

Darla M. Goeres

Research Professor of Regulatory Science

Center for Biofilm Engineering

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AREAS OF EXPERTISE

Standardized biofilm methods development and validation, biological reactor design, evaluation of biofilms in the built environment, efficacy testing of potential anti-biofilm treatments

EDUCATION

Ph.D.	Environmental Engineering	Montana State University, Bozeman, MT	2006
M.S.	Environmental Engineering	Montana State University, Bozeman, MT	1996
B.S.	Chemical Engineering	Montana State University, Bozeman, MT	1994

EXPERIENCE

3/2020 – present	Research Professor of Regulatory Science
2/2015 – 3/2020	Associate Research Professor of Chemical & Biological Engineering
1/2014 – 5/2014	Fulbright Scholar, Åbo Akademi University, Turku, Finland
7/2006 – 2/2015	Assistant Research Professor of Chemical & Biological Engineering
7/2006 – present	Senior Research Engineer, Center for Biofilm Engineering, Montana State University, Bozeman, MT.
8/2010 – 5/2015	Faculty Fellow, Montana State University Honors College
7/2000 – present	Standardized Biofilm Methods Laboratory Coordinator, Center for Biofilm Engineering, Montana State University, Bozeman, MT.
6/1999 – 8/2004	Research Experience for Undergraduates Research Coordinator, Center for Biofilm Engineering, Montana State University, Bozeman, MT.
5/1997 – 6/2006	Research Engineer, Center for Biofilm Engineering, Montana State University, Bozeman, MT.
4/1996 – 3/1997	Visiting Scientist, Danish Technological Institute, Aarhus, Denmark.
5/1994 – 1/1996	Research Assistant, Center for Biofilm Engineering, Montana State University, Bozeman, MT.

PUBLICATIONS

- Goeres D.M.**, S. Pedersen, B. Warwood, D.K. Walker, A.E. Parker, M. Mettler, P. Sturman. 2020 "Design and Fabrication of Biofilm Reactors." Invited Chapter, *Recent Trends in Biofilm Science and Technology* M. Simões, A. Borges, L.C. Simões (Eds.), Academic Press, Elsevier, London, UK.
- Goeres D.M.**, A.E. Parker, D.K. Walker, K. Meier, L. Lorenz, K. Buckingham-Meyer. 2020 "Drip Flow Reactor Method Exhibits Excellent Reproducibility Based on a 10 Laboratory Collaborative Study." *Journal of Microbiological Methods*. <https://doi.org/10.1016/j.mimet.2020.105963>
- Schwarzer, S., G.A. James, **D. Goeres**, T. Bjarnsholt, K. Vickery, S.L. Percival, P. Stoodley, G. Schultz, S.O. Jensen, M. Malone. 2019 "The Efficacy of Topical Agents Used in Wounds for Managing Chronic Biofilm Infections: A Systematic Review" *Journal of Infection* <https://doi.org/10.1016/j.jinf.2019.12.017>
- Allkja, J., T. Bjarnsholt, T. Coenye, P. Cos, A. Fallarero, J.J. Harrison, S.P. Lopes, A. Oliver, M.O. Pereira, G. Ramage, M.E. Shirtliff, P. Stoodley, J.S. Webb, S.A.J. Zaat, **D.M. Goeres**, N.F. Azevedo. 2019 "Minimum Information Guideline for Spectrophotometric and Fluorometric Methods to Assess Biofilm Formation in Microplates" *Biofilm* <https://doi.org/10.1016/j.biofilm.2019.100010>

