TECHNISCHE UNIVERSITÄT DARMSTADT

STFS

6th Two-Day Meeting

Creating a Reference Data Set for Model Development on SCR Systems

Summary

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- Self-introduction
- Introducing the Problem
- Experimental Investigation
- Numerical Simulation
- Discussion

Self-Introduction

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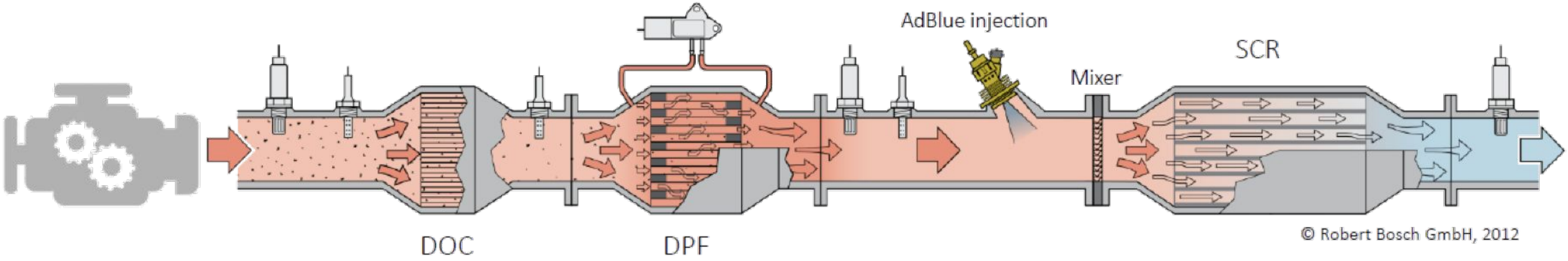
- Brazilian
- Chemistry and Chemical Engineering (UFRJ)
- Wikki Brasil (~ 5 years)
- STFS - TU Darmstadt (12.23)

Introducing the problem

Introducing the Problem



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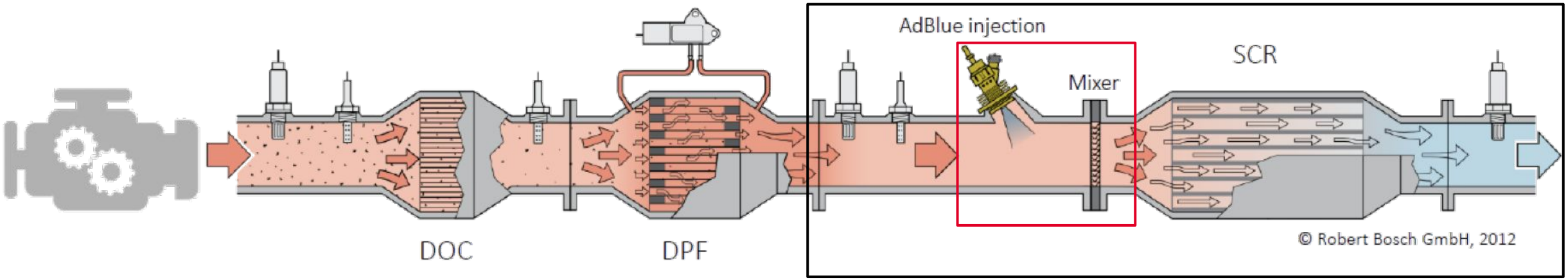

Introducing the Problem

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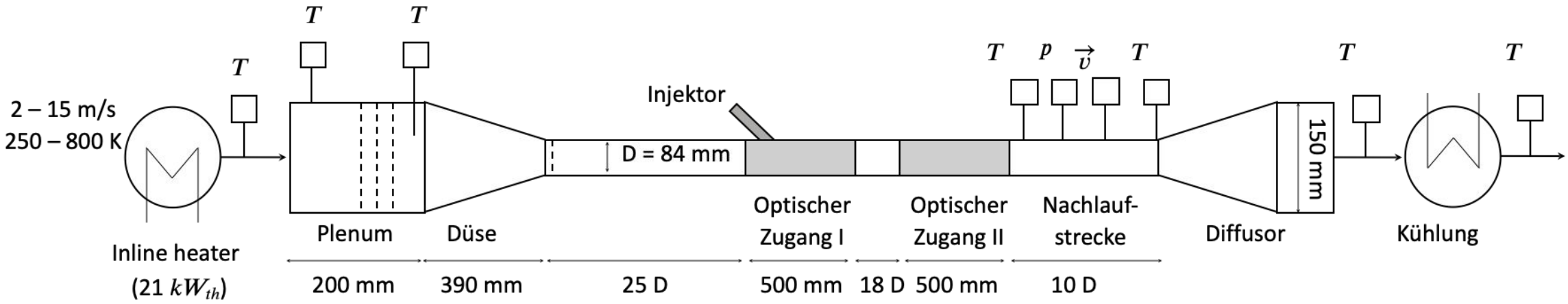
Objective:

To obtain feedback on the definition of a broad set of reference data for the development of fundamental models for spray wall models in SCR systems.

Adjustable hot gas test bench enables:

- Validation of Spray-Flow interaction
- Validation of Wall-film-Flow interaction
- Investigation of variable spray-mixer configurations
- Deposits tendencies

Introducing the Problem



- Dr. Steven Wagner
- Matthias Bonarens
- Leon Schuhmann
- Dr. Anna von der Heyden
  (RSM - TU Darmstadt)
- Prof. Dr. Christian Hasse
- Jannis Reusch
- Roberto Lange
  (STFS - TU Darmstadt)

Introducing the Problem

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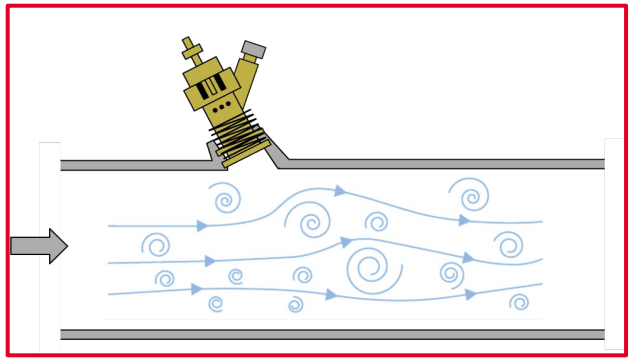
What is happening?



