



OPUS

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OPUS is a spectral probe for the online measurement of nitrogen and carbon compounds. By analyzing a complete spectrum, OPUS is able to provide reliable measurement values for $\text{NO}_3\text{-N}$, $\text{NO}_2\text{-N}$, organic constituents (COD_{eq} , BOD_{eq} , DOC_{eq} , TOC_{eq}) and a number of other parameters.

OPUS aero is a variant of OPUS for the online measurement of nitrate and nitrite in waste water aeration tanks. By analyzing a full spectrum, OPUS aero is able to provide reliable readings for either $\text{NO}_3\text{-N}$ only or $\text{NO}_3\text{-N}$ and $\text{NO}_2\text{-N}$, depending on calibration.

OPUS is equipped with the TriOS G2 interface and thus allows simple and fast sensor configuration using a web browser. This makes integration into existing process control systems and external data loggers uncomplicated.

Mobile applications can also be realized with the optionally available battery pack. A laptop, tablet or smart-phone can be used for control via WLAN without the need to install special application software or an app.

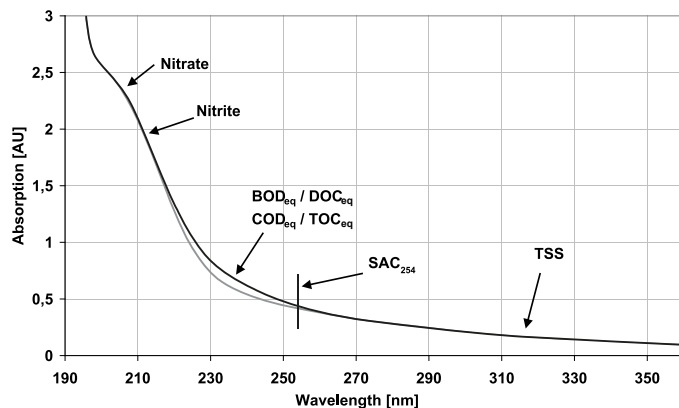
Advantages

- Without sampling and sample preparation
- Without delay
- Without reagents
- Optical window with nano coating
- Pre-installed application calibration

Applications

- Waste water
- Environmental monitoring
- Drinking water monitoring
- Industrial applications
- Aeration in clarifiers (OPUS aero)
- Use on Argo floats
- Versions available for deep-sea applications up to 2,000 m and 6,000 m

Absorption spectrum with/without COD_{eq}



Technical specifications

Measure- ment tech- nology	Light source	Xenon flash lamp
	Detector	High-end miniature spectrometer
		256 channels
		200 to 360 nm
		0.8 nm/pixel
Optical path	OPUS	0.3 mm, 1 mm, 2 mm, 5 mm, 10 mm, 20 mm, 50 mm
	OPUS aero	0.3 mm, 1 mm, 2 mm
Parameters	OPUS	See chapter "OPUS measuring ranges and detection limits"
	OPUS aero	Nitrate NO ₃ -N or Nitrate NO ₃ -N+NitriteNO ₂ -N
Measuring range	OPUS	See chapter "OPUS measuring ranges and detection limits"
	OPUS aero	See chapter "OPUS aero measuring ranges"
Measuring accuracy	OPUS	See chapter "OPUS measuring ranges and detection limits"
	OPUS aero	± (5 % + 0,1)
Turbidity compensation		Yes
Data logger		~ 2 GB
Response time T100		2 min
Measuring interval		≥ 1 min

Housing material		Stainless steel (1.4571/1.4404) or titanium (3.7035)
Dimensions (L x Ø)		470 mm x 48 mm (with 10 mm path)
Weight	VA	~ 3 kg (with 10 mm path)
	Ti	~ 2 kg (with 10 mm path)
Interface	digital	Ethernet (TCP/IP)
		RS-232 or RS-485 (Modbus RTU)
Power consumption		≤ 8 W
Power supply		12-24 VDC (± 10 %)
Maintenance effort		≤ 0.5 h/month typical
Calibration/maintenance interval		24 months
System compatibility		Modbus RTU
Warranty period		1 year (EU: 2 years)

INSTALLATION

Max. pressure	with Sub-conn*	30 bar
	with fixed cable	3 bar
	in flow unit	1 bar, 2...4 L/min
Protection class		IP68

*Not OPUS aero

Sample temperature	+2...+40 °C
Ambient temperature	+2...+40 °C
Storage temperature	-20...+80 °C
Approach velocity	0.1...10 m/s

Measuring ranges and detection limits OPUS

The following tables provide an overview of the measuring ranges of the various parameters as a function of the path length.

