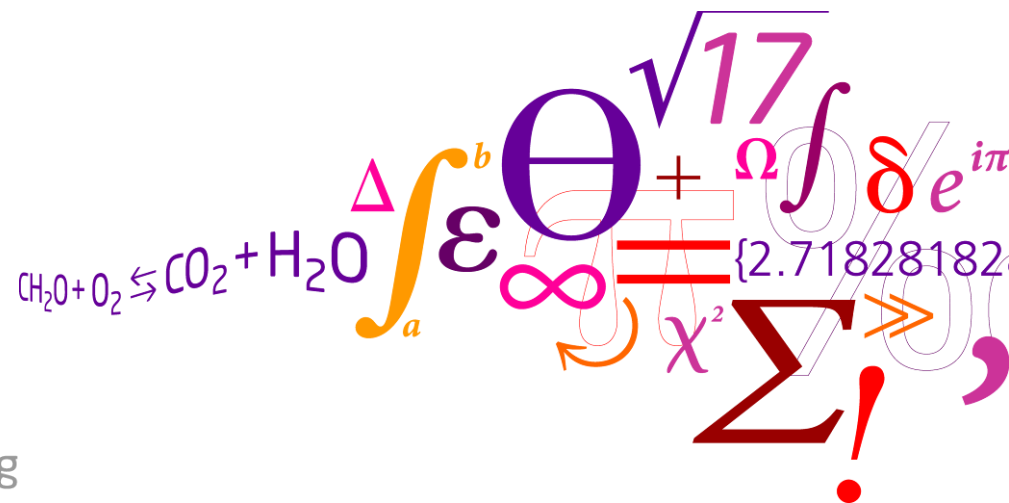


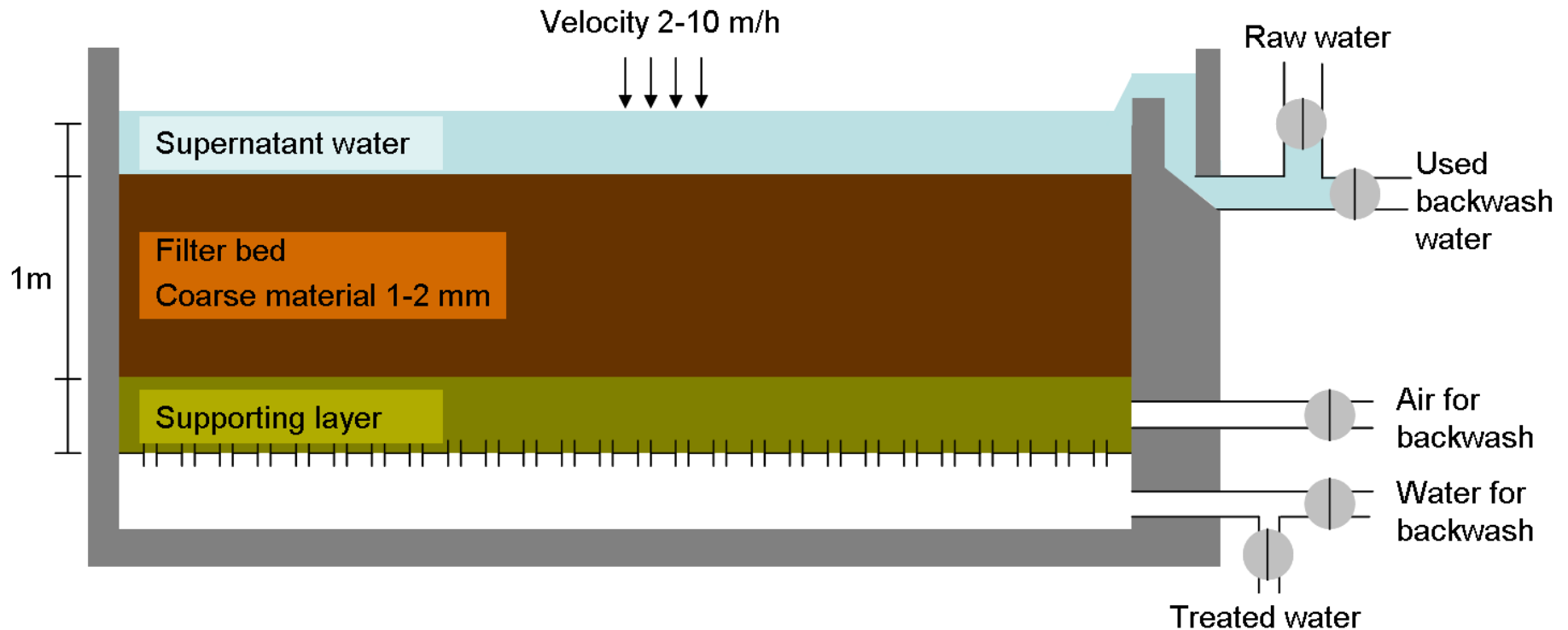
BUBBLE FORMATION IN RAPID SAND FILTERS

Laure Lopato, Philip Binning, Erik Arvin

4th Annual Meeting of DWRP 10, January 28-29 2010



Background



- Rapid sand filtration is a commonly used water treatment process
- Last step in drinking water treatment in Denmark

Background

- Documented presence of bubbles:
 - WTP in Denmark
 - Scardina and Edwards 2002
- Cause of bubble presence:
 - Supersaturated inlet water
 - Air backwash
- Formation of air bubbles in filter media:
 - Reduces water saturation
 - Creates channeling
 - Increases measured turbidity

