



No. C 343
September 2018

Benchmark data – biofilm fouling experiments on dissolved oxygen sensors

Oscar Samuelsson, Anders Björk, Jesús Zambrano, Bengt Carlsson



In cooperation with Uppsala university, Mälardalen university,
Stockholm Water, Käppala Association, Syvab, and the Swedish Water
and Wastewater

Author: Oscar Samuelsson, Anders Björk, Jesús Zambrano, Bengt Carlsson

Funded by: Stockholm Water, Käppala Association, Syvab, Foundation for IVL Swedish Environmental Research Institute, and the Swedish Water and Wastewater Association.

Report number: C 343

Original source: Fault signatures and bias progression in dissolved oxygen sensors, *Water Science and Technology* (2018). DOI: <https://doi.org/10.2166/wst.2018.350>

Download data: <https://www.ivl.se/webdav/files/Projekt/C343data.zip>

Citation: Cite the original source for publications using the data.

© IVL Swedish Environmental Research Institute 2018

IVL Swedish Environmental Research Institute Ltd.

P.O Box 210 60, S-100 31 Stockholm, Sweden

Phone +46-(0)10-7886500 // www.ivl.se

This report has been reviewed and approved in accordance with IVL's audited and approved management system.



Abstract

The dataset contain experimental data from dissolved oxygen sensors in water resource recovery facilities (WRRFs), evaluated in (Samuelsson et al. 2018). Data from both clean and fouled (both artificially fouled with grease and real biofilm fouling) oxygen sensors have been recorded. Data from the phenomena when the sensor signals temporally changes during automatic air-cleaning cleaning (denoted impulse response) are stored separately.

Specifications Table

Subject area	Environmental research
More specific subject area	Instrumentation, control and related technologies
Type of data	Time series dissolved oxygen sensor data
How data was acquired	Experiments conducted in two water resource recovery facilities
Data format	Raw and filtered and pre-processed to only contain impulse responses
Experimental factors	Real process conditions measuring at aerated and unaerated zones in activated sludge process.
Experimental location	Stockholm, Sweden. Artificial fouling data (Henriksdal WRRF), biofilm fouling data (Bromma WRRF).
Related research article	Fault signatures and bias progression in dissolved oxygen sensors. Samuelsson O. et al (2018).
Contact information	oscar.samuelsson@ivl.se, anders.bjork@ivl.se. +46 10 788 66 64

Value of the Data

- High time resolution data with both normal and fouled (real biofilm) dissolved oxygen sensors during both warm and cold conditions
- The data allows benchmarking of early warning and fault detection methods.



Data

Pre-processed experimental data are provided in MATLAB .mat format. Three datasets are provided:

- 1) ArtificialFoulingImpulseData.mat (impulse response data)
- 2) BiofilmFoulingImpulseData.mat (impulse response data)
- 3) BiofilmFoulingTimeSeriesData.mat (time series data “raw data” 1 Hz)

The variable structure for the datasets is described below.

1. ArtificialFoulingImpulseData

MEC: Membrane electrochemical DO sensor

Sensor condition

.normal: Clean

.fouled: Fouled with grease mixture

.damaged: Mechanically damaged membrane

.wornout: Repeated air cleaning impulses

.lowair: one loose air hose to cleaning system

.chemicalDamage: Harsh chemical cleaning substance

.highSS: Measuring in return sludge channel

.lowSS: Measuring in unaerated zone, normal suspended solids concentration (about 3000 mg/L)

OPT: Fluorescent DO sensor

Sensor condition

.normal: Clean

.fouled: Fouled with grease mixture

2. BiofilmFoulingImpulseData

.zone5: Zone where the optical DO sensor was studied, MEC-type reference sensor.

.zone6: Zone where the membrane electrochemical sensor was studied, MEC-type reference sensor.

.MECtest: Membrane electrochemical DO sensor – test sensor (increasingly fouled)

.OPTtest: Fluorescent DO sensor – test sensor (increasingly fouled)

.MECref: Membrane electrochemical sensor – reference sensor (no fouling)

.time: Datetime time format

.indicate: Vector indicating active air cleaning impulse (1= active, 0= no cleaning)

.testPeriod: Period 1-6 as indicated in (Samuelsson et al. 2018)

3. BiofilmFoulingTimeSeriesData

.zone5: Zone where the optical DO sensor was studied, MEC-type reference sensor.

.zone6: Zone where the membrane electrochemical sensor was studied, MEC-type reference sensor.

.time: Datetime time format



.data: Matrix containing reference sensor, test sensor, impulse indication, and Not a Number (NaN) indications.

.metaData: Information about data

Materials and Methods

The experiments have been described in (Samuelsson *et al.* 2018).

Acknowledgments

The assistance from several people was invaluable to obtain the data. Simon Robertsson assisted in constructing experimental equipment and conducting experiments with artificial biofilm fouling. Kristin Ahlström assisted in maintaining sensors at Bromma WRRF. Anders Pålsson assisted with data collection in Bromma WRRF. Funding is gratefully acknowledged from Foundation for IVL Swedish Environmental Research Institute, Stockholm Water, Käppala Association, Syvab, and the Swedish Water and Wastewater Association. Sensor equipment was kindly provided by Cerlic controls AB.

References

Samuelsson O., Björk A., Zambrano J. and Carlsson B. (2018) Fault signatures and bias progression in dissolved oxygen sensors. *Water Science and Technology* (in press)



IVL Swedish Environmental Research Institute Ltd.
P.O. Box 210 60 // S-100 31 Stockholm // Sweden
Phone +46-(0)10-7886500 // Fax +46-(0)10-7886590 // www.ivl.se