ColiMinder
rapid microbiology by VWM SOLUTIONS

References

Awards &

Scientific Publications

This document covers information about VWMS customers in different application fields and awards won for the technology as well as a list of peer-reviewed scientific publications.

BOTTLED WATER

Customer:	Romaqua – Mineral Water Production Romania, 2 ColiMinder in 2 bottling plants
Application:	Online monitoring of microbiological water quality of two mineral water wells and quality control throughout entire bottling process.
Task:	Safeguarding product quality, enable evidence-based decision-making to CIP (Clean in Place) based on information of actual microbiological level, testing final product prior to delivery, increase safety and efficiency of the bottling process.
Target organism:	Total Microbiological Activity (ALP)
Contact:	further information available through VWMS

ROMAQUA GROUP
BORSEC

Customer:	**Nestlé Waters**
Application:	Piloting the ColiMinder
Task:	-
Target organism:	-
Contact:	no disclosure of information possible due to an NDA.

Customer:	**Major international soft drink bottling company,** South Africa
Application:	Online monitoring of microbiological water quality of water production from municipal tap water and quality control though out the soft drink production process.
Task:	Safeguarding product quality and increase safety and efficiency of the soft drink production process.
Target organism:	Total Microbiological Activity (ALP)
Contact:	further information available through VWMS

Customer:	**Major international bottling company,** Austria
Application:	Pilot and technology evaluation using the ColiMinder for continuous monitoring of raw water intake and tanks.
Task:	Safeguarding product quality, increase safety and efficiency of bottling process.
Target organism:	Total Microbiological Activity (ALP)
Contact:	further information available through VWMS

DRINKING WATER

Customer:	WSD – public **W**ater **S**upply **D**epartment, Hong Kong
Application:	Technology evaluation project: "*Pilot Trial on the use of novel on line monitoring technology for fast process monitoring of microbial quality at water treatment works*"
Task:	Ensuring microbial safety in drinking water supply.
Target organism:	Total Microbiological Activity (ALP)
Contact:	via VWMS

Water Supplies Department
The Government of the Hong Kong Special Administrative Region

Customer:	Unitywater - drinking water utility, Australia
Application:	Online monitoring of microbiological water quality of final drinking water in Unitywater's network, installed at BliBli reservoir.
Task:	Ensuring safety of drinking water supply.
Target organism:	Total Microbiological Activity (ALP)
Contact:	**via Optimosgroup, ColiMinder distributor for Australia** Mr. Phil Krasnostein phil@optimosgroup.com.au

Unitywater

Customer:	**De Watergroep**, national drinking water supply, Belgium
Application:	Scientific "rapid microbiology" techniques comparison: Online monitoring of microbiological water quality in a national drinking water network. During evaluation period, different spiking trials with various water qualities.
Task:	Ensuring safety of drinking water supply. Results of evaluation prove the sensitivity and reliability of the ColiMinder.
Target organism:	Total Microbiological Activity (ALP)
Contact:	**Han Vervaeren** De Watergroep Vooruitgangstraat 189 B - 1030 Brussels Email: Han.Vervaeren@dewatergroep.be Web: www. dewatergroep.be

De Watergroep

Customer:	**Bathurst Regional Council,** municipal drinking water supply, Australia
Application:	Online monitoring of raw water quality for drinking water production – installed at pumping station located in a 21 km long pipeline between reservoir and drinking water production facility
Task:	Ensuring safety of drinking water supply
Target organism:	E. coli
Contact:	**Phil Krasnostein** Director Optimos Solutions (VWMS' distribution partner) Mobile: +61 409359155 Email: phil@optimosgroup.com Web: optimosgroup.com

Customer:	**MEKOROT**, Israel's public water supplier
Application:	online monitoring of drinking water supply and delivery network with ColiMinder ERU
Task:	Ensuring safety of drinking water supply and network
Target organism:	E. coli and Total Activity (ALP)
Contact:	Dalit Vaizel-Ohayon, PhD Chief Bacteriologist Mekorot National Water Company Jordan District, Central Laboratory P.O.Box 610 Nazareth Illit 17105, Israel Tel: +972 4 6500685 Mobile phone: +972 50 7126839 Email: dvaizel@mekorot.co.il

Customer:	**Ville de Laval, municipal drinking water supply, Canada**
Application:	The ColiMinder is installed at raw water intake from river "Rivière des Mille Îles" to a drinking water plant
Task:	Monitoring of microbiological quality of raw water
Target organism:	E.coli
Contact:	via VWMS

Customer:	**Seoul Water Institute,** Public drinking water supplier of **Seoul Metropolitan Government**, Republic of Korea
Application:	Drinking water production, monitor biological performance of activated carbon filtration/adsorption system
Task:	Monitoring quality and functionality of activated carbon filter activity and its backwashing
Target organism:	Total Microbiological Activity (ALP)
Contact:	via VWMS GmbH

Customer: **EVN**, public drinking water supplier, Lower Austria

Application: Monitoring of drinking water wells, riverbank filtration wells, storage tanks and supply network.

