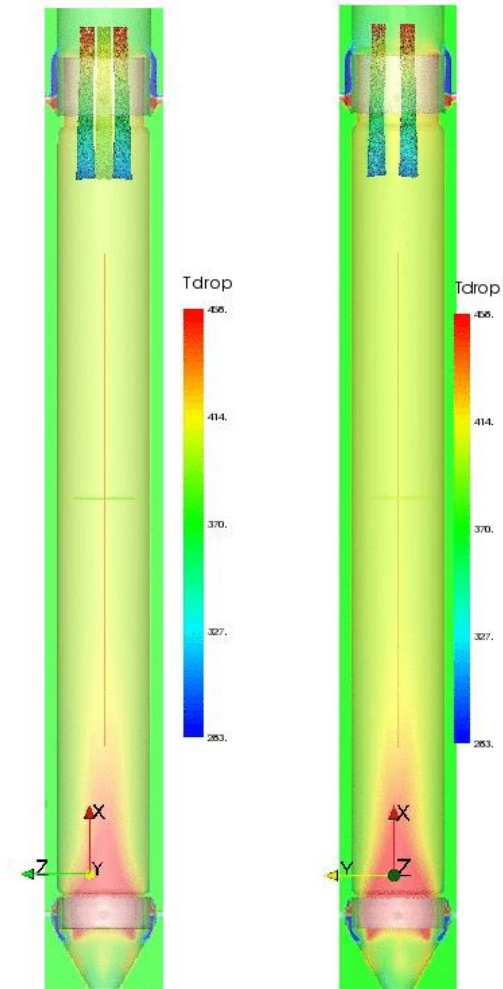
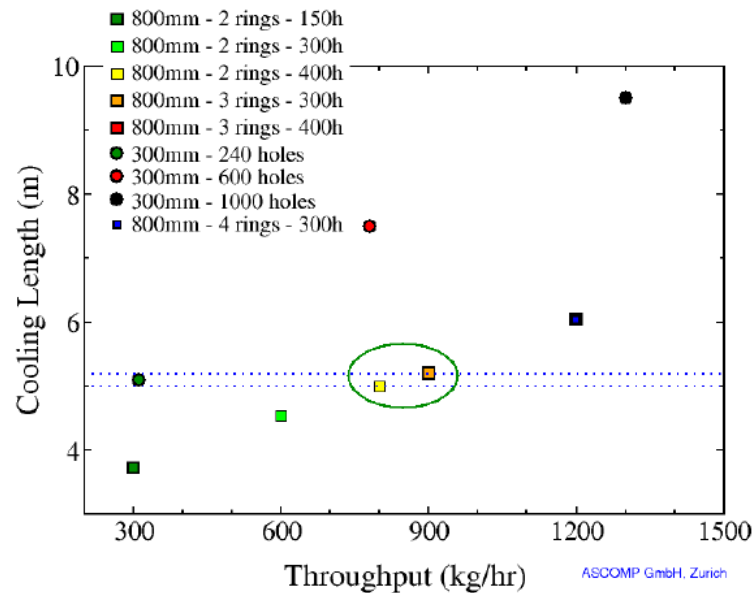
- Use TransAT with the Eulerian-Lagrangian model.



240 hole, 600 hole, and 1000 hole configurations

Droplet cooling in gravity towers

- 22m high tower
- No. of comp. particles: 20 million
- Re of flow: $Re_D = 75000$
- Mass loading = 0.1.
- Diameter range: 600 microns