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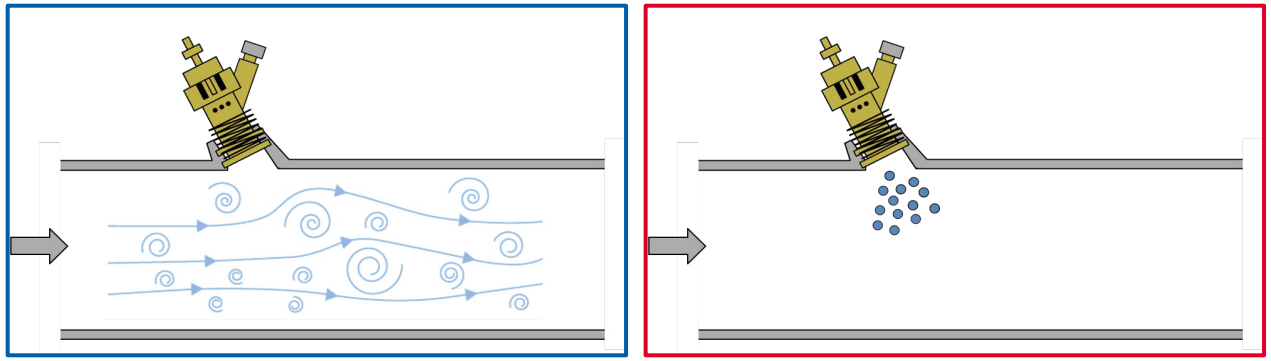

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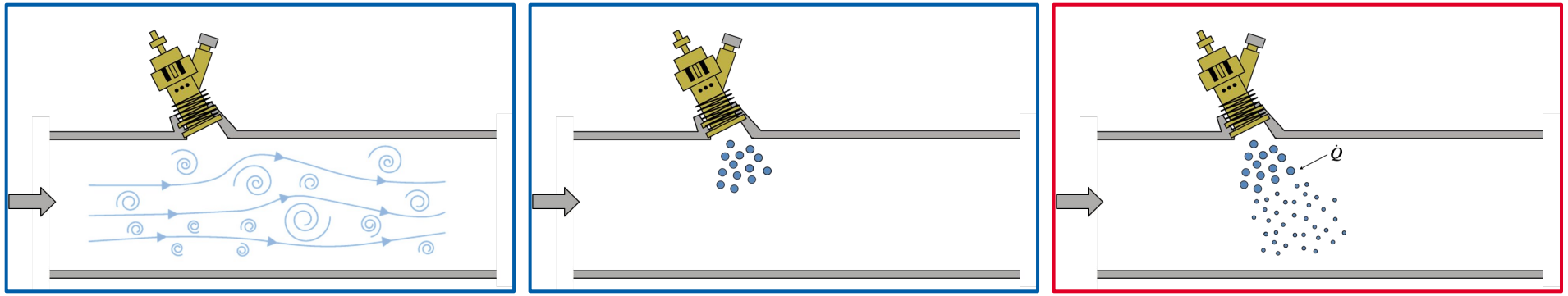

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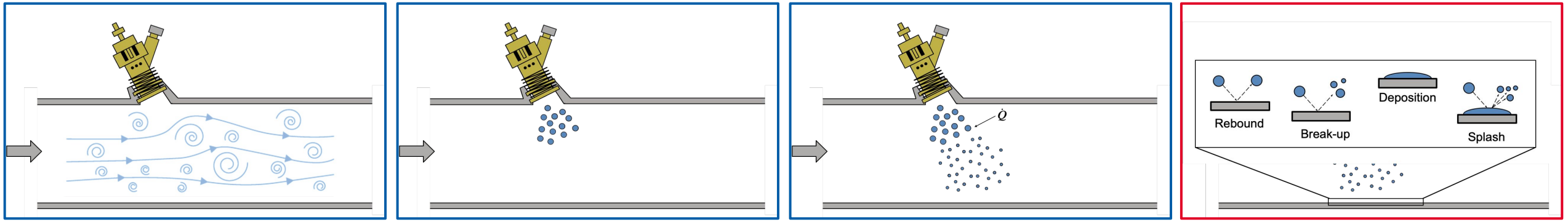

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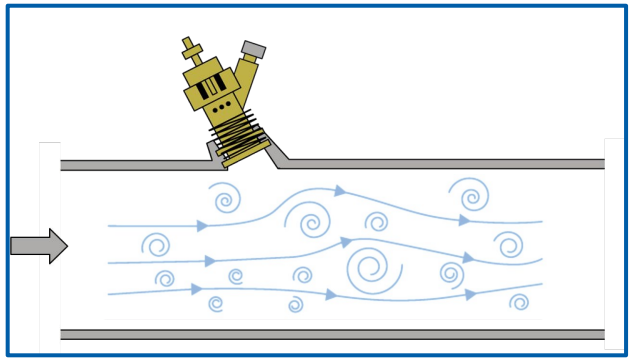