Task: monitoring for early detection of contamination; rapid response on contaminations, ensuring safety in public drinking water supply

Target organism: E. coli for wells & raw water and Total Activity (ALP) for network and storage

Contact:

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Customer: **Gemeinde Weiden an der March** (Municipality), Lower Austria

Application: Monitoring of drinking water production quality and performance

Task: The ColiMinder is monitoring at raw water intake and after activated carbon filtration to control process performance. After activated carbon filtration a UV disinfection is installed. The municipality intends to switch off UV disinfection in case contamination is low according to ColiMinder results.

Target organism: Total Microbiological Activity (ALP)

Contact:

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SURFACE & BATHING WATER

Customer: **Eau de Paris - public water utility for Paris**

Application: using 2 ColiMinder devices for
1. surface water monitoring in different public recreation areas, **dedicated for swimming competition at Olympic Games 2024**
2. deployment in raw water monitoring for **drinking water production**
3. monitoring combined sewer overflows in rivers and recreational waters
4. monitoring drinking water production in a DWP

Task: ensuring safety in bathing waters / enabling quick reaction on contamination events / monitoring drinking water safety

Target organism: E. coli, Enterococcus in some cases

Contact :

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Customer: **Ville de Paris – Government of the City of Paris**

Application: using 2 ColiMinder for surface water monitoring of a bathing scene at Seine River, **dedicated for swimming competition at Olympic Games 2024**

Task: Ensuring safety in bathing waters, enabling quick reaction on contamination events (closing/opening beaches)

Target organism: E. coli, Enterococcus in some cases

Contact :

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Bureau de Miguel GILLON-RITZ
Responsable du pôle d'expertise grand cycle et qualité de l'eau I Direction de la Propreté et de l'Eau
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Customer: **EKEO, Energizing Kowloon East Office, Smart City Project, together with CEDD (Civil Engineering Development Department), Hong Kong**

Application: The ColiMinder is installed to monitor E. coli level at Kwun Tung Typhoon Shelter at the former airport in Hong Kong, an urban development site

Task: Monitoring fecal contamination in surface & recreational water

Target organism: E. coli saline

發展局
Development Bureau
Kowloon East Office
九龍東辦事處

CEDD Civil Engineering and Development Department
The Government of the Hong Kong Special Administrative Region

Customer:	**Ville Saint-Jérôme**, municipal bathing water and drinking water, Canada
Application:	The ColiMinder is installed at raw water intake from a river to a drinking water production, at the same time monitoring a bathing site nearby.
Task:	Monitoring of microbiological quality of surface and raw water
Target organism:	E. coli

VILLE DE SAINT-JÉRÔME

Customer:	**Ville de L'Assomption**, municipal bathing water and drinking water production, Canada
Application:	The ColiMinder is installed at raw water intake from a river to a drinking water production, at the same time monitoring a bathing site nearby.
Task:	Monitoring of microbiological quality of surface and raw water
Target organism:	E. coli
Contact:	via VWMS

NIL MAGNUM SINE LABORE
L'ASSOMPTION
Ville de culture et de patrimoine

Customer:	**University of Tokyo**
Application:	surface water monitoring in different public recreation areas, also the ones **dedicated for swimming competition at upcoming Olympic Games**
Task:	ensuring safety in bathing waters, enabling quick reaction on contamination events
Target organism:	E. coli
Contact:	**Prof. Hiroyuki Katayama** University of Tokyo Department of Urban Engineering, Graduate School of Engineering Bunkyo-ku, Tokyo, 113-8656 I Japan

東京大学
THE UNIVERSITY OF TOKYO

Customer:	**major water company in France, via VWMS' partner SubseaTech**
Application:	monitoring bathing water quality at Marseille's Mediterranean beaches
Task:	Measurements of different samples from beaches at Mediterranean Sea in Southern France, using the ColiMinder ERU in a car, in order to open / close beaches for swimming and helping to identify sources of contamination
Target organism:	E. coli / Enterococcus in saline water

Contact : **Yves Chardard, Président / CEO**

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Customer: **NIWA - National Institute of Water and Atmospheric Research**

Application: Surface water monitoring using ColiMinder ERU in different applications and both fresh and saline waters.