Aspen's cyclone separator

- **Objectives:**

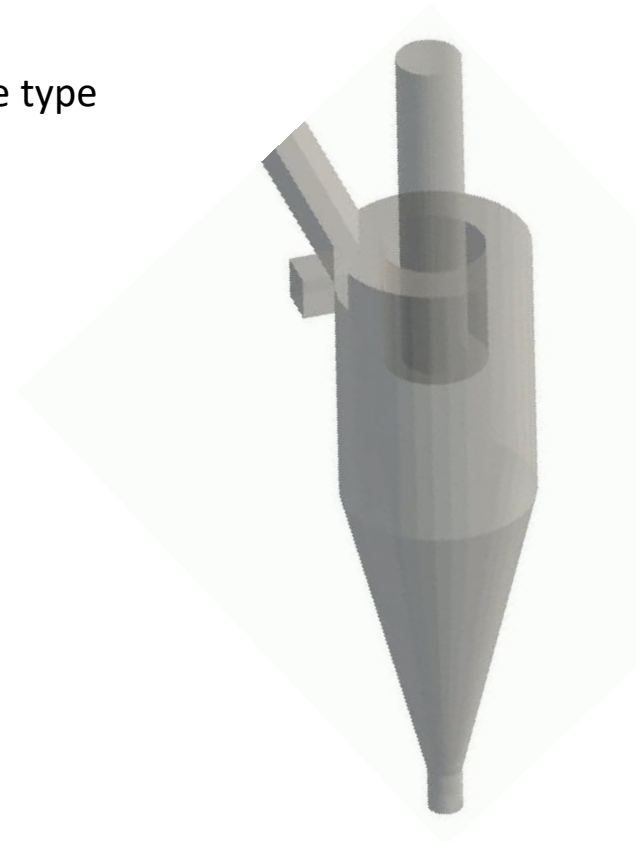
- The aim is to analyse the performance of these type of separators for variable flow conditions.

- **Points of interest:**

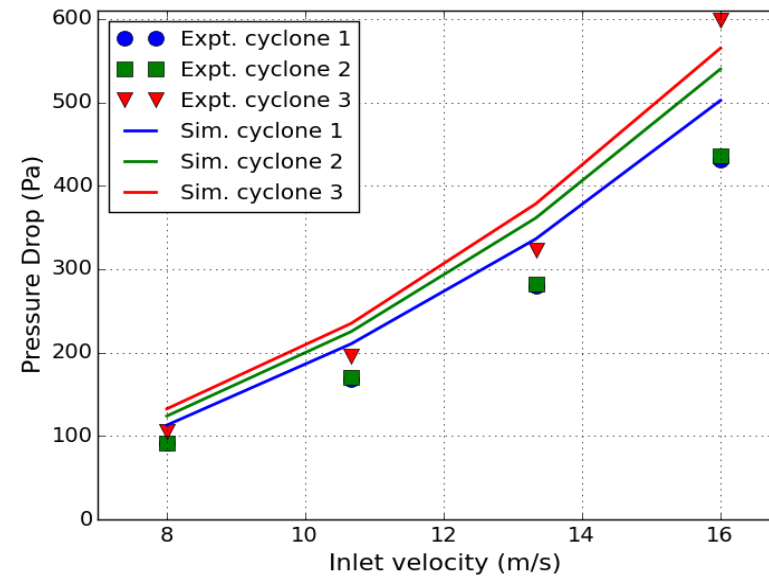
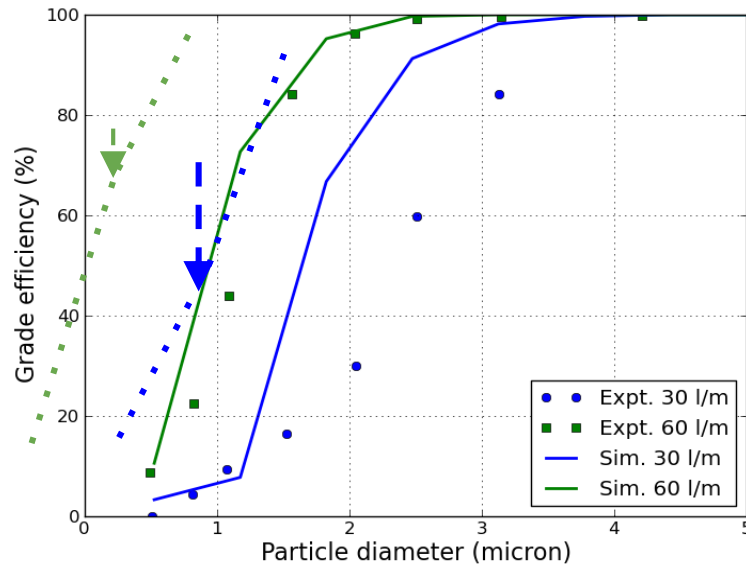
- Optimize the inflow conduit
- Analyse the deflecting mechanism to enhance mixing efficiency
- Modifying inflow mass flowrates
- Repeat for various particle diameters.

- **Solutions:**

- Use the N-phase model in TransAT using the Eulerian-Lagrangian model.