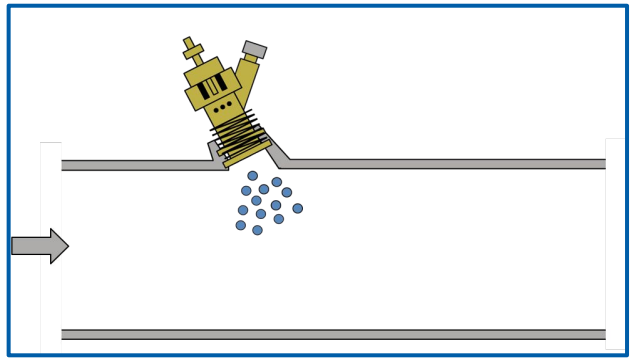

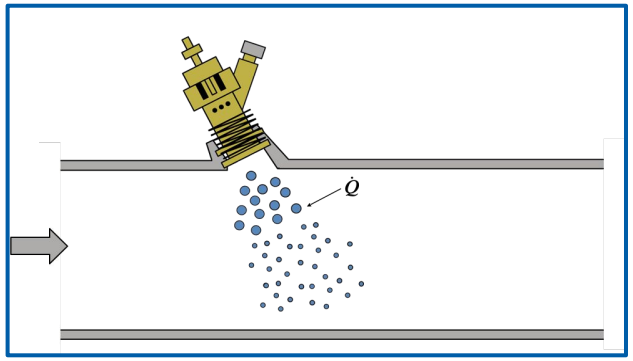

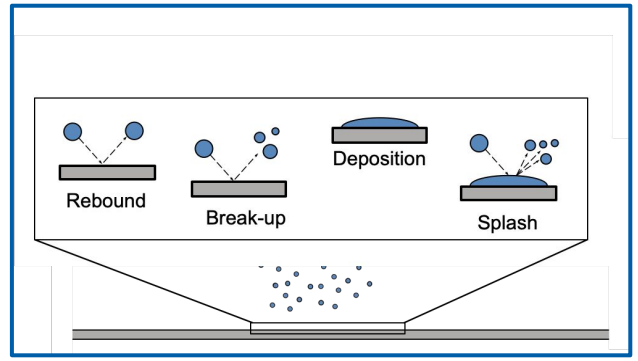

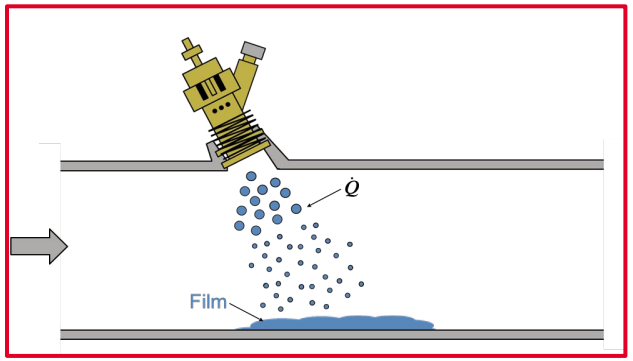

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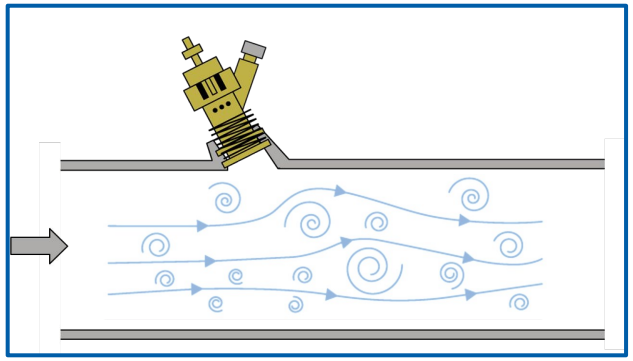

