CHALMERS
UNIVERSITY OF TECHNOLOGY

Modified surfaces to enhance vertical falling film heat transfer

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Vertical falling film

- **A liquid film with a distinct interface flowing down a vertical wall.**
- **Low residence time and a large contact area**
- **Used in varies fields.**
- **Limited knowledge about dynamics within the liquid film.**

Playback:
1/12 x

$h_s \approx 1800$
$W/(m^2K)$

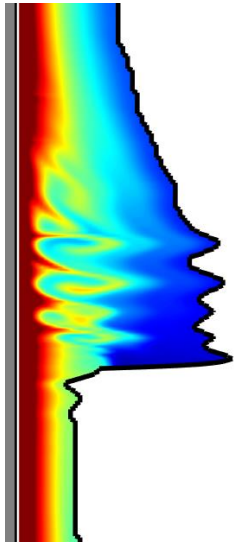
Approach

Numerical

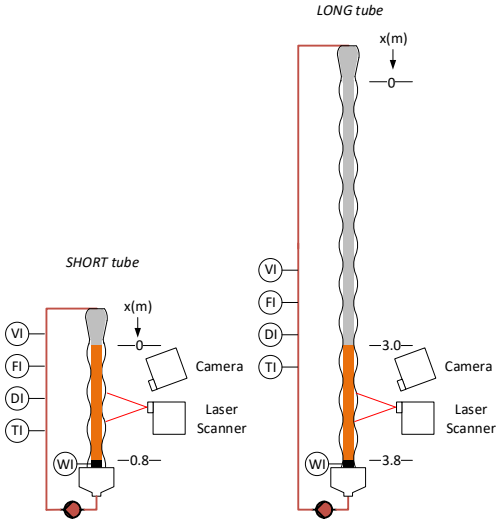
Experimental

Heating and Hydrodynamics

CFD

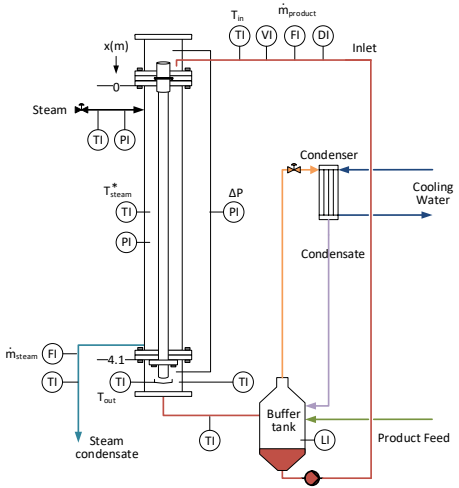


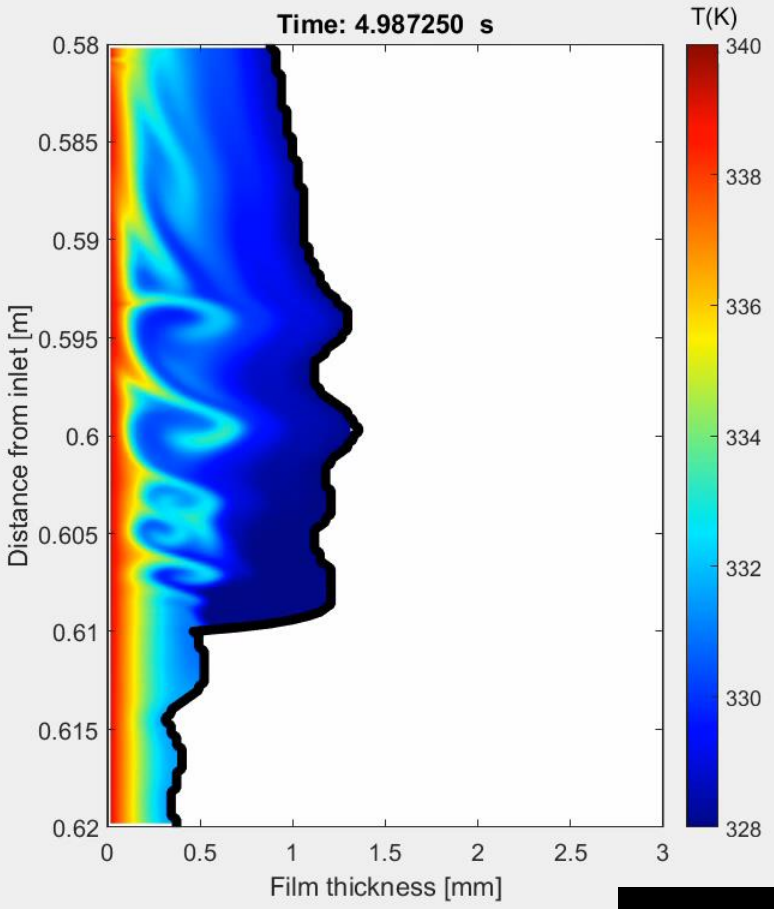
Atmospheric setup

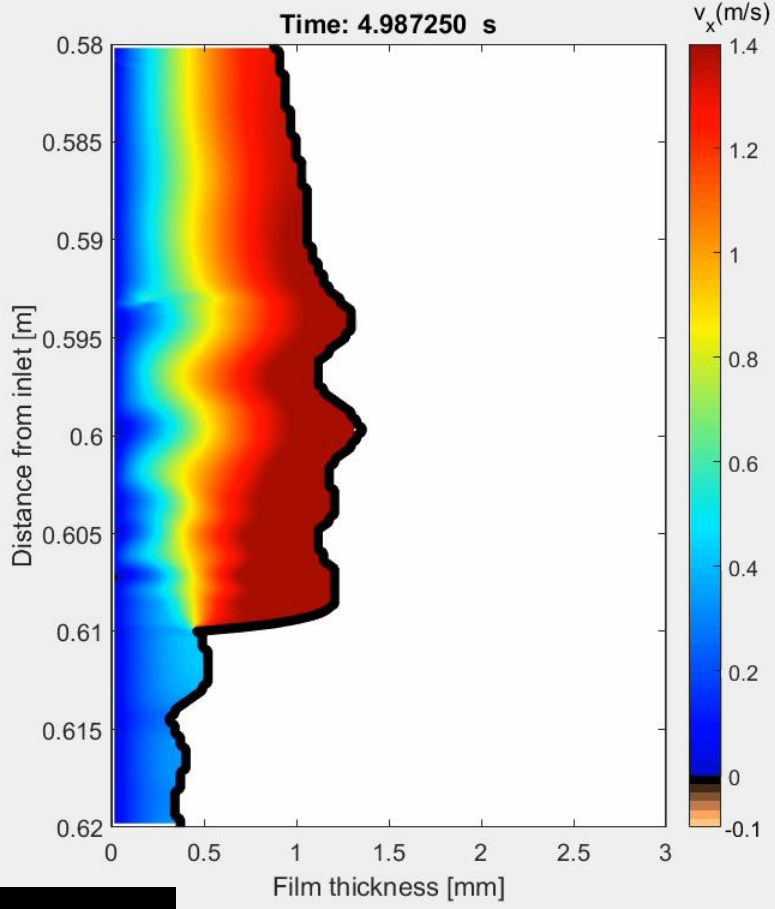


Evaporation

Pilot evaporator



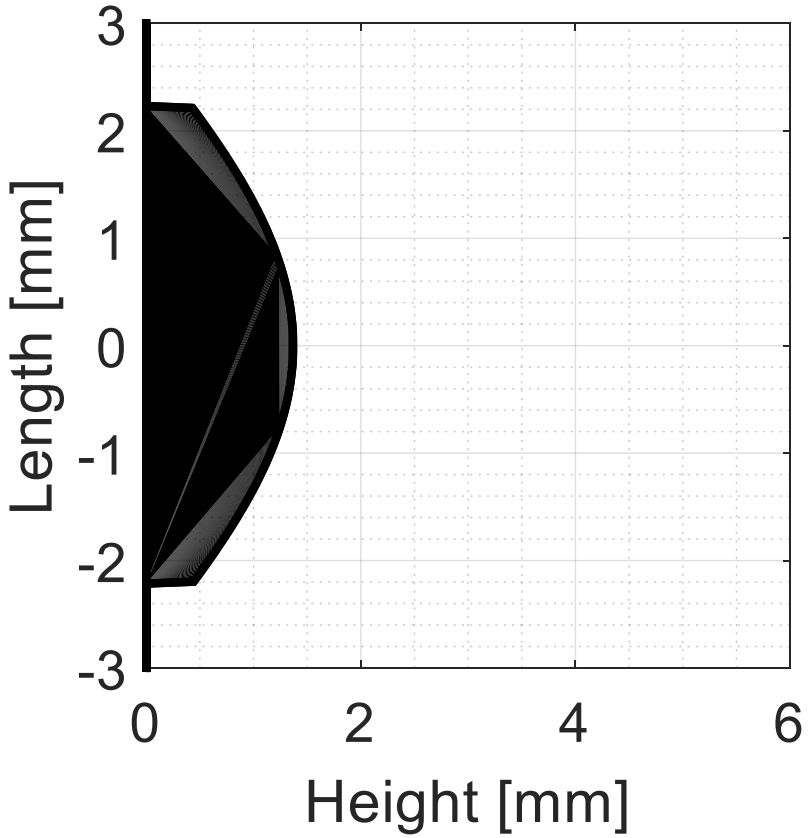

Time: 4.987250 s
T(K)
Distance from inlet [m]
Film thickness [mm]