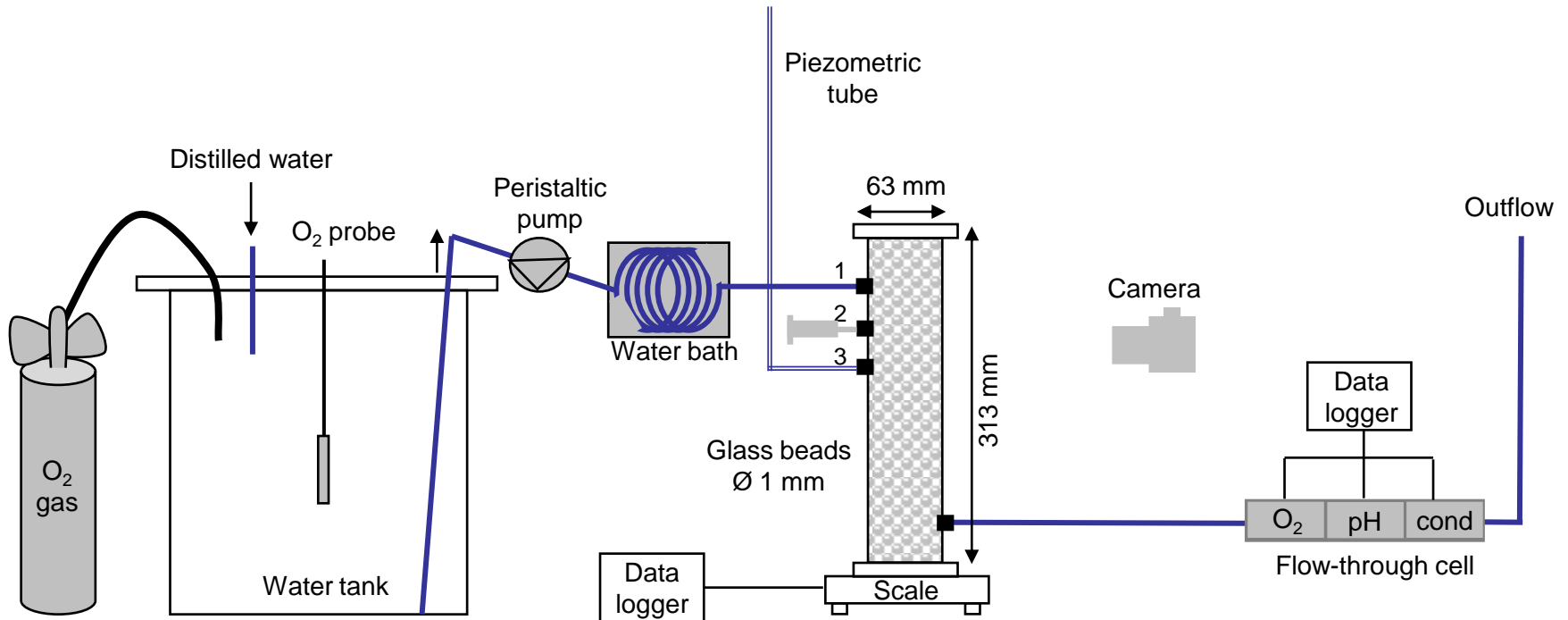


Objectives

Investigate the bubble development
pattern

Assess the impact of bubble formation
on filter hydraulics

Experimental setup



- Constant inlet flow of 2.2 l/h
- Oxygen supersaturation: 1.1 atm
- Tracer injections: 2 mL of Na₂SO₃ at 60 g/l