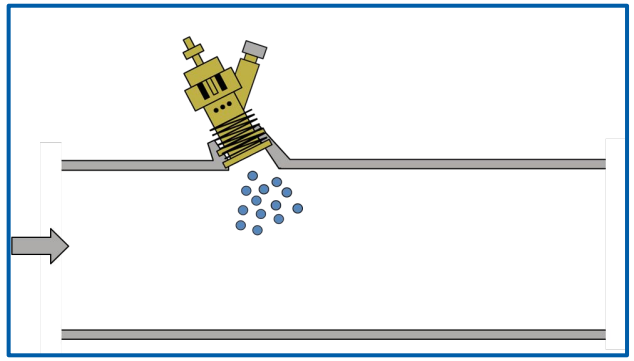

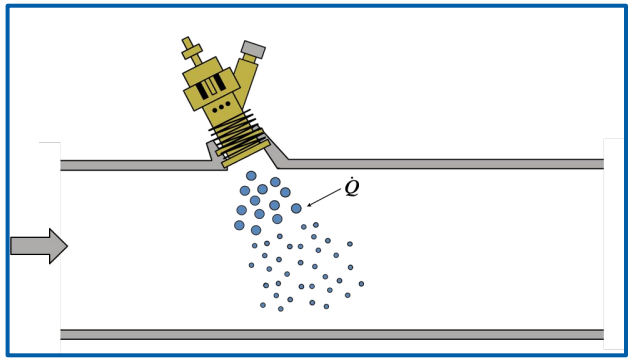

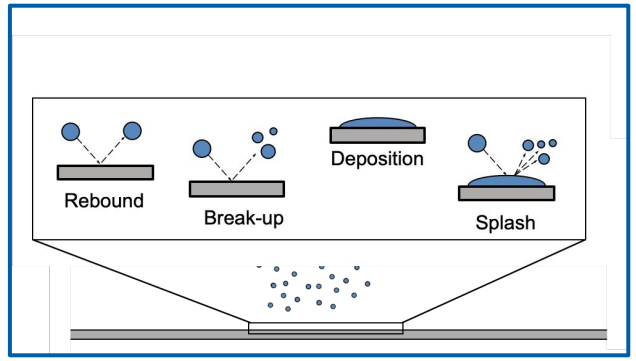

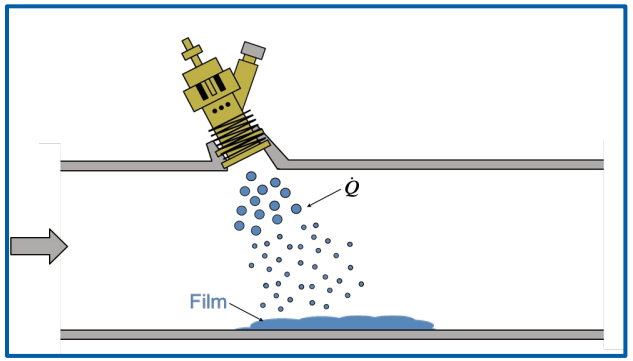

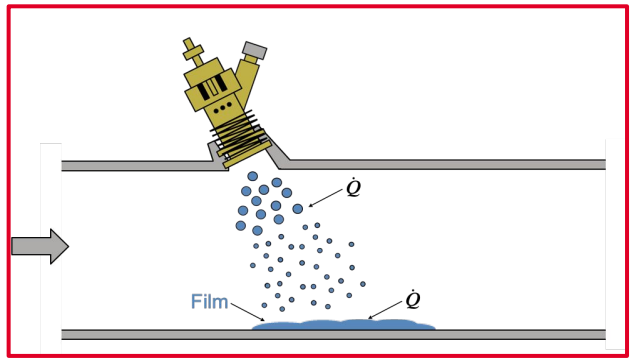

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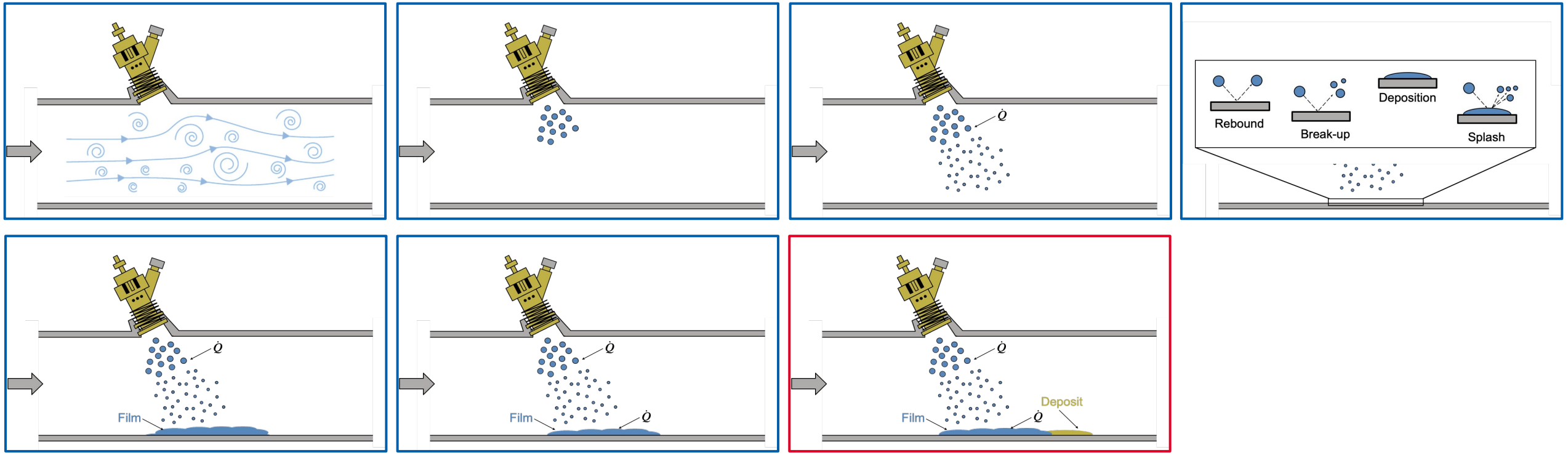

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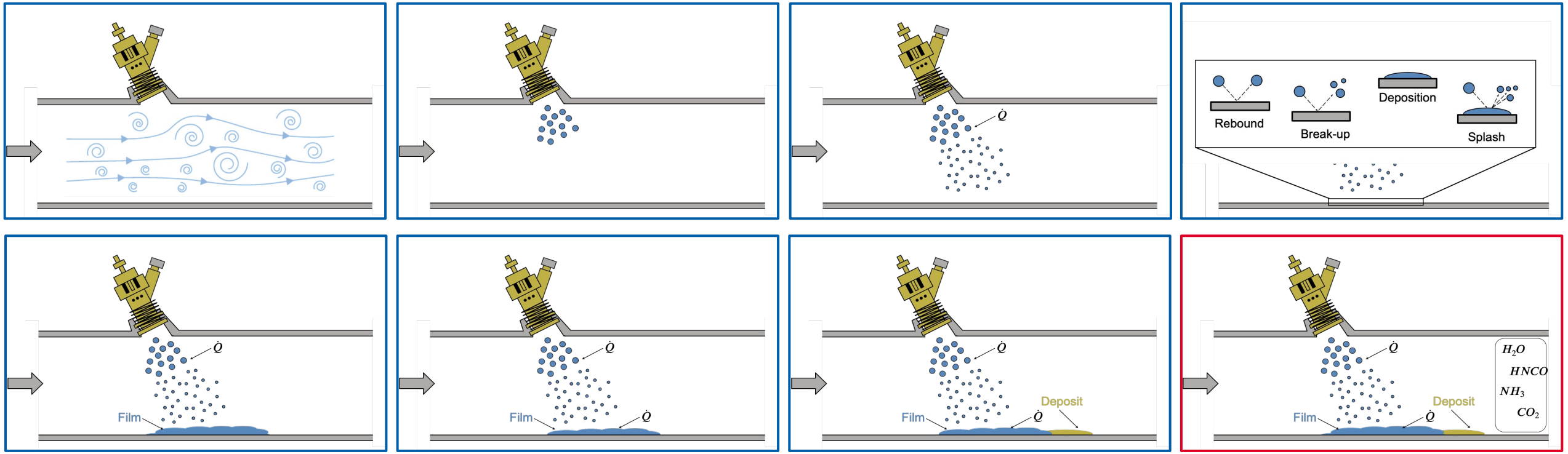

Introducing the Problem

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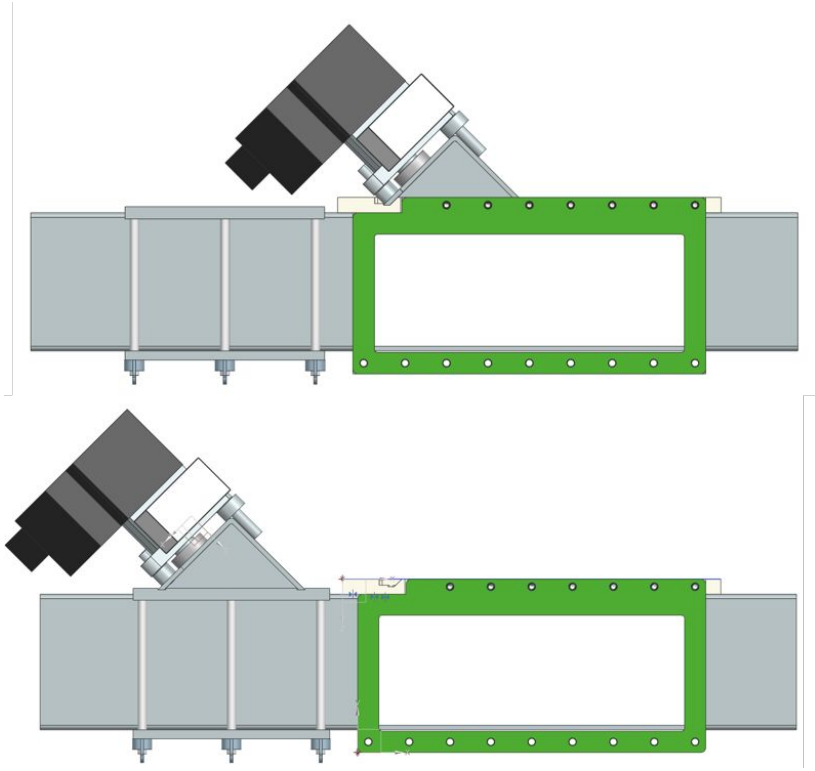
What can be measured?

