

# Sensor fault detection methods applied on dissolved oxygen sensors at a full scale WWTP

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# Dissolved oxygen (DO) sensor fault detection

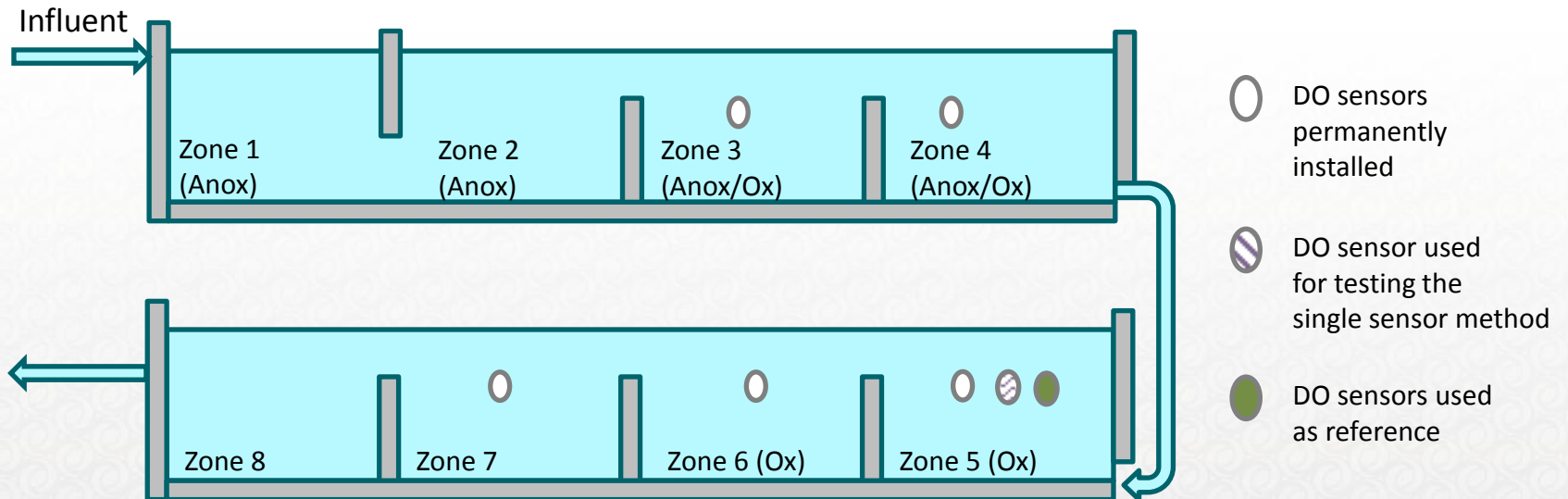
- Sensor location: Activated sludge process
- Fault to be detected: Clogging

Two methods tested:

1. Single sensor fault detection using the response to automatic cleaning with air.
2. Multi-signal sensor fault detection based on PCA, using DO measurements along the treatment line and the air flow rates to the aerated zones.

# Case study plant

- Bromma WWTP, Stockholm, Sweden
- Design flow 160 000 m<sup>3</sup>/day
- Activated sludge process with pre-denitrification



# Single sensor fault detection

- DO sensors: Cerlic O2X with built-in automatic flushing with air
- Additional manual cleaning normally carried out once every other week

	Evaluated sensor	Reference sensor
Type of sensor	Optical	Electro chemical (Clark cell)
Interval between automatic cleaning	100 minutes	100 minutes
Length of each automatic cleaning period	10 seconds	10 seconds
Manual cleaning	No	Yes