Experimental setup

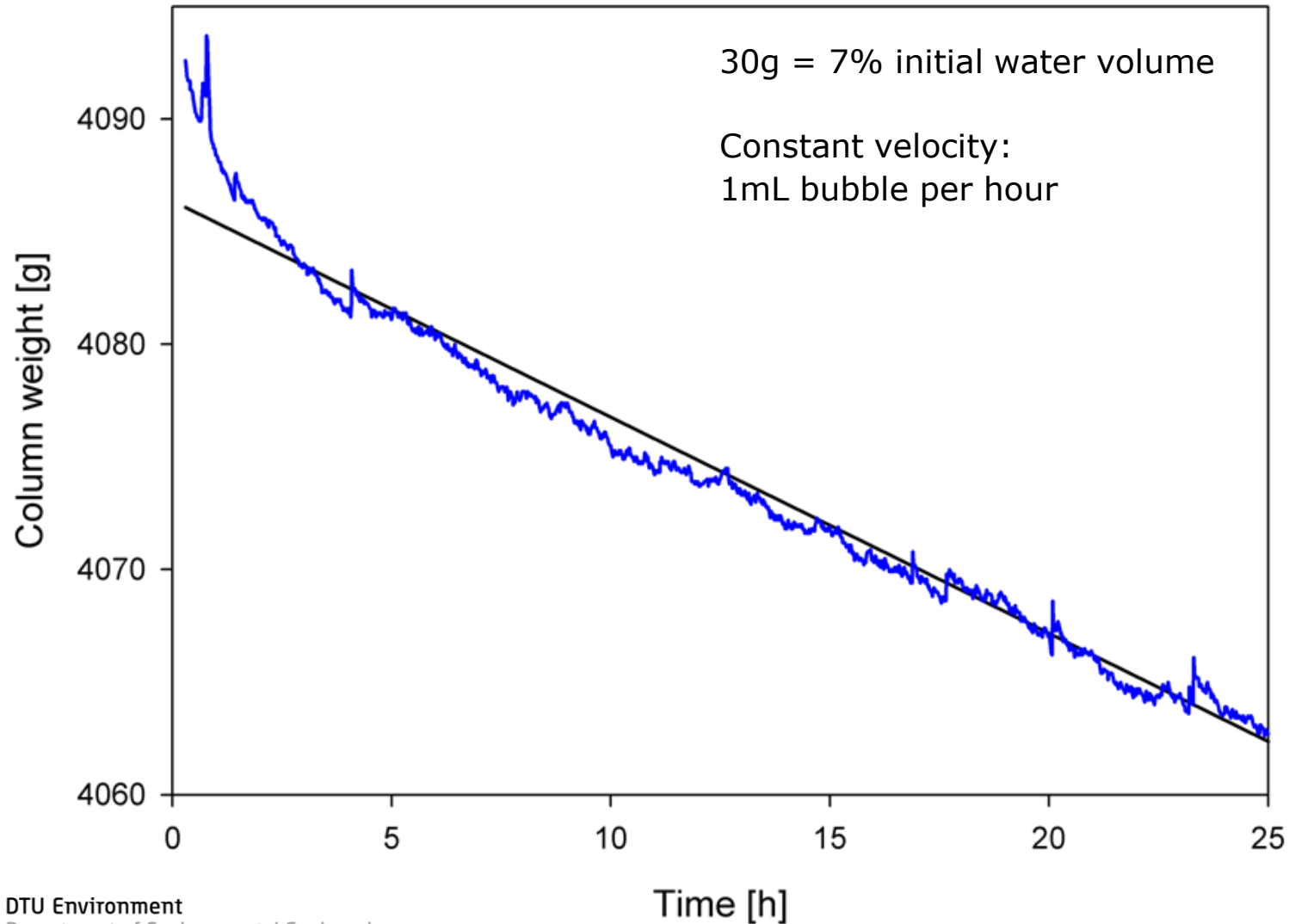
Peristaltic pump

Water bath

Column

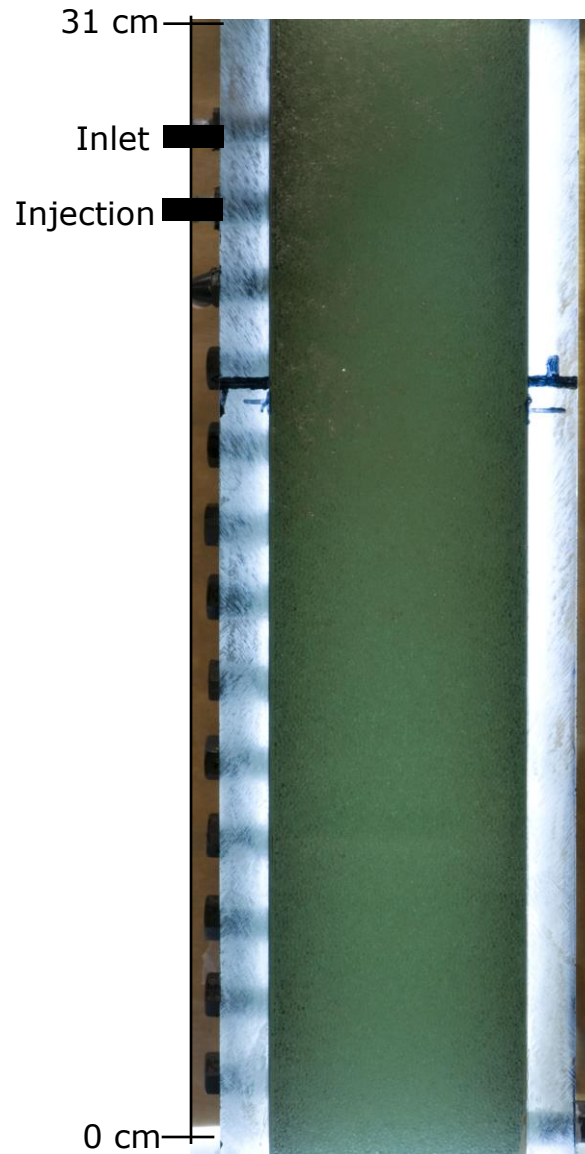
Oxygen,
conductivity, pH

Formation of bubbles



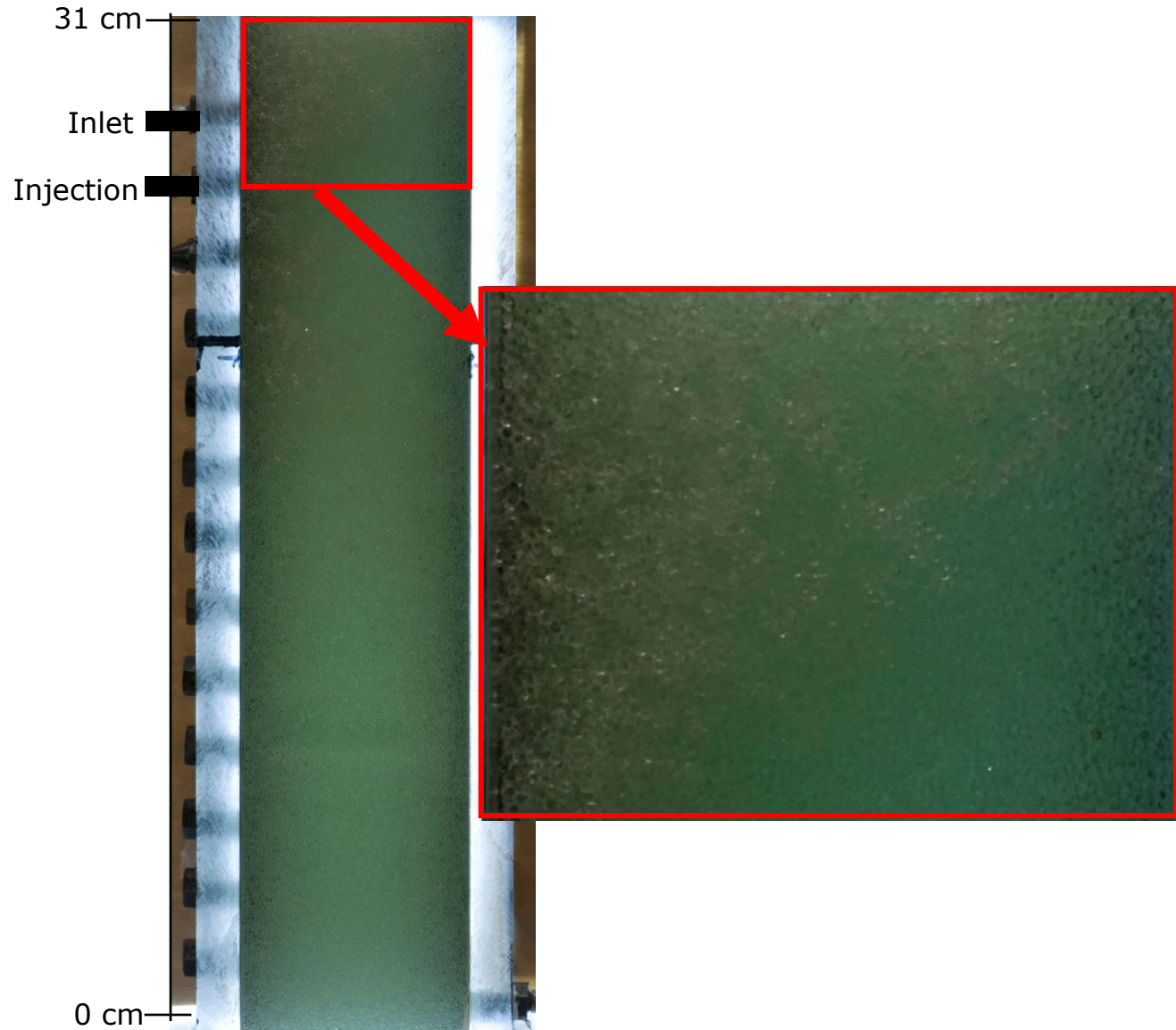
Formation of bubbles

- Pictures taken every 30 min
- View of the column after 26 hours
- Photo processing in Photoshop