- PIV - water injections
- Gas phase temperature profile
- Gas phase flow rate
- Gas phase composition
- Temperature (thermo couples under the film and on walls)
- Film volume
- Film thickness and temperature (one point)
- Wetting area



Experimental Investigation

Experimental Investigation

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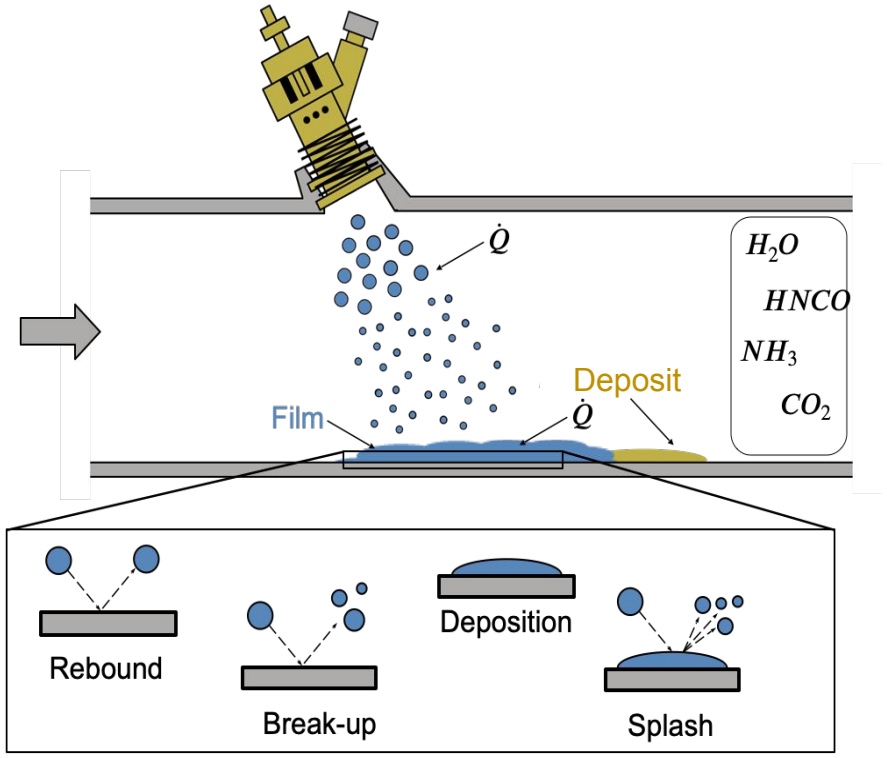
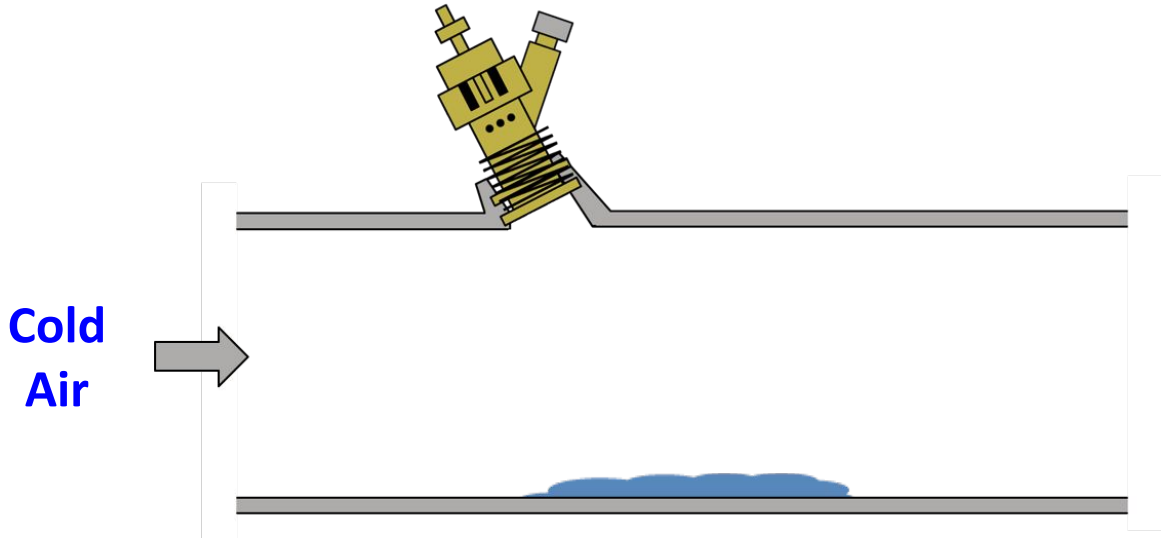
New measurement campaign: adBlue injections