Task: scientific studies, validations, research projects

Target organism: E. coli, Enterococcus in Fresh-/Saline-Waters

Contact: **Dr Rebecca Stott**
Environmental Health I Microbiology Scientist
Gate 10 Silverdale Road, Hillcrest
Hamilton | New Zealand
www.niwa.co.nz
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Customer: **KIT – Karlsruhe Institute of Technology**

Application: Surface water monitoring in different applications using ColiMinder Mobile. Current project: karstic spring monitoring throughout Europe

Task: scientific studies, validations, research projects in real world setting

Target organism: E. coli

Contact: Prof. Nico Goldscheider
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Institute of Applied Geosciences
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Customer: **Université Polytechnique de Montréal**

Application: monitoring of surface water and raw water in drinking water production, bathing water and sewage plant discharge using 6 ColiMinder devices

Task: scientific validation of the technology; helping municipalities and other institutions to ensure water safety

Target organism: E. coli

Contact: **Sarah Dorner, PhD**
Canada Research Chair in Source Water Protection
Department of Civil, Geological and Mining Engineering
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Customer:	**AgResearch, New Zealand**
Application:	monitoring of surface water in agricultural production and land use
Task:	Monitoring at different sites / of different streams and effluents in agricultural land use and production
Target organism:	E. coli
Contact:	**via VWMS**

WASTEWATER

Customer: **DSD - Drainage Service Department**, public wastewater institution Hong Kong, with **ARUP** International Consultancy

Application: Sewage treatment monitoring and controlled disinfection at Stonecutters Island Sewage Treatment Works (SCISTW), one of the world's largest wastewater treatment plants.

渠務署 Drainage Services Department

Target organism: E. coli (saline water)

Task: official statement from DSD dated 2018:

DSD and ARUP present an innovative project at Hong Kong´s Stonecutters Island Treatment Works (SCISTW).
As an attempt to adopt new technology in order to improve efficiency and efficacy of sewage treatment, DSD and ARUP are trialing VWMs' ColiMinder technology at HK Stonecutters Island.
The treatment works at Stonecutters Island consists of Chemically Enhanced Primary Treatment (CEPT) and disinfection with Sodium Hypochlorite. The SCISTW services a population of more than 5 Million and with a design ADWF of 2,450,000 m^3/d is it one of the world's largest CEPT wastewater treatment plants.
Sodium Hypochlorite for disinfection consists as one of the significant operating costs. A number of inherent technical issues, including variable wastewater chlorine demand and fluctuating environmental conditions provide a challenge for the operators to optimize the chemical consumption while meeting disinfection objectives.
The goal of DSD and ARUP is to:

- *Improve process efficiency*
- *Safeguard water quality*

The trial has been under way since December 2017 and so far over 5,000 measurements have been recorded without failure or need for re-calibration of the unit. While the trial period is planned for 12 months in order to cover all expected process conditions, initial performance indicates that the equipment is reliable and the relationship between ColiMinder and Laboratory results is positive.

Contact:

Alan S. Yuen
ATAL Engineering Ltd (ColiMinder distributor for Hong Kong),
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Customer:	**MSD Cincinnati, Ohio, US**
Application:	Controlled disinfection in sewage treatment discharge, monitoring before and after disinfection
Task:	Monitoring sewage treatment process performance
Target organism:	E. coli
Contact:	**via VWMS GmbH**

Customer:	**Trojan UV** in cooperation with **Western University, Ontario, Canada**
Application:	Controlled disinfection in sewage treatment discharge
Task:	Monitoring sewage contamination after UV disinfection
Target organism:	E. coli
Contact:	**via VWMS GmbH**

MEMBRANE INTEGRITY

Customer:	**Herlev Hospital in cooperation with DHI Group, Denmark**
Application:	DHI acted as engineering company for a hospital sewage plant discharge quality monitoring, using the ColiMinder to monitor membrane integrity in a public hospital's MBR plant. **Project has been awarded by Danish EPA as "BAT" (Best Available Technology).** The hospital has overtaken operation of the plant.
Task:	Fully automated contamination monitoring of sewage plant discharge before drained into a recreational area. Automatic warnings in case of increased contamination due to broken UF membranes.
Target organism:	E. coli
Contact:	**Claus Jørgensen** DHI Group Agern Alle 5 DK-2970 Hørsholm E-Mail: clj@dhigroup.com www.dhigroup.com