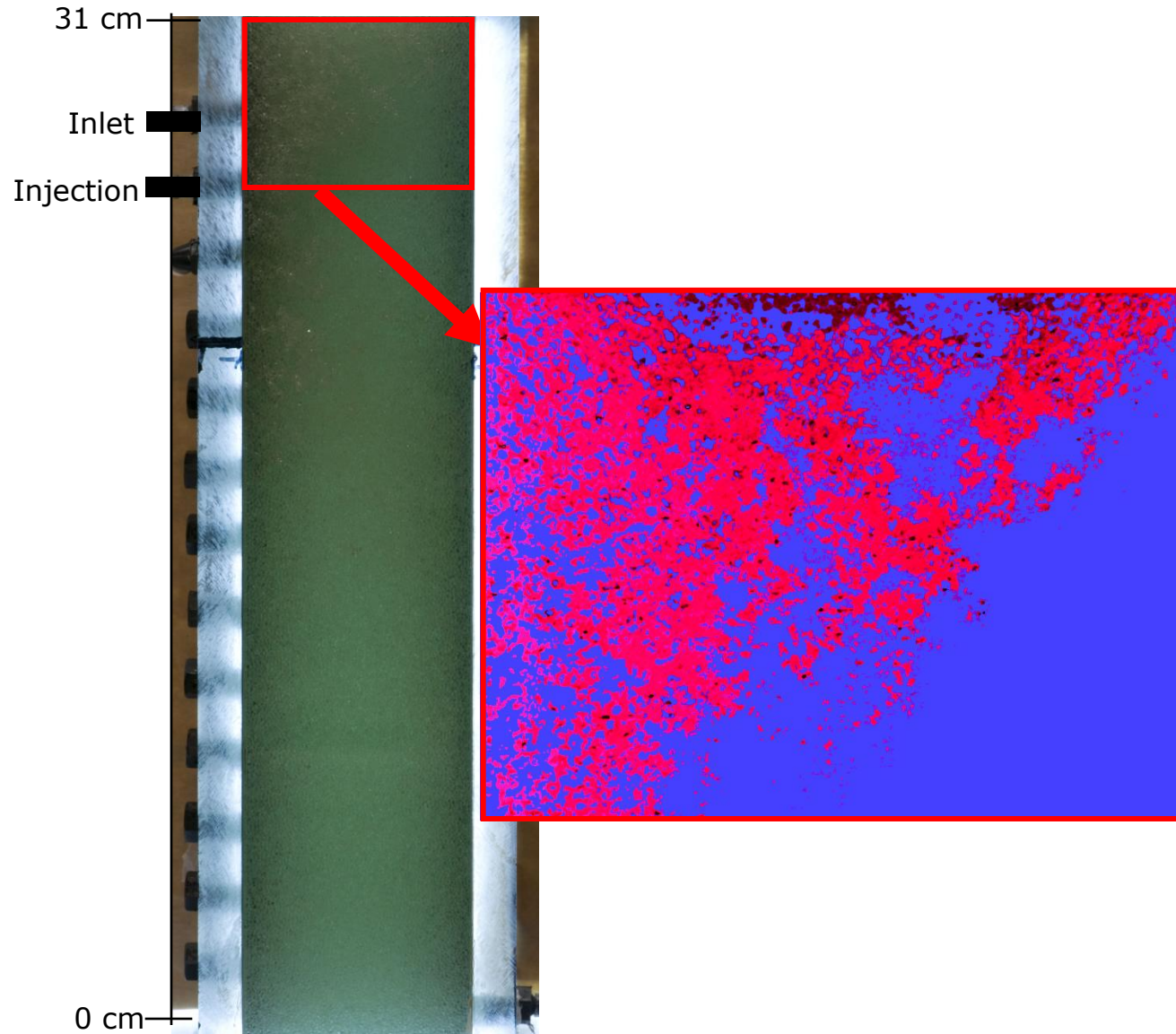
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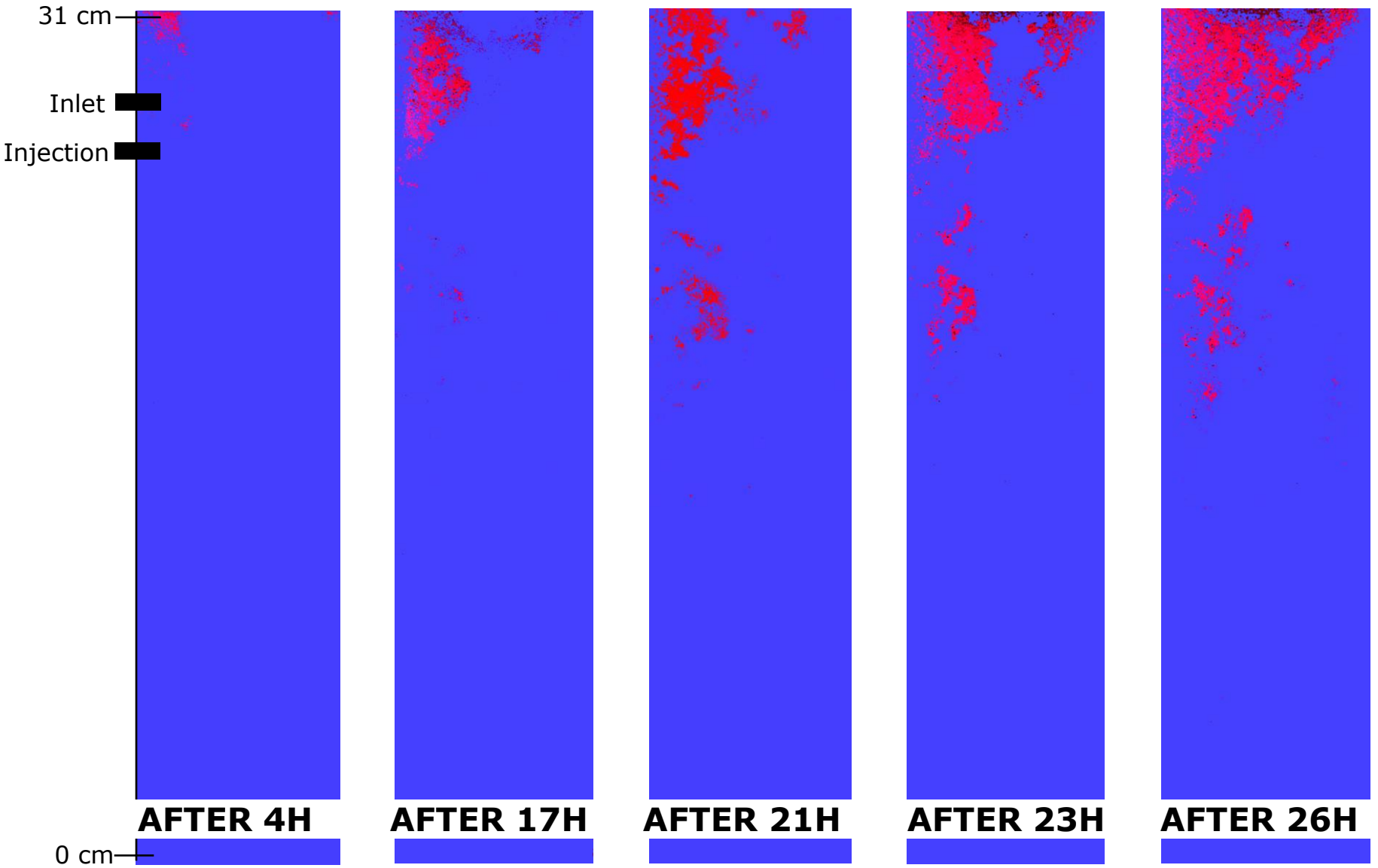