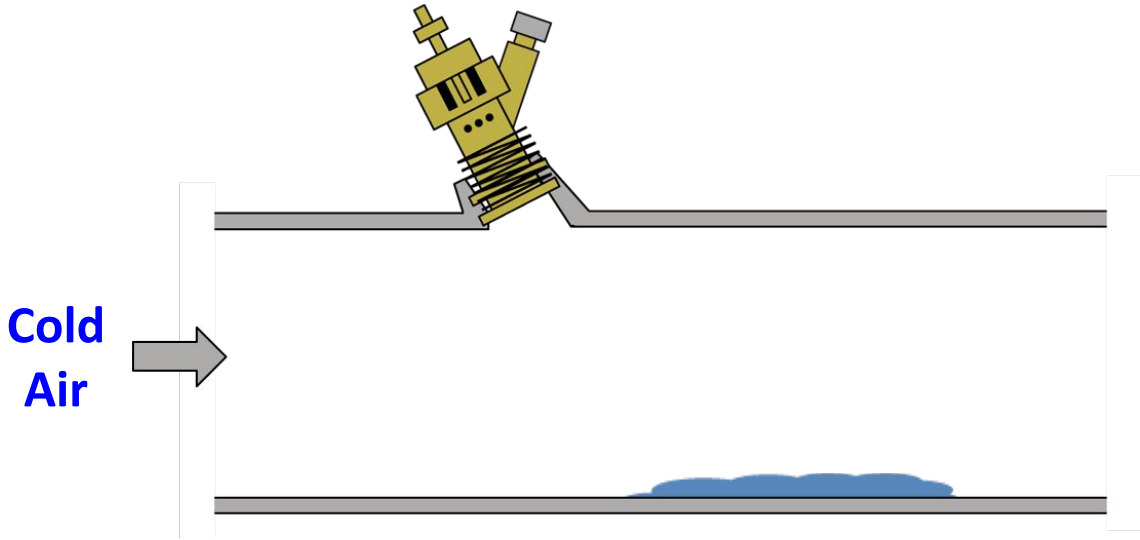
No.	α	$T\,/°C$	$\vec{v}\,/\frac{m}{s}$	$\dot{m}_{Air}\,/\frac{kg}{h}$	$\dot{m}_{DEF}\,/\frac{g}{h}$	Reynolds number
C1	1	180	6.5	129	697	$17.6 \cdot 10^3$
C2	1	250	3	51	278	$6.8 \cdot 10^3$
C3	1	250	6.5	111	604	$14.8 \cdot 10^3$
C4	1	250	10	171	929	$22.3 \cdot 10^3$
C5	1	350	6.5	94	507	$11 \cdot 10^3$
C6	2	250	6.5	111	1208	$14.8 \cdot 10^3$
C7	3	250	6.5	111	1812	$14.8 \cdot 10^3$
C8	0.5	250	6.5	111	302	$14.8 \cdot 10^3$
C9	0.75	250	6.5	111	453	$14.8 \cdot 10^3$
C10	?	20	?	?	?	



Experimental Investigation

1. Water spray: evaluating film movement





Experimental Investigation

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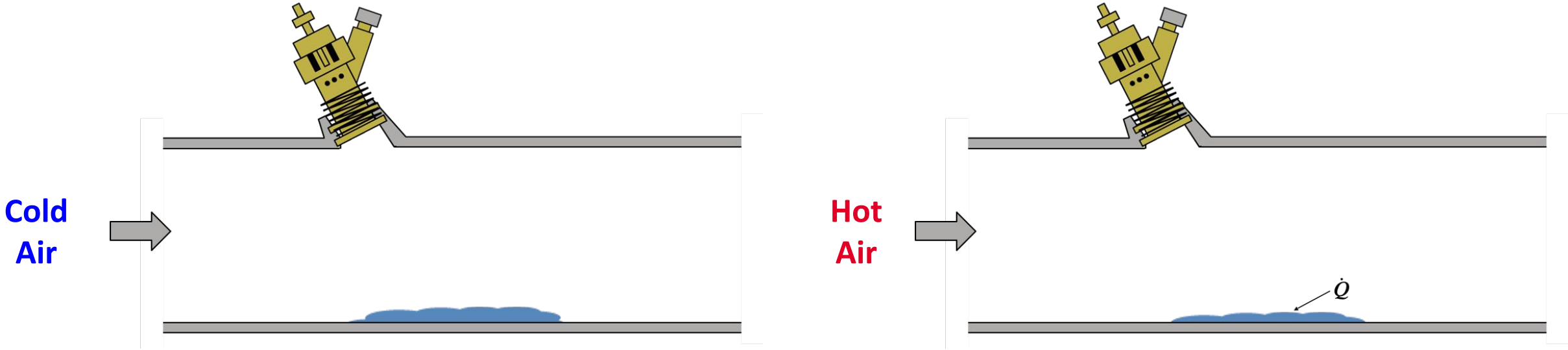
2. Water spray: evaluating film evaporation and movement



Experimental Investigation

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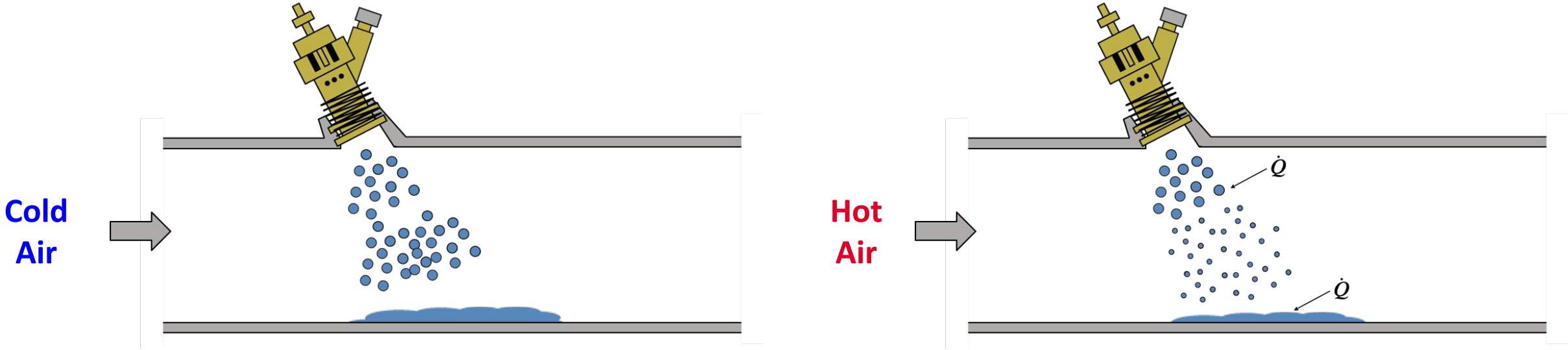
3. Water spray: evaluating particles and film evaporation