PROCESS WATER

Customer:	**Producer of metal working fluids, Europe** Cannot be named due to an existing NDA.
Application:	Monitoring of microbiological contamination in metal working fluids in industrial production process.
Task:	Automated quality monitoring and disinfection
Target organism:	Total Activity (ALP)
Contact:	via VWMS

… more customers are using the ColiMinder, and many more will do so. List to be continued.

AWARDS won by ColiMinder

GLOBAL CHALLENGE: ISRAEL: BACTERIA DETECTION

CONNECTING INNOVATIVE SOLUTIONS WITH THE MEKOROT NATIONAL WATER UTILITY - ISRAEL

THE WATER COUNCIL | WATER TECH HUB

2019:

September 2019:

Winner of the MEKOROT -Bacterial Detection Challenge

2016:

October 2016 **WaterSmart Innovations Conference**

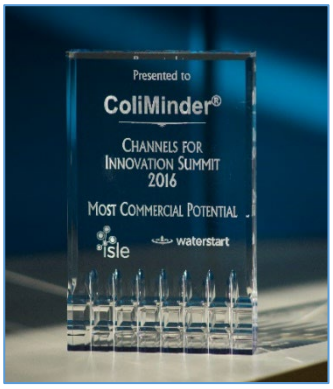
LAS VEGAS Channels for Innovation Summit:

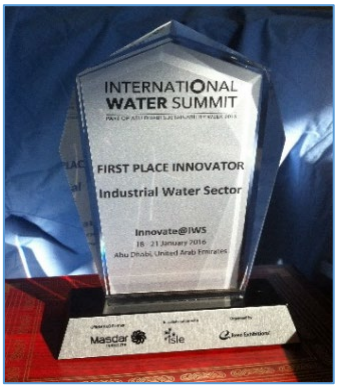
- **MOST INNOVATIVE NEW TECHNOLOGY**

July 2016 **Singapore Water Week**

TechXchange: WINNER OF INNOVATION AWARD

- **1st Place voted by the Jury**
- **1st Place voted by TechXchange Participants**





Jan 2016 **International Water Summit ABU DHABI**

Innovate@IWS: FIRST PLACE INNOVATOR

- **WINNER OF INDUSTRIAL WATER SECTOR**

2015:

- 3/2015 - Neptun Water- Award
- 3/2015 - Science2business Award 2015

2014 :

- 12/2014 - STEP AWARD – Germany – TOP 20
- 11/2014 - Austrian Young Entrepreneurs Competition – Winner Category Environment
- 11/2014 - Austrian Young Entrepreneurs Competition - 9. Rank
- 10/2014 - NÖ Future Award – 2. Rank
- 10/2014 - Green Business Award 2014 – 1. Rank
- 10/2014 - Cisco + Pioneers – Innovation Challenge – Top 50
- 10/2014 - Innovationspreis 2014 – outstanding Innovation
- 09/2014 - DAPHNE Environment Award – awarded Excellent Project

2013 :

- 12/2013 RIZ Niederösterreich – Genius Ideas Award – 3. Rank
- 10/2013 GC- Genius Ideas Competition 2013 – 2. Rank Product Development
- 11/2013 Austrian Young Entrepreneurs Competition – 62. Rank

List of scientific publications

A. List of peer-reviewed publications
B. Further references (articles, oral presentations, poster presentations)

A. List of peer-reviewed publications

Favere, J., Waegenaar, F., Boon, N., & De Gusseme, B. (2021). Online microbial monitoring of drinking water: How do different techniques respond to contaminations in practice? *Water Research*, 117387. https://doi.org/10.1016/j.watres.2021.117387.