Formation of bubbles

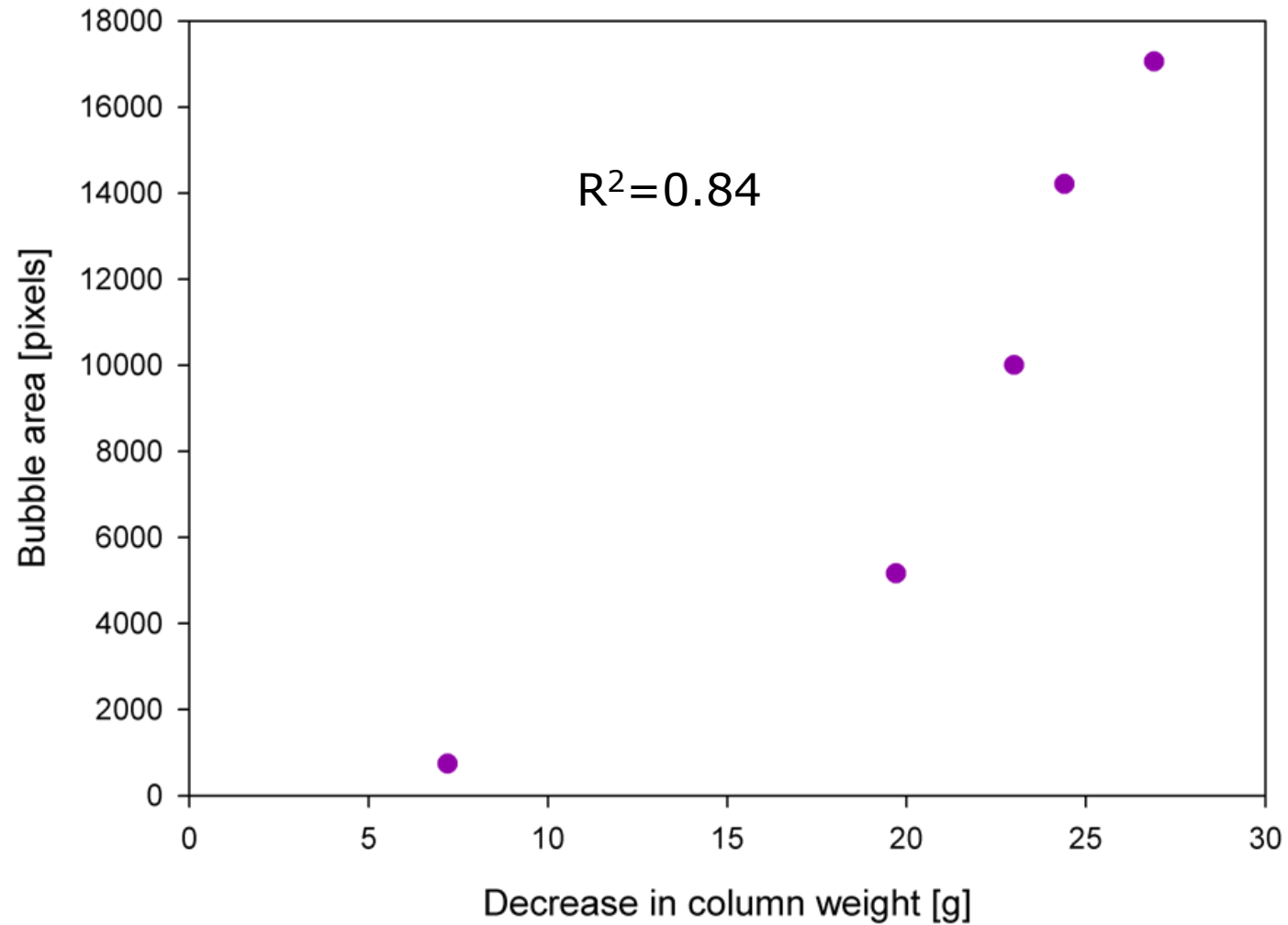
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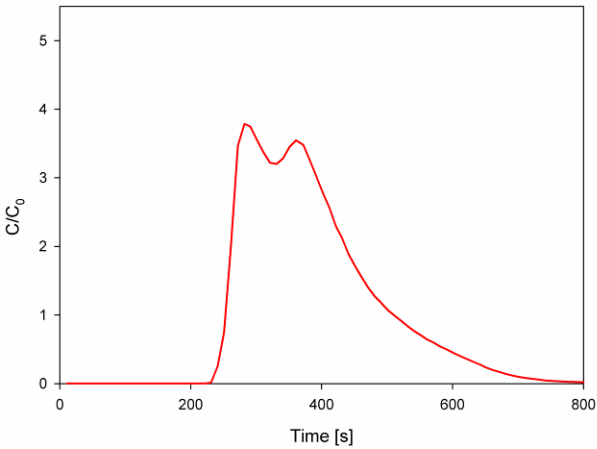
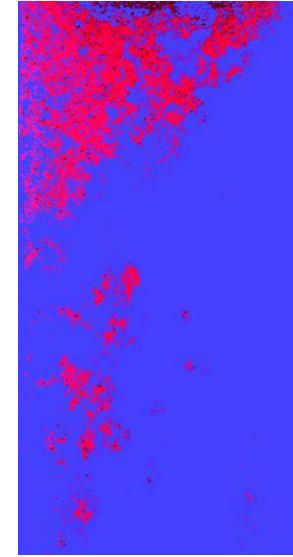
Formation of bubbles