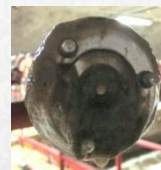
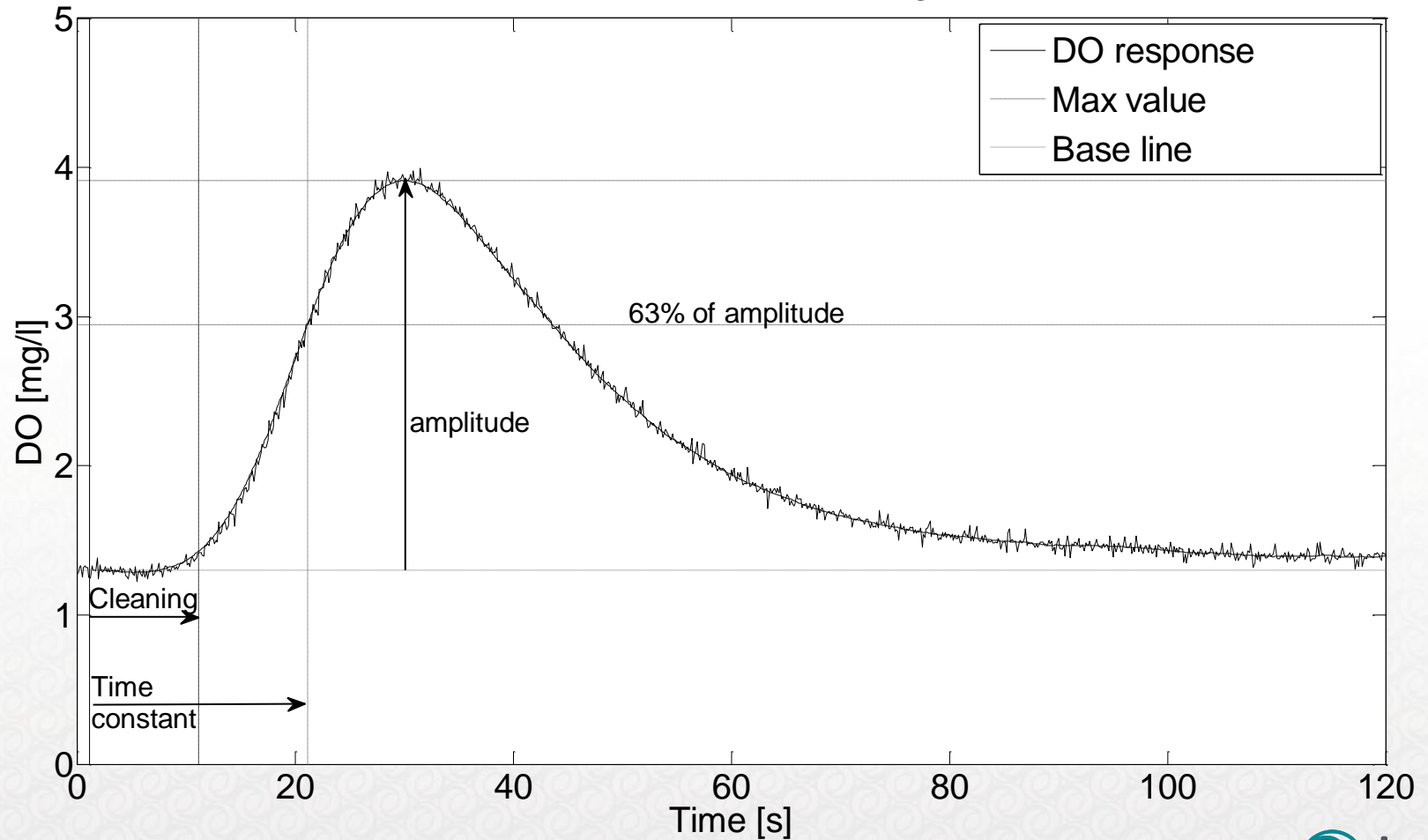