- Summers J., **D.M. Goeres**. 2019 “Catheter-associated Urinary Tract Infections: Development of a Test Method for Assessing the Efficacy of Antimicrobial Technologies/Products.” invited Chapter, Targeting Biofilms in Translational Research, Device Development, and Industrial Sectors, D.L. Williams (Ed.), Springer Nature, New York City.
- Goeres D.M.**, D.K Walker, K. Buckingham-Meyer, L. Lorenz, J. Summers, B. Fritz, D. Goveia, G. Dickerman, J. Schultz, A.E. Parker. 2019 “Development, Standardization, and Validation of a Biofilm Efficacy Test: The Single Tube Method” *J. Microbiological Methods* DOI 10.1016/j.mimet.2019.105694
- Walsh, D.J., T. Livinghouse, **D.M. Goeres**, M. Mettler, P.S. Stewart. 2019 “Antimicrobial Activity of Naturally Occurring Phenols and Derivatives against Biofilm and Planktonic Bacteria” *Frontiers in Chemistry* DOI 10.3389/fchem.2019.00653
- Parker, A.E., M.A. Hamilton, **D.M. Goeres**. 2018 “Reproducibility of Antimicrobial Test Methods” *Scientific Reports* DOI 10.1038/s41598-018-30282-3
- Frattarelli, D., L. Powers, D. Doshi, K. Vargo, B. Patel, J. Liboon, M. Gallagher, R. Monticello, **D. Goeres**, L. Lorenz, K. Buckingham-Meyer. 2018 “Holistic Management of Textile Odor Using Novel Silver-Polymeric Complexes” *AATCC Journal of Research* DOI 10.14504/ajr.5.4.2
- Coenye, T., **D. Goeres**, F. Van Bambeke, T. Bjarnsholt. 2018 “Should Standardized Susceptibility Testing for Microbial Biofilms be Introduced in Clinical Practice?” *Clinical Microbiology and Infection* DOI 10.1016/j.cmi.2018.01.003
- Ausbacher, D., L. Lorenz, B. Pitts, P.S. Stewart, **D.M. Goeres**. 2018 “Paired Methods to Measure Biofilm Killing and Removal: A Case Study with Penicillin G treatment of *Staphylococcus aureus* Biofilm” *Letters in Applied Microbiology* 66(3): 231-237.
- Gomes, I.B., A. Meireles, A.L. Gonçalves, **D.M. Goeres**, J. Sjollema, L.C. Simões, M. Simões. 2017 “Standardized Reactors for the Study of Medical Biofilms: A review of the Principles and Latest Modifications.” *Critical Reviews in Biotechnology* DOI 10.1080/07388551.2017.1380601
- Manner, S., **D.M. Goeres**, M. Skogman, P. Vuorela, A. Fallarero. 2017 “Prevention of *Staphylococcus aureus* Biofilm Formation by Antibiotics in 96-Microtiter Well Plates and Drip Flow Reactors: Critical Factors Influencing Outcomes.” *Scientific Reports* 7:43854 DOI 10.1038/srep43854
- Malone, M., **D.M. Goeres**, I. Gosbell, K. Vickery, S. Jensen, P. S. Stoodley. 2016 “Approaches to Biofilm-associated Infections: The Need for Standardized and Relevant Biofilm Methods for Clinical Applications.” *Expert Review of Anti-infective Therapy* 15(2):147-156.
- Fritz, B.G., D.K. Walker, D.E. Goveia, A.E. Parker, **D.M. Goeres**. 2015 “Evaluation of Petrifilm™ Aerobic Count Plates as an Equivalent Alternative to Drop Plating on R2A Agar Plates in a Biofilm Disinfectant Efficacy Test.” *Current Microbiology* 70:450-456.
- Oja, T., B. Blomqvist, K. Buckingham-Meyer, **D. Goeres**, P. Vuorela, A. Fallarero. 2014 “Revisiting an Agar-based Plate Method: What the Static Biofilm Method Can Offer for Biofilm Research” *J. Microbiol. Methods* 107:157-160.
- Parker, A.E., D.K. Walker, **D.M. Goeres**, N. Allan, M.E. Olson, A. Omar. 2014 “Ruggedness and Reproducibility of the MBEC Biofilm Disinfectant Efficacy Test.” *J. Microbiol. Methods* 102:55-64.
- Lourenco, A., T. Coenye, **D.M. Goeres**, G. Donelli, A.S. Azevedo, H. Ceri, F.L. Coelho, H-C. Flemming, T. Juhna, S.P. Lopes, R. Oliveira, A. Oliver, M.E. Shirliff, A.M. Sousa, P. Stoodley, M.O. Pereira, N.F. Azevedo. 2014 “Minimum Information about a Biofilm Experiment (MIABIE): Standards for Reporting Experiments and Data on Sessile Microbial Communities Living at Interfaces.” *Pathogens and Disease* 70:250-256.
- Manner, S., M. Skogman, **D. Goeres**, P. Vuorela, A. Fallarero. 2013 “Systematic Exploration of Natural and Synthetic Flavonoids for the Inhibition of *Staphylococcus aureus* Biofilms.” *Int. J. Mol. Sci.* 14:19434-19451.
- Hamilton, M.A., G.C. Hamilton, **D.M. Goeres**, A.E. Parker. 2013 “Guidelines for the Statistical Analysis of a Collaborative Study of a Laboratory Method for Testing Disinfectant Product Performance.” *J. AOAC International* 96(5):1138-1151.
- Goeres, D.M.**, P. Hartemann, J.V. Dadswell. 2013 “Treated Recreational Water Venues.” Invited Chapter, Russell, Hugo & Ayliffe’s: Principles and Practice of Disinfections, Preservation and Sterilization, 5th Edition, A.P. Fraise, J-Y. Maillard, S.A. Sattar (Eds.), Blackwell Publishing, West Sussex, UK, pp. 478-484.
- Lorenz, L.A., B.D. Ramsay, **D.M. Goeres**, M.W. Fields, C.A. Zapka, D.R. Macinga. 2012 “Evaluation and Remediation of Bulk Soap Dispensers for Biofilm.” *Biofouling* 28(1):99-109.