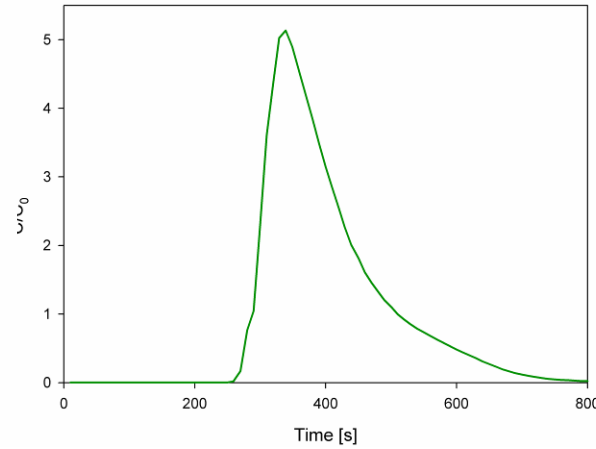
Formation of bubbles



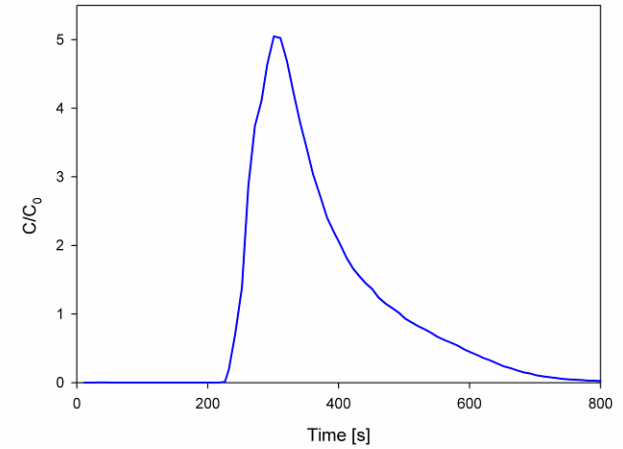
Hydraulics in the column



AFTER 17H



AFTER 23H



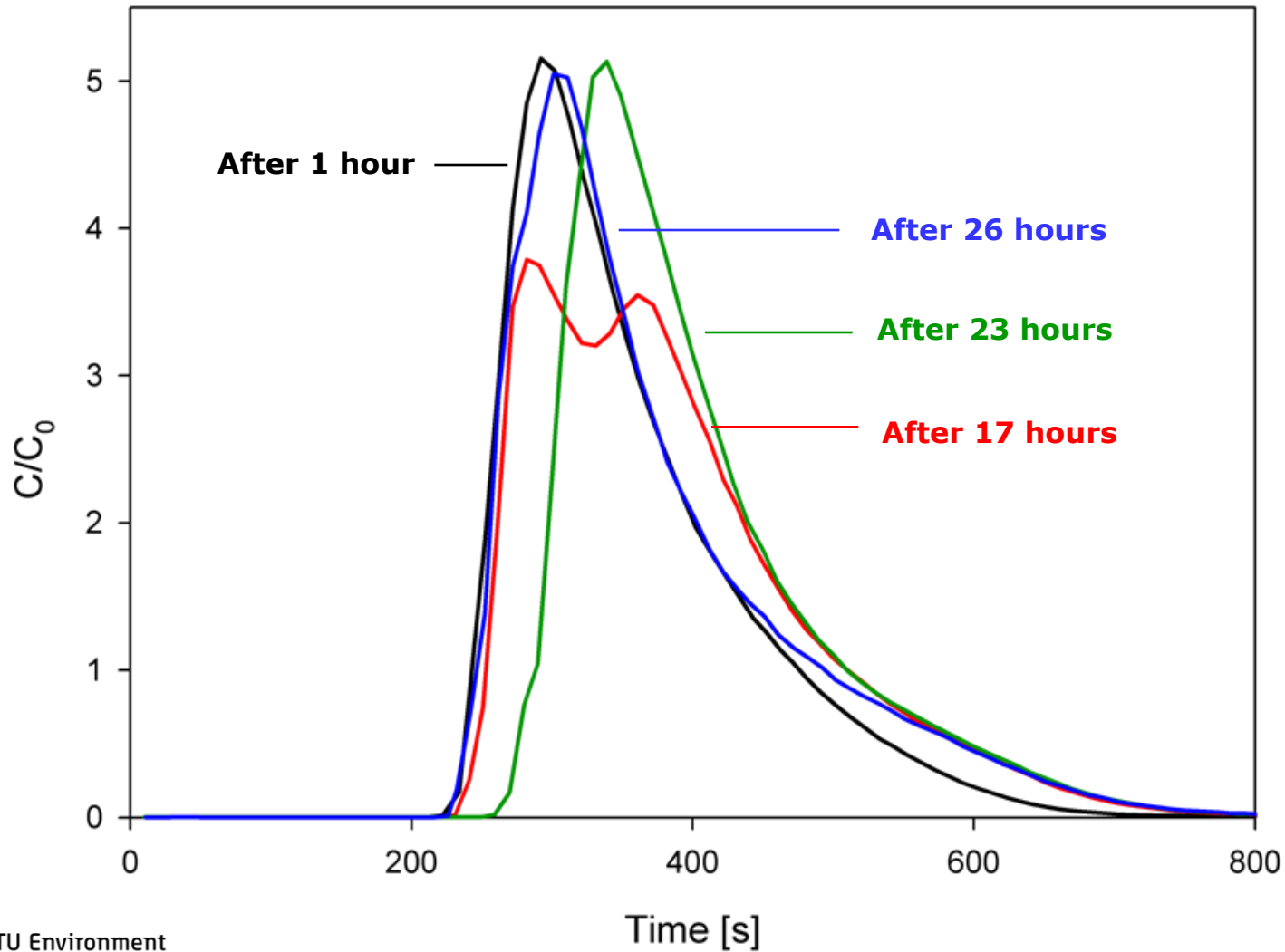
AFTER 26H

0 cm —

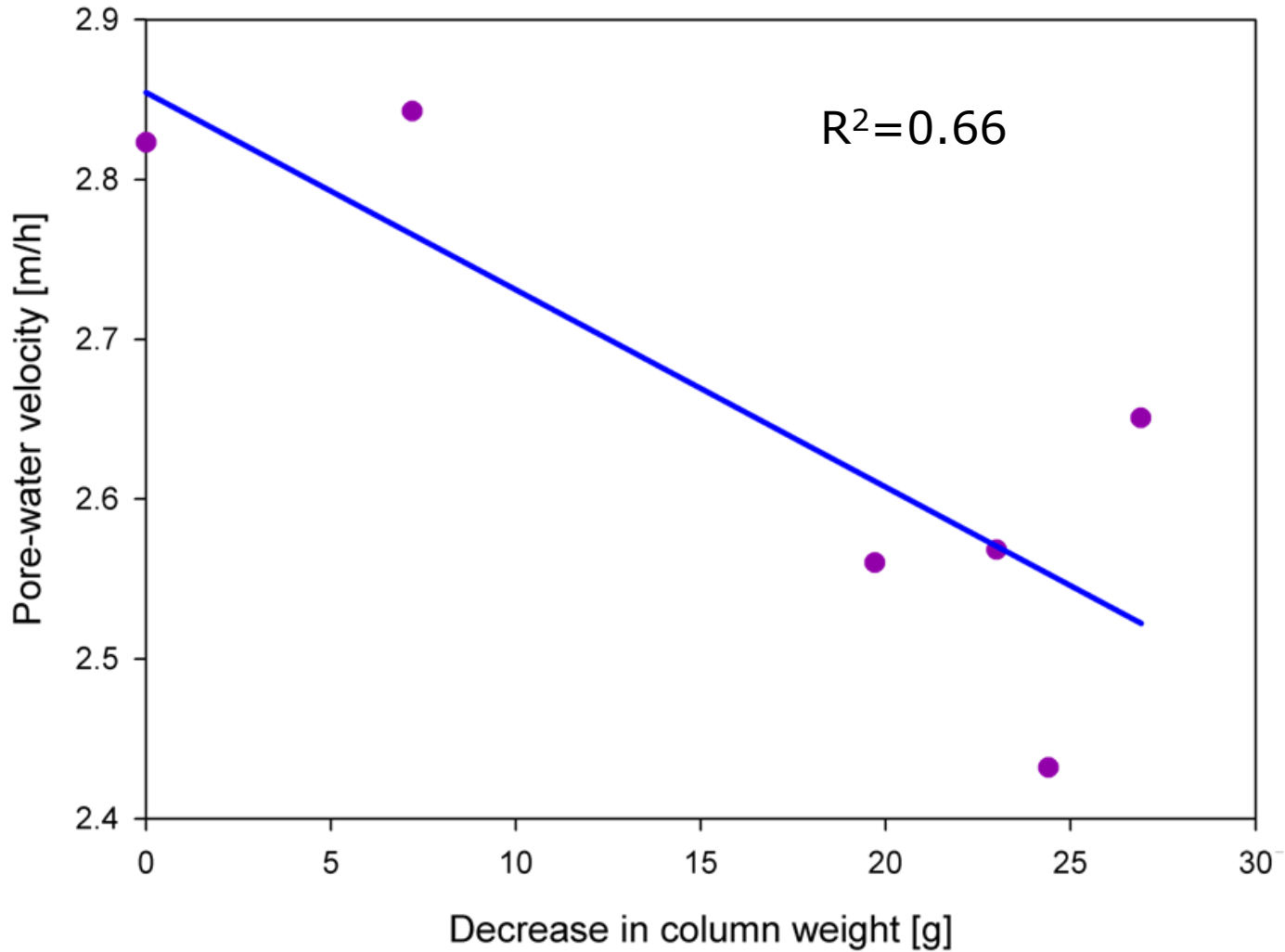
0 cm —

0 cm —

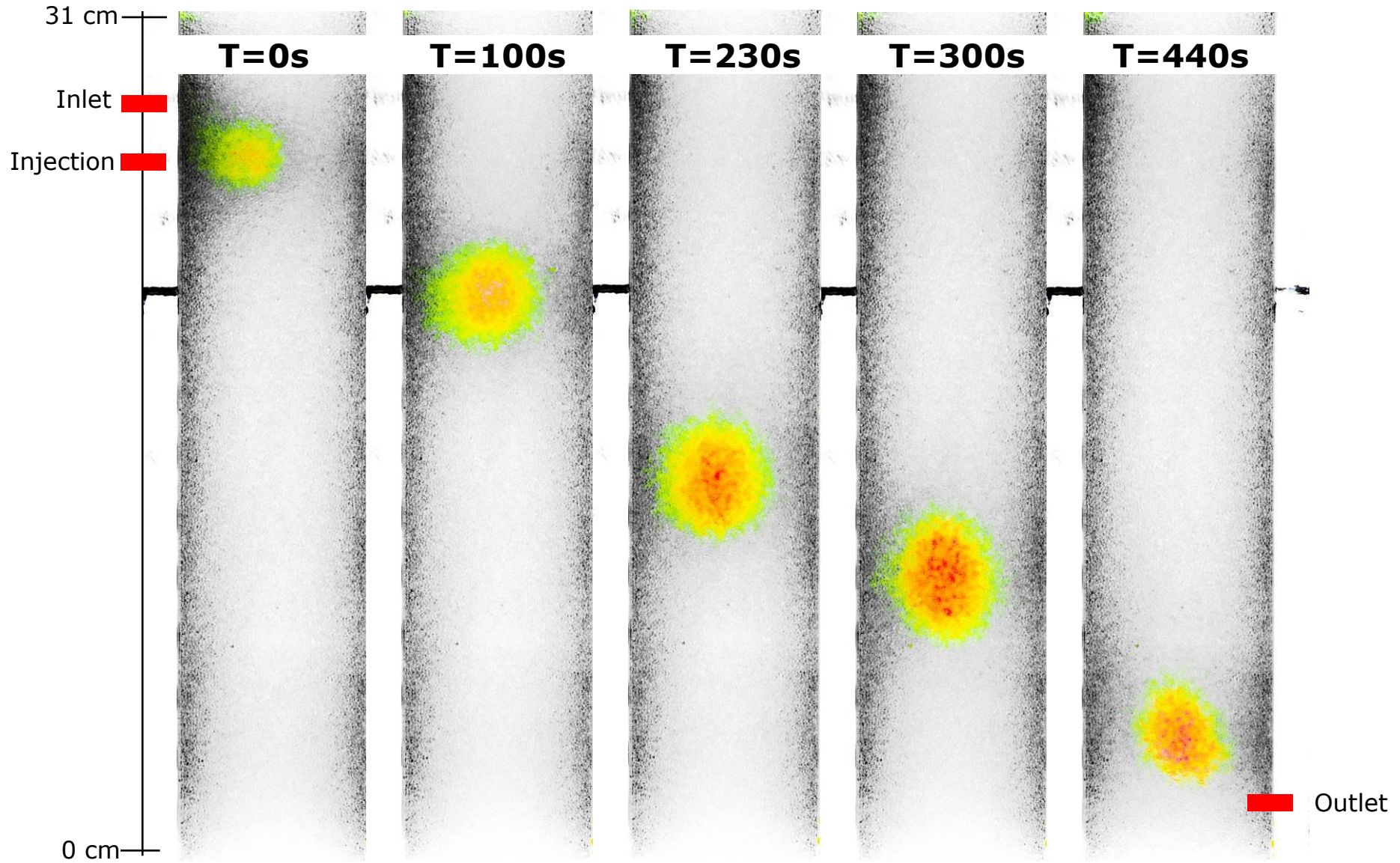
Hydraulics in the column



