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Model-based investigation of the performance of a novel aeration system in the Dommel river

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Background

<u>Problem:</u> Discharges of > 200 combined sewer overflows (CSOs) + Eindhoven WWRP → Low dissolved oxygen concentration (DO) in the Dommel river, The Netherlands.

<u>Solution:</u> The Waterboard De Dommel, The Netherlands is installing additional aeration systems at different locations in the Dommel river.

Objectives

Study the impact of a novel aeration system on DO in a stretch of the Dommel river, just upstream of the Eindhoven WWTP.

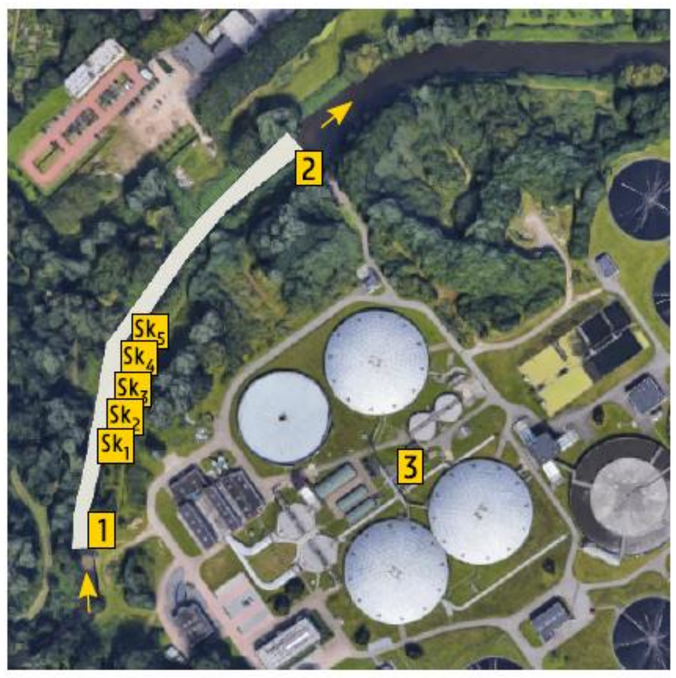

Figure 1 – Location of the studied river stretch (white): 1 – inlet; 2 – outlet; 3 – Eindhoven WWTP; Sk1, Sk2, SK3, Sk4, and Sk5 – position of the 5 aeration skids that compose the aeration system.

Aeration system

- **5 aeration skids at 10 m from each other. Each of them include 4 flowmixers (Pathema BV, The Netherlands).**
- **A saturated water jet is released from the flowmixers together with air bubbles.**

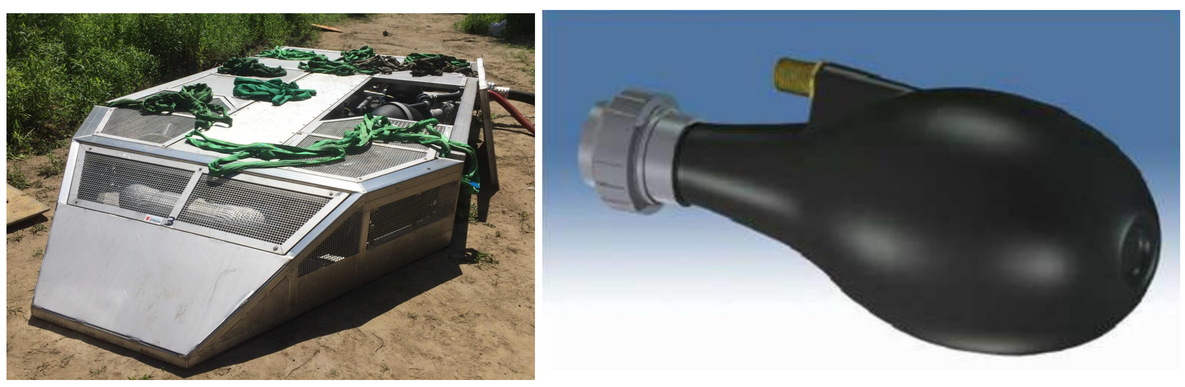

Figure 2 – Right: Aeration skid. Left: Flowmixer.

CFD scenarios

Name	Weather conditions	DO of the water jet [mg/L]	Average bubble size [mm]
Nominal case	Dry	9.1	1.0
Wet weather	Wet	9.1	1.0
Supersaturated	Dry	35.0	1.0
Micro bubbles	Dry	9.1	0.1

Results

Nominal case

Almost vertical aeration plume with limited mixing on the sides.