Time: 4.987250 s
v_x(m/s)
Distance from inlet [m]
Film thickness [mm]

Numerical

Introducing surface modifications

- **Idea: Disturb the flow pattern to cause more bulk mixing**



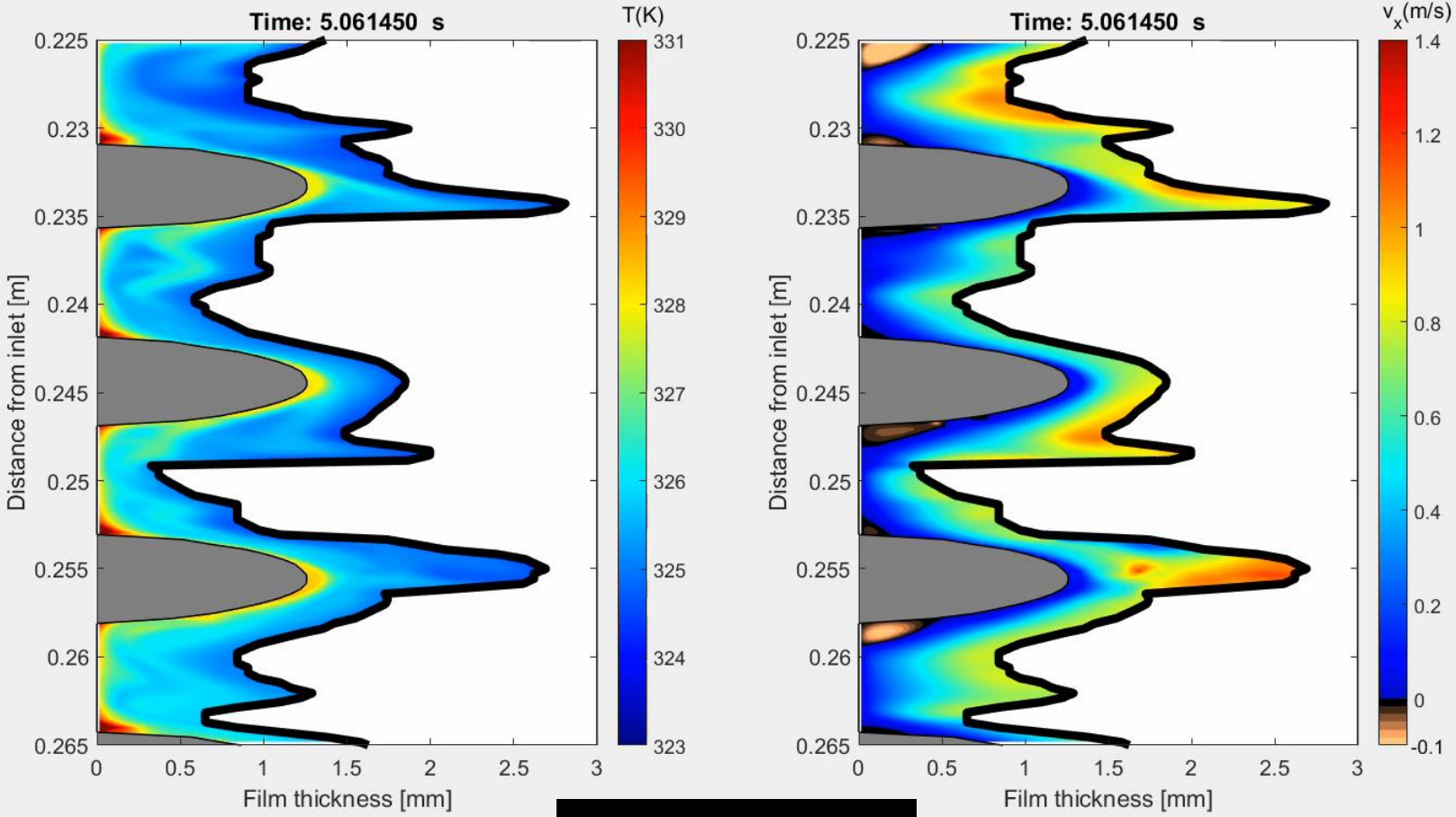
Experimental Results

- **Chaotic flow pattern**
- **Thicker liquid film**
- **Significantly higher heat transfer**