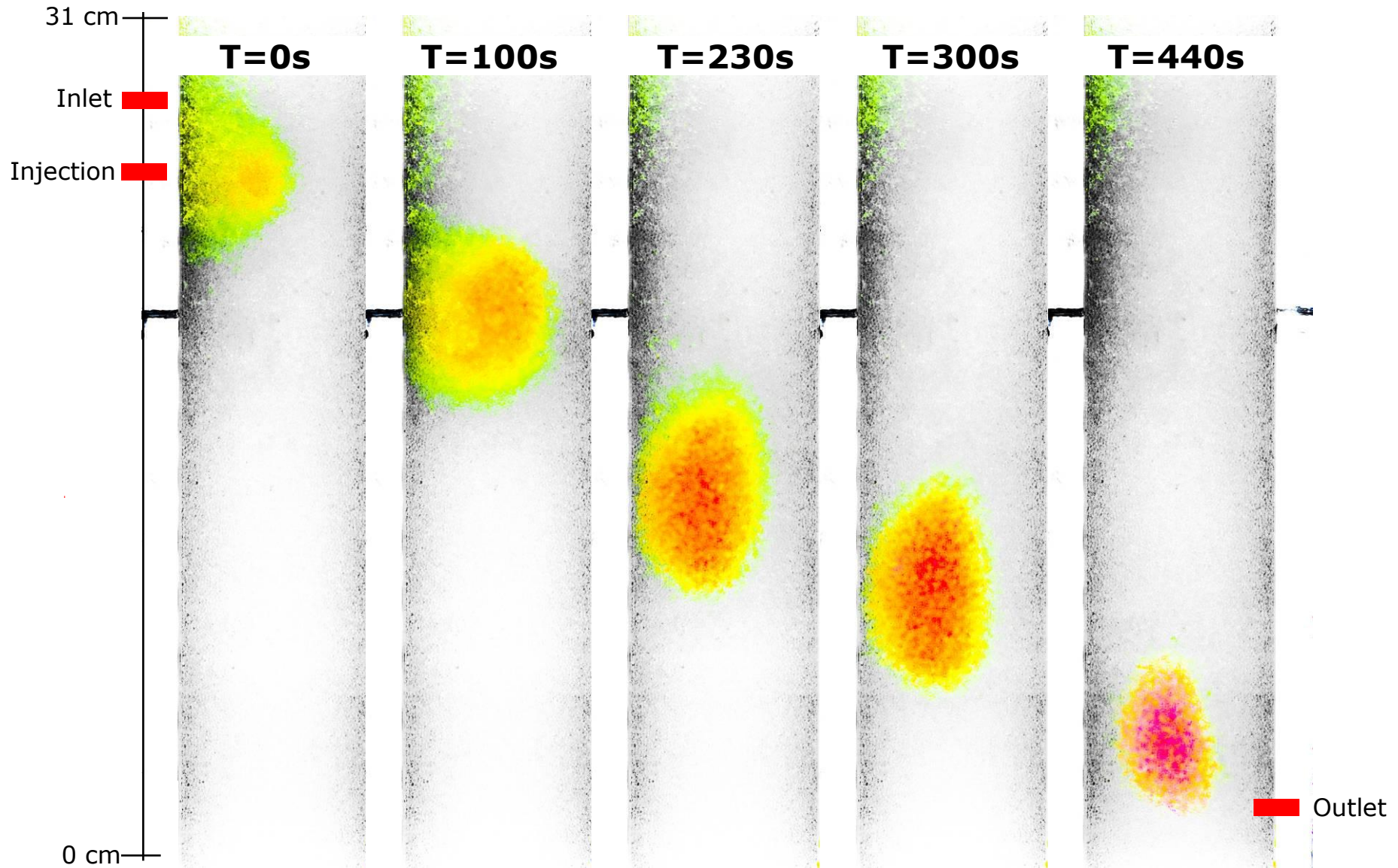
Hydraulics in the column



Tracer plume in clean column



Tracer plume in column filled with bubbles



Conclusions

- Bubbles form in the column due to supersaturation in inlet water
- Bubble distribution is heterogeneous and dynamic
- Bubble distribution depends on inlet configuration
- Hydraulics are influenced by the bubble distribution

- Future work:
Assess the amount of gas bubbles trapped in the media (air backwash condition) thanks to sulfite tracer analyses and modeling.

Acknowledgments

-  **Grontmij | Carl Bro**
- Urban Water Tech Research School
- Bent Skov

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