- Saha, R., R.S. Donofrio, **D.M. Goeres**, S.T. Bagley. 2012 "Rapid Detection of rRNA group I Pseudomonads in Contaminated Metalworking Fluids and Biofilm Formation by Fluorescent In Situ Hybridization." *Appl Microbiol Biotechnol* 94:799-808.
- Goeres, D.M.** 2010 "Understanding the Importance of Biofilm Growth in Hot Tubs." invited Chapter, Applied Biomedical Microbiology: A Biofilms Approach, D.S. Paulson (Ed.), CRC Press, Boca Raton, FL, pp. 133-148.
- Hamilton, M.A., K. Buckingham-Meyer, **D.M. Goeres**. 2009 "Checking the Validity of the Harvesting and Disaggregating Steps in Laboratory Tests of Surface Disinfectants." *J. AOAC International* 92(6):1755-1762.
- Goeres, D.M.**, M.A. Hamilton, N.A. Beck, K. Buckingham-Meyer, J.D. Hilyard, L.R. Loetterle, L.A. Lorenz, D.K. Walker, P.S. Stewart. 2009 "A Method for Growing a Biofilm under Low Shear at the Air-liquid Interface using the Drip Flow Biofilm Reactor." *Nature Protocols* 4(5):783-788.
- Buckingham-Meyer, K., **D.M. Goeres**, M.A. Hamilton. 2007 "Comparative Evaluation of Biofilm Efficacy Tests." *J. Microbiol. Methods* 70(2):236-244.
- Goeres, D.M.**, L.R. Loetterle, M.A. Hamilton. 2007 "A Laboratory Hot Tub Model for Disinfectant Efficacy Evaluation." *J. Microbiol. Methods* 68:184-192.
- Goeres, D.M.**, L.R. Loetterle, M.A. Hamilton, R. Murga, D.W. Kirby, R. M. Donlan. 2005 "Statistical Assessment of a Novel Laboratory Method for Growing Biofilms." *Microbiology* 151:757-762.
- Goeres, D.M.**, T. Palys, B.B. Sandel, J. Geiger. 2004 "Evaluation of Disinfectant Efficacy against Biofilm and Suspended Bacteria in a Laboratory Swimming Pool Model." *Water Research* 38:3103-3109.
- Hamilton, M., J. Heersink, K. Buckingham-Meyer, **D. Goeres** (Eds.). 2003 The Biofilm Laboratory: Step-by-Step Protocols for Experimental Design, Analysis, and Data Interpretation, Cytergy, Bozeman, MT.
- Zelver, N., M. Hamilton, **D. Goeres**, J. Heersink. 2001 "Development of a Standardized Antibiofilm Test." invited Chapter, Biofilms: Methods Enzymology Series, R.J. Doyle (Ed.), Academic Press, San Diego, CA, pp. 363-376.
- Sturman, P.J., **D.M. Goeres**, M.A. Winters. 1999 "Control of Hydrogen Sulfide in Oil and Gas Wells with Nitrite Injection." Society of Petroleum Engineers Paper #56772, Proceedings SPE Annual Technical Conference, Houston TX, 3-6 October 1999.
- Zelver, N., M. Hamilton, B. Pitts, **D. Goeres**, D. Walker, P. Sturman, J. Heersink. 1999 "Methods for Measuring Antimicrobial Effects on Biofilm Bacteria: from Laboratory to Field." invited Chapter, Biofilms: Methods Enzymology Series, R.J. Doyle (Ed.), Academic Press, San Diego, CA, pp.608-628.
- Sturman, P.J., **D.M. Goeres**. 1999 "Control of Hydrogen Sulfide in Oil and Gas Wells with Nitrite Injection" SPE 56772.
- Goeres, D.M.**, P.H. Nielsen, H.D. Smidt, B. Frølund. 1998 "The Effect of Alkaline pH Conditions on a Sulfate Reducing Consortium from a Danish District Heating Plant." *Biofouling* 12(4):273-286.