Burnet, J.-B.; Habash, M.; Hachad, M.; Khanafer, Z.; Prévost, M.; Servais, P.; Sylvestre, E.; Dorner, S. (2021). Automated Targeted Sampling of Waterborne Pathogens and Microbial Source Tracking Markers Using Near-Real Time Monitoring of Microbiological Water Quality. Water, 13, 2069. https://doi.org/10.3390/w13152069

Sylvestre, É., Prévost, M., Burnet, J.-B., Smeets, P., Medema, G., Hachad, M., & Dorner, S. (2021). Using surrogate data to assess risks associated with microbial peak events in source water at drinking water treatment plants. *Water Research*, *200*, 117296. https://doi.org/10.1016/j.watres.2021.117296. *In press*

Sylvestre, É., Prévost, M., Burnet, J.-B., Pang, X., Qiu, Y., Smeets, P., Medema, G., Hachad, M., & Dorner, S. (2021). Demonstrating the reduction of enteric viruses by drinking water treatment during snowmelt episodes in urban areas. *Water Research X*, *11*, 100091. https://doi.org/10.1016/j.wroa.2021.100091

Cazals, M., Stott, R., Fleury, C., Proulx, F., Prévost, M., Servais, P., Dorner, S., & Burnet, J.-B. (2020). Near real-time notification of water quality impairments in recreational freshwaters using rapid online detection of β-D-glucuronidase activity as a surrogate for *Escherichia coli* monitoring. *Science of The Total Environment*, *720*, 137303. https://doi.org/10.1016/j.scitotenv.2020.137303

Sylvestre, É., Burnet, J., Dorner, S., Smeets, P., Medema, G., Villion, M., Hachad, M., & Prévost, M. (2020). Impact of Hydrometeorological Events for the Selection of Parametric Models for Protozoan Pathogens in Drinking-Water Sources. *Risk Analysis*, risa.13612. https://doi.org/10.1111/risa.13612

Sylvestre, É., Burnet, J.-B., Smeets, P., Medema, G., Prévost, M., & Dorner, S. (2020). Can routine monitoring of *E. coli* fully account for peak event concentrations at drinking water intakes in agricultural and urban rivers? *Water Research*, *170*, 115369. https://doi.org/10.1016/j.watres.2019.115369

Demeter, K., Burnet, J.-B., Stadler, P., Kirschner, A., Zessner, M., & Farnleitner, A. H. (2020). Automated online monitoring of fecal pollution in water by enzymatic methods. *Current Opinion in Environmental Science & Health*, *16*, 82–91. https://doi.org/10.1016/j.coesh.2020.03.002

Burnet, J.-B., Sylvestre, É., Jalbert, J., Imbeault, S., Servais, P., Prévost, M., & Dorner, S. (2019). Tracking the contribution of multiple raw and treated wastewater discharges at an urban drinking water supply using near real-time monitoring of β-d-glucuronidase activity. *Water Research*, *164*, 114869. https://doi.org/10.1016/j.watres.2019.114869

Burnet, J.-B., Dinh, Q. T., Imbeault, S., Servais, P., Dorner, S., & Prévost, M. (2019). Autonomous online measurement of β-D-glucuronidase activity in surface water: Is it suitable for rapid *E. coli* monitoring? *Water Research*, *152*, 241–250. https://doi.org/10.1016/j.watres.2018.12.060

Stadler, P., Loken, L. C., Crawford, J. T., Schramm, P. J., Sorsa, K., Kuhn, C., Savio, D., Striegl, R. G., Butman, D., Stanley, E. H., Farnleitner, A. H., & Zessner, M. (2019). Spatial patterns of enzymatic activity in large water bodies: Ship-borne measurements of beta-D-glucuronidase activity as a rapid indicator of microbial water quality. *Science of The Total Environment*, *651*, 1742–1752. https://doi.org/10.1016/j.scitotenv.2018.10.084

Ender, A., Goeppert, N., Grimmeisen, F., & Goldscheider, N. (2017). Evaluation of β-d-glucuronidase and particle-size distribution for microbiological water quality monitoring in Northern Vietnam. *Science of The Total Environment*, *580*, 996–1006. https://doi.org/10.1016/j.scitotenv.2016.12.054

Stadler, P., Blöschl, G., Vogl, W., Koschelnik, J., Epp, M., Lackner, M., Oismüller, M., Kumpan, M., Nemeth, L., Strauss, P., Sommer, R., Ryzinska-Paier, G., Farnleitner, A. H., & Zessner, M. (2016). Real-time monitoring of beta-d-glucuronidase activity in sediment laden streams: A comparison of prototypes. *Water Research*, *101*, 252–261. https://doi.org/10.1016/j.watres.2016.05.072

B. Further references (articles, oral presentations, poster presentations)

Vogl, W. (2021). *Fully Automated Rapid Microbiology—Basic Considerations Regarding Different Measurement Approaches And Evaluation Of The Enzymatic Measurement Approach*. Singapore International Water Week 2021 Online.