These values apply to individual substances in ultrapure water under laboratory conditions.

Path length 1 mm

Path (mm)	Parameters	Measuring principle	Measuring unit	Measuring range	Detection limit	Limit of quantification	Precision	Accuracy*
1	Nitrate N-NO ₃	spectral	mg/L	0...100	0,3	0,5	0,05	± (5 % + 0,1)
	Nitrite N-NO ₂	spectral	mg/L	0...150	0,5	1,2	0,12	± (5 % + 0,1)
	COD _{eq}	spectral	mg/L	0...2200***	30	100	10	
	BOD _{eq}	spectral	mg/L	0...2200***	30	100	10	
	DOC _{eq}	spectral	mg/L	0...1000	5	10	1	
	TOC _{eq}	spectral	mg/L	0...1000	5	10	1	
	TSS _{eq}	spectral	mg/L	0...1500	60	200	20	
	KHP	spectral	mg/L	0...4000	5	10	1	± (5 % + 2)
	SAC ₂₅₄	Single wavelength	1/m	0...2200	15	50	5	
	COD-SAC _{eq} **	Single wavelength	mg/L	0...3200	22	73	7,3	
	BOD-SAC _{eq} **	Single wavelength	mg/L	0...1050	7,2	24	2,4	

* Based on a standard calibration solution

** Based on KHP (100 mg COD standard solution corresponds to 85 mg/L KHP)

*** Dependent on the composition of the COD and BOD (sum parameter)

1 mg/L N-NO₃ corresponds to 4.43 mg/L NO₃

1 mg/L N-NO₂ corresponds to 3.29 mg/L NO₂

Path length 10 mm

Path (mm)	Parameters	Measuring principle	Unit of measurement	Measuring range	Detection limit	Limit of quantification	Precision	Accuracy*
10	Nitrate N-NO ₃	spectral	mg/L	0...10	0,03	0,05	0,005	± (5 % + 0,1)
	Nitrite N-NO ₂	spectral	mg/L	0...15	0,05	0,12	0,012	± (5 % + 0,1)
	COD _{eq}	spectral	mg/L	0...220***	3	10	1	
	BOD _{eq}	spectral	mg/L	0...220***	3	10	1	
	DOC _{eq}	spectral	mg/L	0...100	0,5	1	0,1	
	TOC _{eq}	spectral	mg/L	0...100	0,5	1	0,1	
	TSS _{eq}	spectral	mg/L	0...150	6	20	2	
	KHP	spectral	mg/L	0...400	0,5	1	0,1	± (5 % + 2)
	SAC ₂₅₄	Single wavelength	1/m	0...220	1,5	5	0,5	
	COD-SAC _{eq} **	Single wavelength	mg/L	0...320	2,2	7,3	0,73	
	BOD-SAC _{eq} **	Single wavelength	mg/L	0...105	0,72	2,4	0,24	

* Based on a standard calibration solution

** Based on KHP (100 mg COD standard solution corresponds to 85 mg/L KHP)

*** Dependent on the composition of the COD and BOD (sum parameter)

1 mg/L N-NO₃ corresponds to 4.43 mg/L NO₃

1 mg/L N-NO₂ corresponds to 3.29 mg/L NO₂

OPUS aero measuring ranges

Path (mm)	Nitrate N-NO ₃	Nitrate N-NO ₂
0,3	2,4...120	4,4...220
1	0,7...36	1,3...67
2	0,35...18	0,65...33,5