TECHNICAL REPORTS

- D.M. Goeres**, P. Sturman, B. Warwood 2018 "Research Support for Design and Fabrication of an Aerated Partially Hydrated Low Shear Biofilm Reactor." Final report submitted to the Montana Board of Research and Commercialization Technology.
- D.M. Goeres**, K. Cook, A.B. Cunningham, B. Warwood 2011 "Research Support for Standardizing a Comprehensive Biofilm Efficacy Test System." Final report submitted to the Montana Board of Research and Commercialization Technology.
- D.M. Goeres**, A.B. Cunningham, B. Warwood 2009 "Research Support for the Development and Manufacturing of a Rapid Biofilm Analysis Test Kit" Final report submitted to the Montana Board of Research and Commercialization Technology.
- D.M. Goeres**, M.A. Hamilton, B. Warwood 2006 "Research Support for the Manufacturing and Marketing of the Drip Flow Biofilm Reactor" Final report submitted to the Montana Board of Research and Commercialization Technology.
- M.A. Hamilton, **D.M. Goeres**, B. Warwood 2003 "Research Support for the Manufacturing and Marketing of the Suspended Coupon Biofilm Reactor" Final report submitted to the Montana Board of Research and Commercialization Technology.

PROFESSIONAL SERVICE

2019 – Present	Editor <i>Biofilm</i> journal.
2015 – 2017	Member of Planetary Protection Subcommittee of the NASA Advisory Council
November 2012	Opponent for Malena Skogman; Åbo Akademi University, Turku, Finland
1999 – Present	Member of American Society for Testing and Materials International (ASTM) Subcommittee E35.15. Technical contact on the five approved ASTM biofilm standard methods (Methods E2196, E2562, E2647, E2799, E2871).
2016 – Present	Elected to the position of Chair of ASTM E35 Main Committee.
2014 – 2015	Elected to the position of First Vice-Chair of ASTM E35 Main Committee.
2009 – 2013	Elected to the position of Recording Secretary of ASTM E35 Main Committee.
2000 – 2015	Liaison between Montana State University's Tech Transfer office and the Center for Biofilm Engineering; assist in the licensing of new biofilm reactor technologies developed at the CBE.

AWARDS

2019	Excellence in Outreach Award Norm Asbjornson College of Engineering MSU
2013	Core Fulbright Scholar Grant to Finland
2013	ASTM International Chip Collins Memorial Award
2008	CBE Outstanding Faculty Award

INVITED PRESENTATIONS (November 2010 – February 2020)