Beyer-Reiter, J., & Vogl, W. (2019). *Rapid detection of microbiological contamination by measurements of specific enzymatic activity*. IWA-HRWM, Vienna.

Vogl, W. (2019). *Rapid enzymatic activity measurement as an indicator of microbiological contamination—Results after 6 years of validations and experiments in different applications*. IWA-ASPIRE, Hong Kong.

Burnet, J.-B. (2018). *Tracking the contribution of multiple treated wastewaters and CSO discharges at drinking water intakes by online E. coli monitoring*. Water Quality Technology Conference 2018, Toronto, Canada.

Vogl, W. (2018). *Rapid detection of microbiological contamination by measurements of specific enzymatic activity – Results after 4 years of validations and experiments in different applications*. WISA 2018, Cape Town, South Africa.

Burnet, J.-B. (2017a). *Analytical validation of automated high frequency monitoring of beta-D-glucuronidase activity in drinking water supplies*. 2017 AWWA Water Quality Technology Conference, Portland, Oregon.

Burnet, J.-B. (2017b). *Automated high frequency monitoring of β-D-glucuronidase activity in drinking water supplies in Québec, Canada*. UNC Water Microbiology Conference 2017 & 19th International Symposium on Health-Related Water Microbiology, Chapel Hill, NC, USA.

Lackner, M., Stadler, P., & Grabow, W. (Eds.). (2017). *Handbook of Online and Near-real-time Methods in Microbiology*. CRC Press.

Milne, J., Madarasz-Smith, A., & Davie, T. (2017). *Recreational water quality monitoring and reporting in New Zealand*.

Stott, R. (2017). *Moving to real-time measurement of microbial health risks in rivers* [Presentation]. 5th Biennial Symposium of the International Society for River Science, Hamilton, New Zealand.

Sylvestre, É. (2017). *Do Current Regulatory Monitoring Frameworks Account for Microbial Risk Associated with Peak Contamination Events?* UNC Water Microbiology Conference 2017, Chapel Hill, NC, USA.

Vogl, W. (2016). *Fully Automated Online Measurement of Bacterial Contamination in Water*. European Wastewater TAG 8, London, UK.

Koschelnik, J., Vogl, W., Epp, M., & Lackner, M. (2015). Rapid analysis of β-D-glucuronidase activity in water using fully automated technology. *WIT Transactions on Ecology and the Environment*, *196*, 471–481. https://doi.org/10.2495/WRM150401

Lendenfeld, T., & Vogl, W. (2015). *Bestimmung der mikrobiologischen Wasserqualität—Neue Methoden—Online Analytik*. ÖWAV, Vienna, Austria.

Stadler, P. (2015). *Rapid and on-site monitoring of beta-d-glucuronidase activity identifies the dynamics of E. coli in surface waters draining an agricultural catchment*. 17th IWA International Conference on Diffuse Pollution and Eutrophication, Berlin, Germany.

Vogl, W. (2015). *Tests and case studies in using rapid and automated measurement technology for detection of faecal contamination*. SWIG Conference, Manchester, UK.

Koschelnik, J. (2014a). *MFU/100ml: New Measurement Parameter for Rapid Enzymatic Monitoring of Fecal-Associated Indicator Bacteria in Water*. UNC Water and Health Conference 2014, Chapel Hill, NC, USA.

Koschelnik, J. (2014b). *Rapid analysis of ß-D-glucuronidase activity in water using fully automated technology*. Water Pollution 2014, Portugal.

Vogl, W. (2014a). *Automatisierte Messung der mikrobiologischen Wassergüte für die Prozesssteuerung*. VDI Workshop, Vienna, Austria.

Vogl, W. (2014b). *Measurement of fecal contamination (E. coli, Coliforms)*. Water Innovation, Brussels, Belgium.

Vogl, W. (2013a). *Quantitative Real-Time Fluorescence Spectrometer for Automated Analysis of Microbial Contamination in Surface/Sanitary Water*. Tradeshow Wasser Berlin, Berlin, Germany.

Vogl, W. (2013b). *Rapid Analysis of Microbial Contamination in Water*. Acquea 2013, Brussels, Belgium.

Vogl, W. (2013c). *Rapid Detection of E. coli in Surface Waters for Quality and Health Monitoring Using Fluorescence-Based ColiMinder V*. WaterMicro2013 - 17th International Symposium on Health-Related Water Microbiology, Florianópolis, Brazil.