Playback:
1/12 x

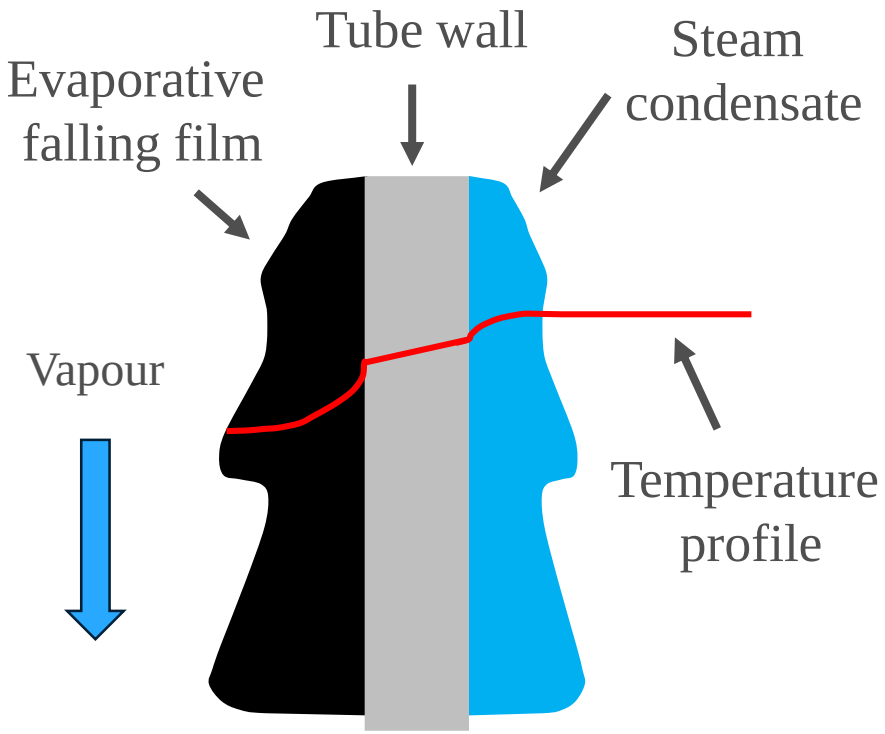
$h_m \approx 3600$ W/(m²K)

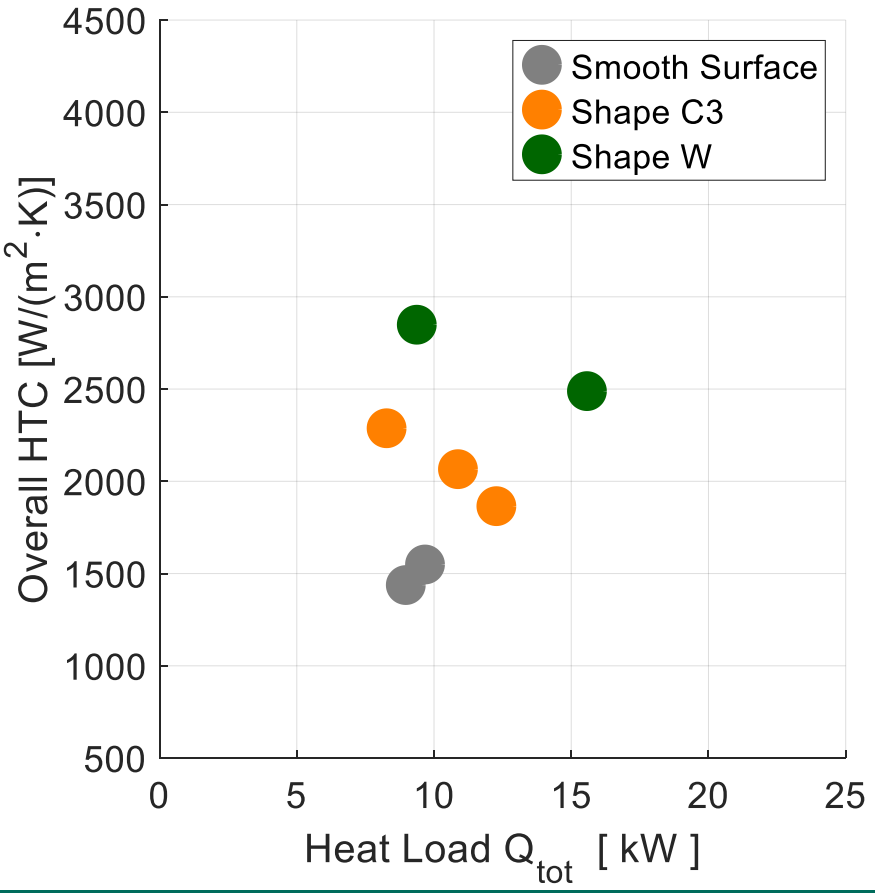
≈ 100 %
Improvement


Time: 5.061450 s
T(K)
Distance from inlet [m]
Film thickness [mm]
Time: 5.061450 s
v_x(m/s)
Distance from inlet [m]
Film thickness [mm]

Numerical

Pilot evaporator





Conclusions

- The heat transfer coefficient can be significantly enhanced with the introduction of surface modifications.
- The enhancement works for both heating and evaporative conditions and at large scale.
- The enhancement appears to be caused by time-dependent recirculation zones behind the surface modifications.

Thank you for your attention!

Anders Åkesjö