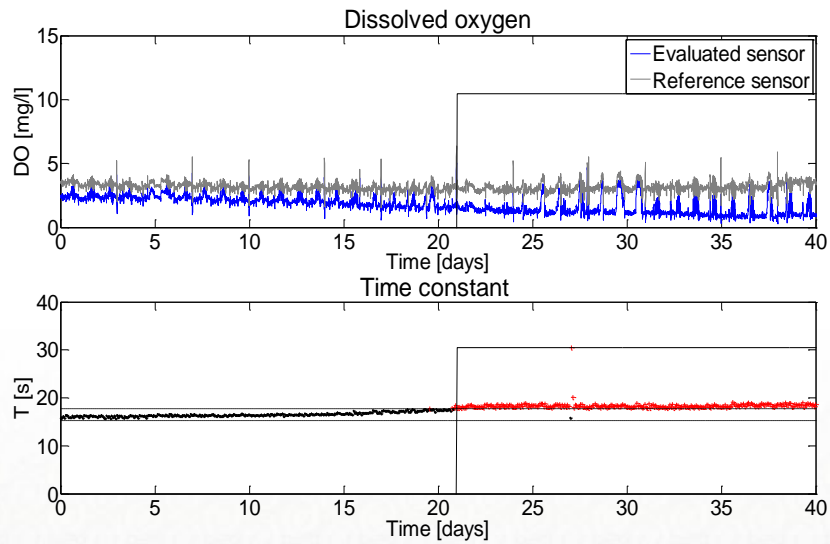
Photo: Pär-Håkan Bergström

# Single sensor fault detection

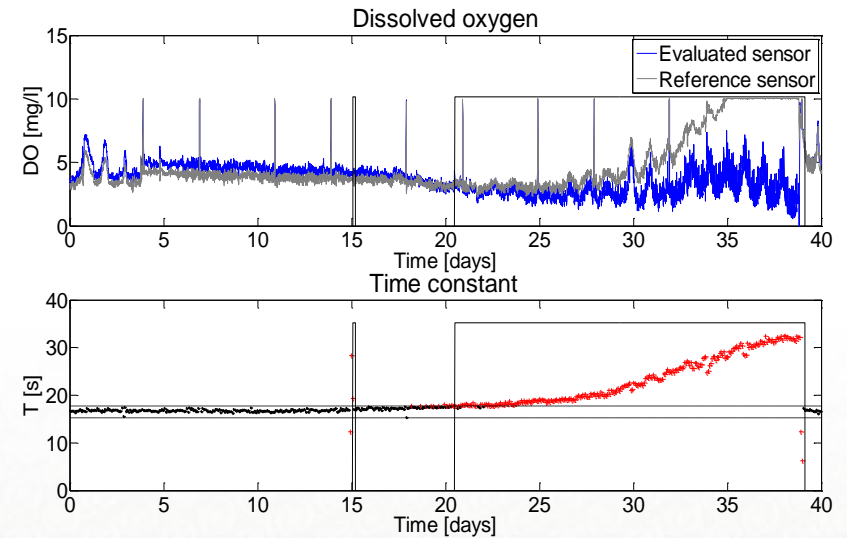
## Response to cleaning



# Single sensor fault detection



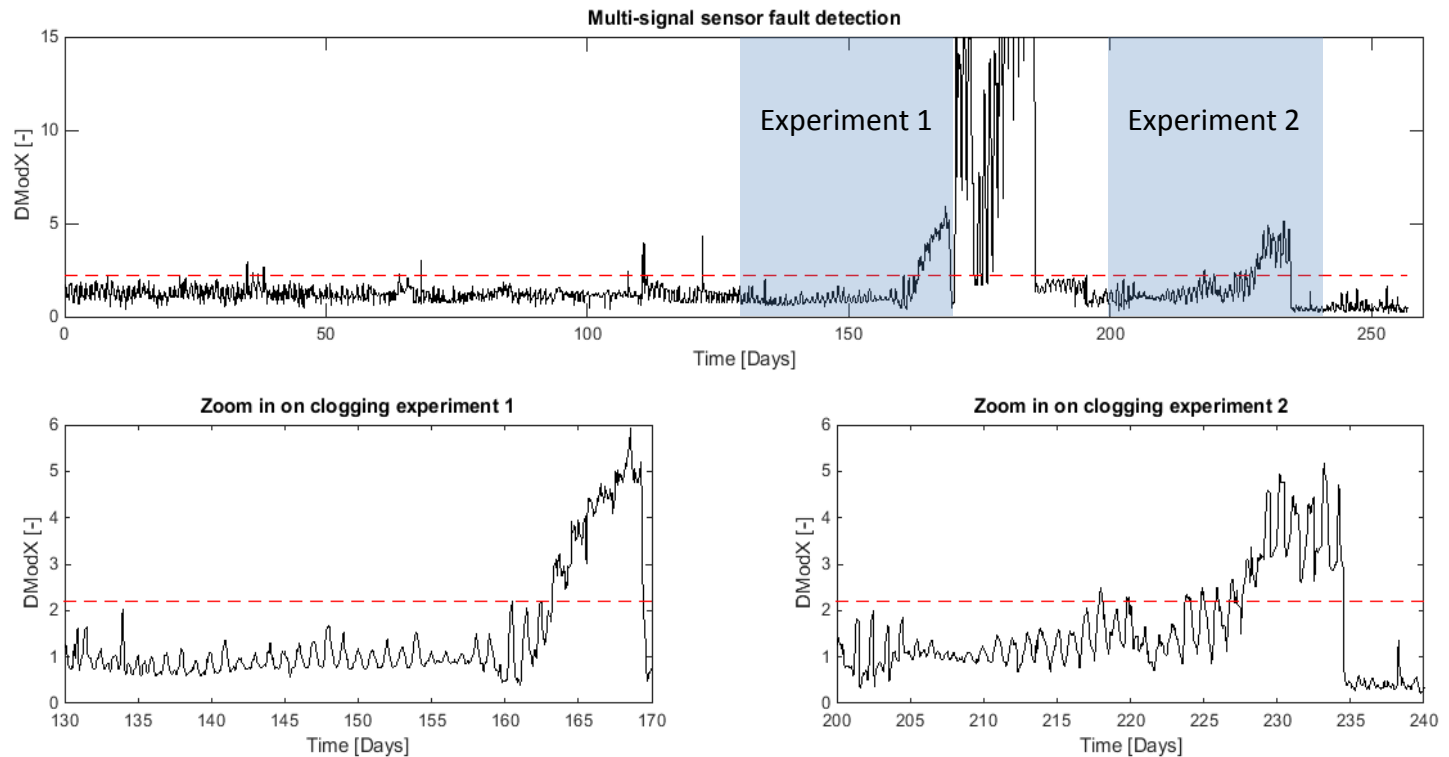
DO sensor used for controlling the aeration is kept clean.



DO sensor used for controlling the aeration is not cleaned, and the aeration increases with time.

# Multi-signal sensor fault detection

- 10 variables: Hourly average data on DO concentration and air flow rates in zone 3-7.
- Training set: four weeklong periods with different DO setpoint combinations, each period directly after manual cleaning of the sensors.



## Summarized performance of the two methods

	Method			
	Single sensor fault detection		Multi-signal sensor fault detection	
Test scenario	Controlling sensor cleaned	Controlling sensor clogging	Controlling sensor clogging (experiment 1)	Controlling sensor clogging (experiment 2)
Time to fault detection <sup>1</sup>	21 days	21 days	33 days	28 days
Sensor drift <sup>2</sup> at fault detection	-0.8 mgO <sub>2</sub> /l	-0.6 mgO <sub>2</sub> /l	-4.7 mgO <sub>2</sub> /l	n.a.
False alarms	0	1	0	2
Diagnostic interval	100 minutes		60 minutes	

1. From last manual cleaning. 2. Compared to reference sensor.



**THANK YOU FOR YOUR ATTENTION!**

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