Experimental Investigation

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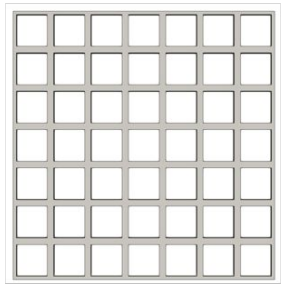
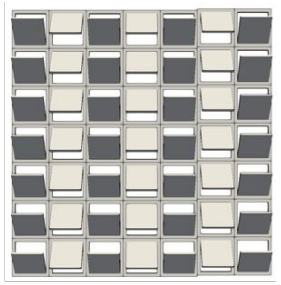
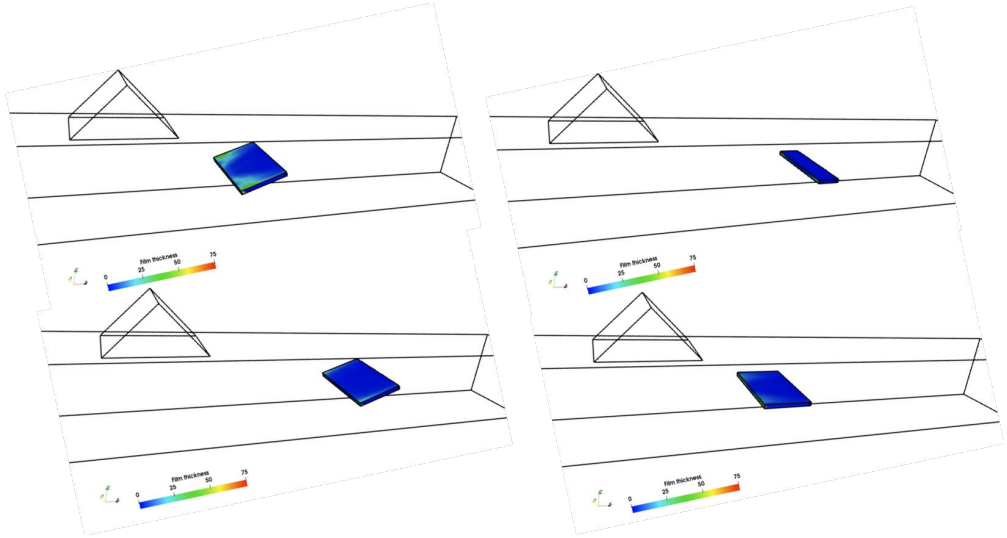
Mixer designs: close-to-application







Mixer designs: minimalist

Numerical Simulation

Numerical Simulation

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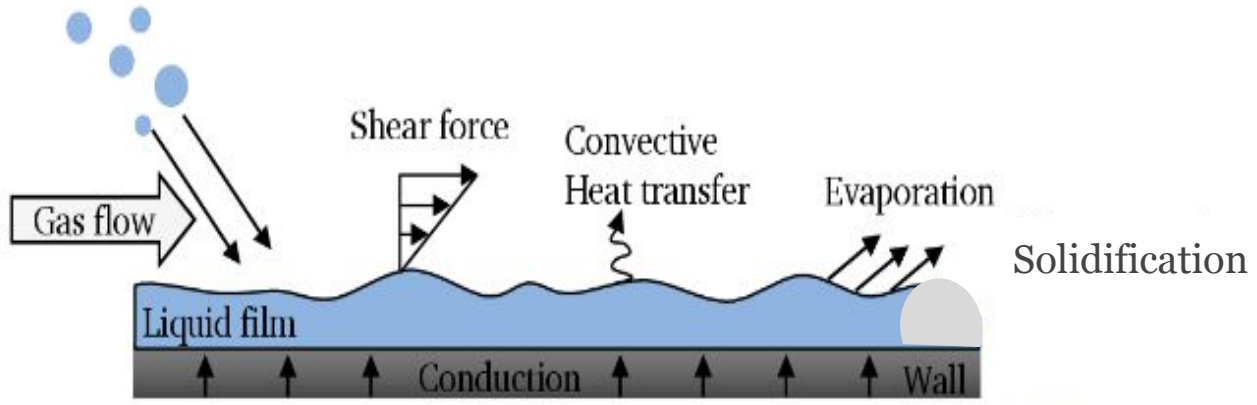
Continuous Phase + Spray + wall-film + walls

- Euler - Lagrange
- Wall-film single layer
- Conjugate Heat Transfer
- submodules



Numerical Simulation

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Topic 1: Cloud model

- Standard: reacting

Numerical Simulation

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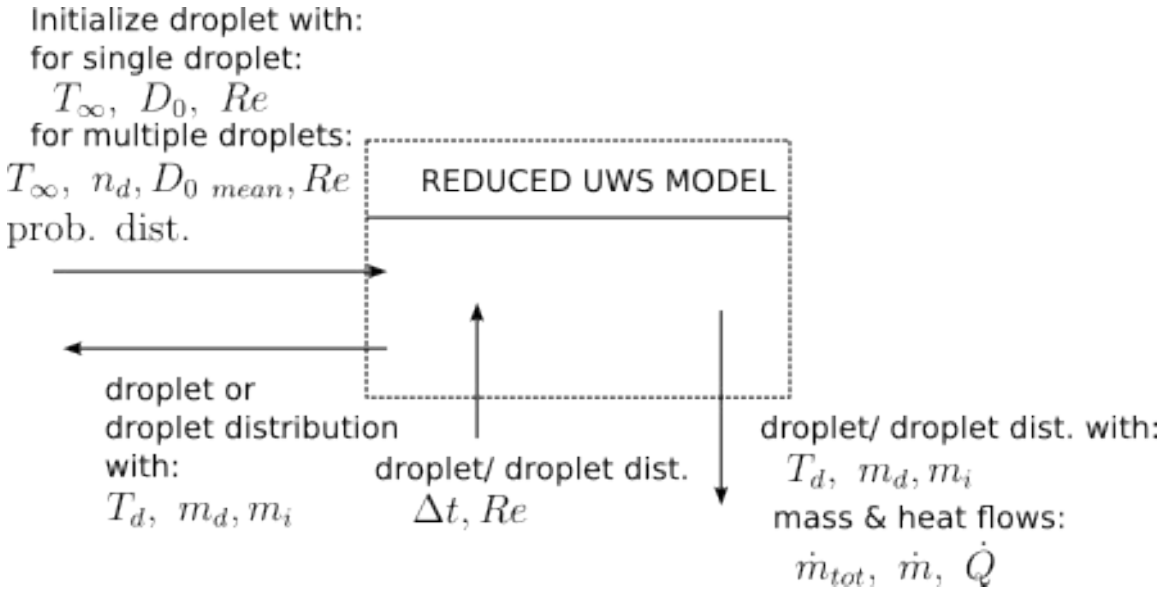
Topic 1: Cloud model

- Standard: reacting
- New feature: reactingTable

reduced UWS model (KIT)