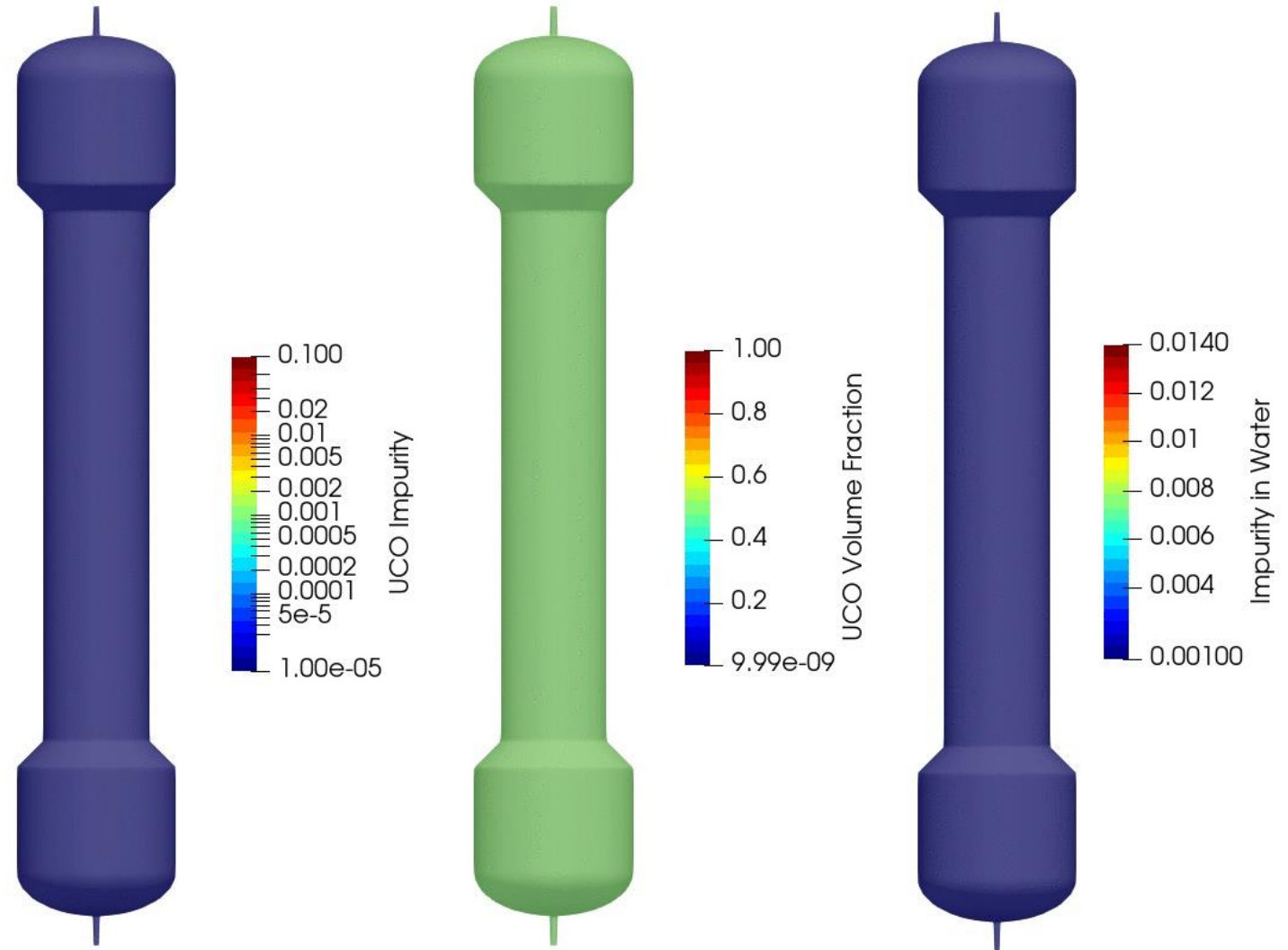
Pressure drop & grade efficiency



Comparison with Xiang experiment

Extraction Reactor

- Oil and water separate
- Mixing happens in the central zone
- Impurity moves from Oil phase to water phase
- Simulation time ~ 3 min





Making Future

— Advanced Modelling & Simulation

— www.poyry.com/ams; ams@afry.com