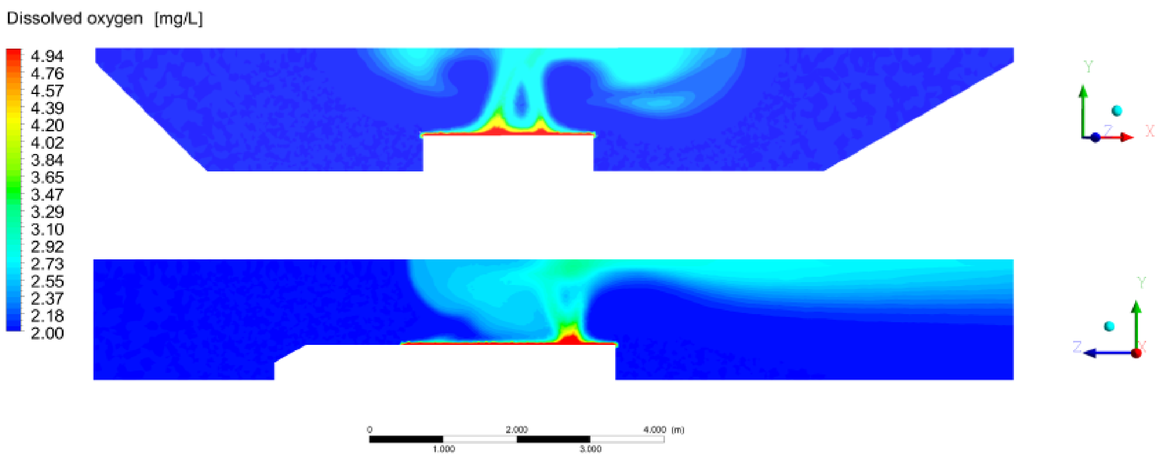

Figure 3 – DO of the first skid under nominal conditions. Top: Axial plane. Bottom: Longitudinal plane.

Comparison nominal case with the different scenarios

Scenario	DO
Wet weather	↓
Supersaturated	↑↑↑
Micro bubbles	↑ & more spatially uniform

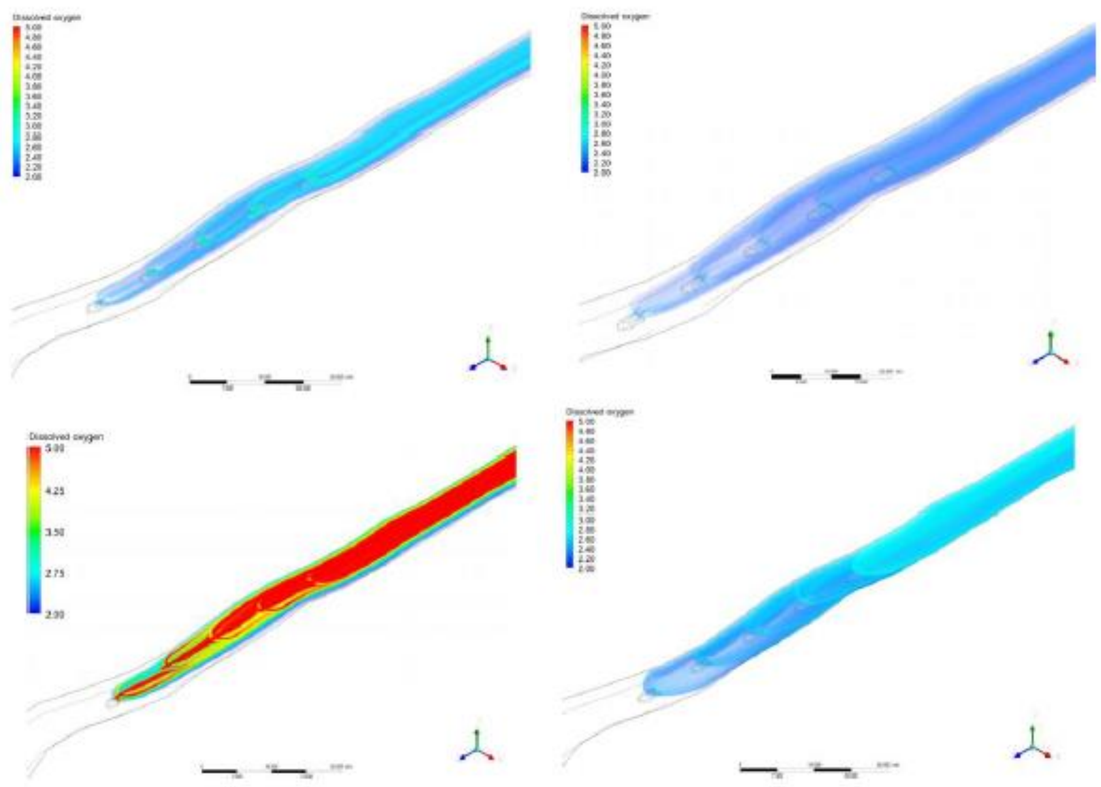

Figure 4 – DO profile. Top left: Nominal case. Top right: Wet weather. Bottom left: Supersaturated. Bottom right: Micro bubbles.

Conclusions

- **DO stratified pattern observed.**
- **Exact knowledge of the actual DO of the water jet and bubble size distribution is highly important to obtain accurate CFD predictions.**
- **Benefits to use CFD to understand the impact of the aeration system in the river is undeniable.**

More info

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