Numerical Simulation

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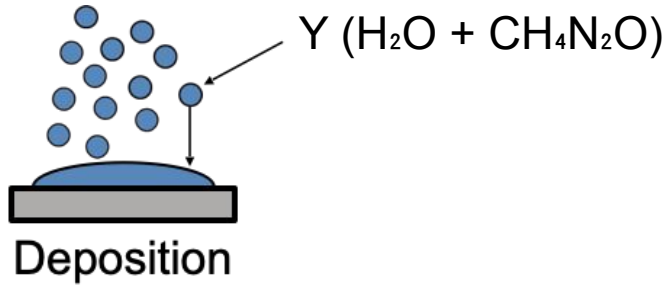
Topic 2: Mass transfer between cloud and wall-film

- Issue: Thermo (one component)
- Kaushal's work: Multicomponent



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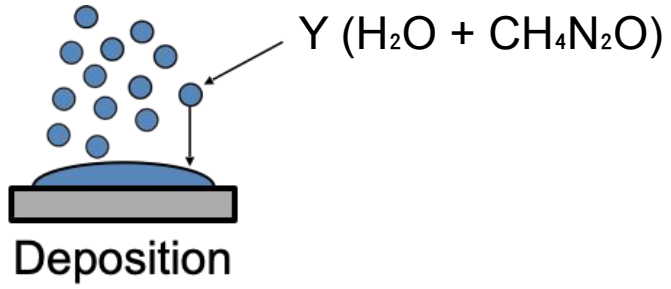
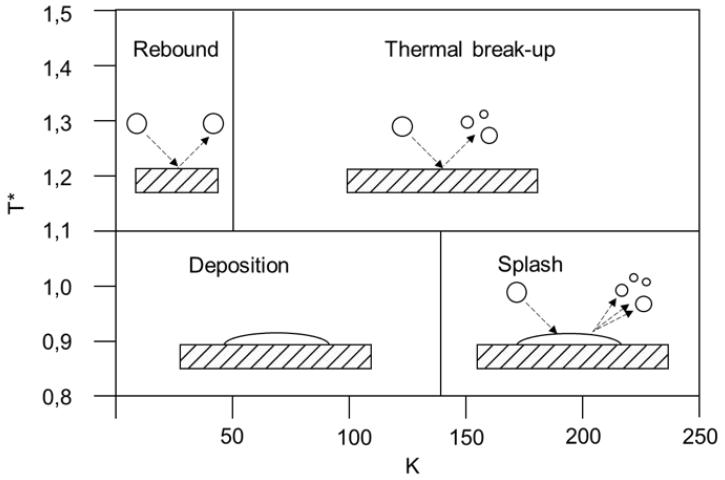


- New feature:
  Multicomponent + spray-wall thermal interaction
  (in progress)



Nach: D. Kuhnke, Ph.D. Thesis, TU Darmstadt 2004

Numerical Simulation

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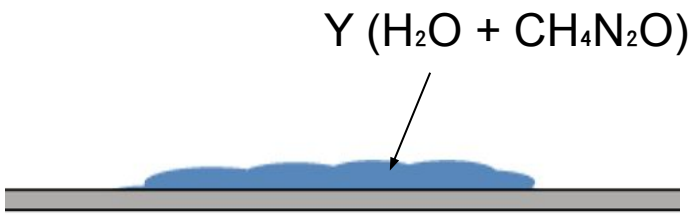
Topic 3: Wall-film model

- Issue: ThermoSingleLayer
- Kaushal's work: multicomponentSingleLayer



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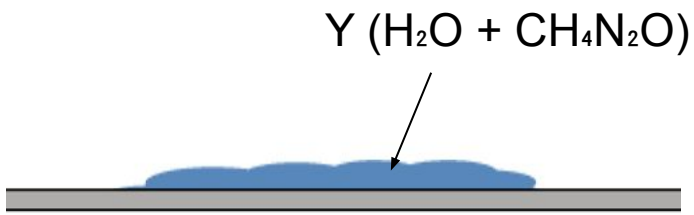
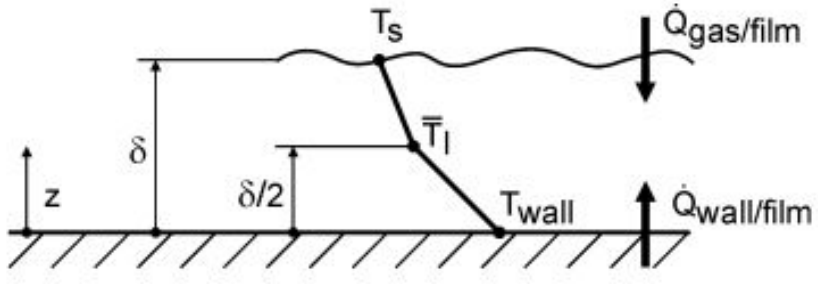


- Issue: ThermoSingleLayer
- Kaushal's work: multicomponentSingleLayer

- New feature:
  Multicomponent + heat transfer (impingement + CHT) + stationary phase (in progress)



Numerical Simulation

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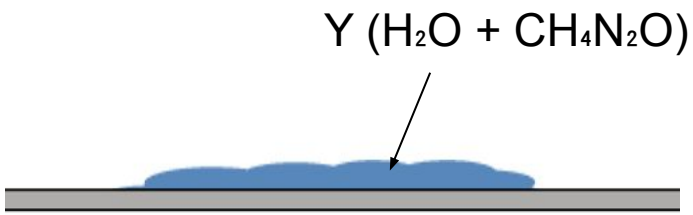
Topic 4: Phase change between film and gas

- Issue: standardPhaseChange
- Kaushal's work: multicomponentPhaseChange



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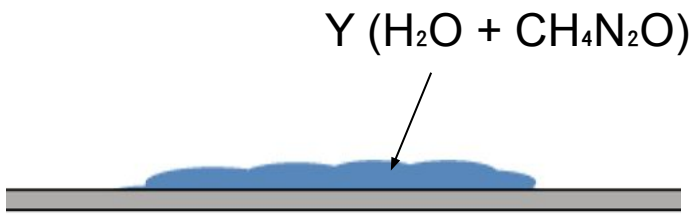

- Issue: standardPhaseChange
- Kaushal's work:
  multicomponentPhaseChange

- New feature:
  solidification and melting → stationary phase (solid urea and subproducts)
  (in progress)

Discussion

Discussion

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Initial topics:

- Values for alpha
- Angles for minimalistic mixer plates
- What results would be interesting

Others topics:

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Thank you very much!

Ing. Roberto Lange
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