- "Evaluating performance criteria for the cleanliness of reusable medical devices" Anti-biofilm Technologies Conference, Arlington, VA. February 2020.
- "Proposed Standard Method for Antimicrobial Urinary Catheters." ASTM F04 Symposium, Houston, TX. November 2019.
- "ASTM Method E2647 Interlaboratory Study Results." ASTM E35.15 Subcommittee Meeting, Houston, TX. October 2019.
- "Viable Plate Counts Can't Do It Alone." CBE Webinar Series. September 2019.
- "Proposed Standard Method for Antimicrobial Urinary Catheters." CBE Biofilm Science & Technology Meeting, Bozeman, MT. July 2019.
- "Reproducibility of Antimicrobial Test Methods." ASTM E35.15 Subcommittee Meeting, Washington DC. October 2018.
- "Building a Biofilm Reactor: Design & Operation Considerations." ASM Biofilm Workshop, Washington DC. October 2018.
- "How Biofilm Impacts the Recreational Water Industry." World Aquatic Health Conference, Charleston, SC. October 2018.
- "Biofilms in Beer." Draught Quality Summit, Denver, CO. September 2018.
- "Standard Methods and Public Health: Review and Evaluation of Case Study Data through an Academic, Regulatory, and Public Health Perspective." ASM Microbe Conference, Atlanta, GA. June 2018.
- "The Impact of Biofilm on Draught Beer Quality." Brewers Association Beer Power Hour. Webinar. May 2018.
- "The Value of Standard Susceptibility Testing for Biofilms – A Pro/Con Debate." European Congress of Clinical Microbiology and Infectious Diseases Conference, Madrid, Spain. April 2018.
- "Ethics in Biosciences." Marie Curie Innovative Training Network Action PRINT-AID Workshop, Helsinki, Finland. March 2018.
- "Effective Technical Presentations." Marie Curie Innovative Training Network Action PRINT-AID Workshop, Helsinki, Finland. March 2018.
- "What's next for biofilm standard methods?" Anti-biofilm Technologies Conference, Arlington, VA. February 2018.
- "Overview of the Center for Biofilm Engineering, Montana State University." The Society of International Sustaining Growth for Antimicrobial Articles (SIAA) Biofilm Conference, Nara, Japan. November 2017.
- "ISO Method 846 Part C: Preliminary Data Collected for Method Modification." International Biodeterioration Research Group (IBRG) Meeting, Nara, Japan. November 2017.

“Understanding the Importance of Biofilm in Recreational Water” World Aquatic Health Conference, Denver, CO. October 2017.

“Standardized Biofilm Methods Development: Approach & Applications.” Steris, Columbus, OH. September 2017.

“Drip Flow Reactor Training Video: Second Video in the SBML Methods Technology Transfer Initiative.” Biofilm Science & Technology Meeting, Bozeman, MT. July 2017.

“Standardized Biofilm Methods Development: Approach & Applications.” SC Johnson & Son, Racine, WI. March 2017.

“Laboratory Attributes of a Low-level Biofilm Claim.” Anti-biofilm Technologies Conference, Arlington, VA. February 2017.

“Methods to Assess Urinary Catheters Designed to Reduce CAUTI.” Biofilm Science & Technology Workshop, Arlington, VA. January 2017.

“The Need for Standardized Biofilm Methods for Medically Relevant Applications.” ESGB EPASG Conference on Biofilm Resistance, Gent, Belgium. October 2016.

“Methods to Assess Biofilm Prevention on Surface Modified Urinary Catheters.” CBE Biofilm Science & Technology Meeting, Bozeman, MT. July 2016.

“Antimicrobial Surface Technology: An Overview.” Planetary Protection Subcommittee of the NASA Advisory Council, Washington DC. June 2016.

“Standardized Biofilm Methods Development: Approach & Applications.” Proctor & Gamble, Mason, OH. March 2016.

“Looking Beyond Pseudomonas: Adapting Standardized Biofilm Growth Methods for Other Bacteria.” ASM Biofilm Workshop, Chicago, IL. October 2015.

“ISO Method 846 Part C: Preliminary Data Collected for Method Modification.” International Biodeterioration Research Group (IBRG) Meeting, Prague, Czech Republic. October 2015.

“Results from Continued Optimization of the Single Tube Method.” CBE Biofilm Science & Technology Meeting, Bozeman, MT. July 2015.

“ASTM biofilm methods: Update on Recent Collaborative Studies.” ASTM E35.15 Subcommittee Meeting, Anaheim, CA. April 2015.

“Medical Device Technologies: Methods for Assessing Biofilm Prevention.” Anti-Biofilm Technologies Conference, College Park, MD. February 2015.

“There and Back Again: A Biofilm Researcher’s Story.” ASTM E35.15 Subcommittee Meeting, New Orleans LA. October 2014.

“Biofilm Methods Development Part 1: A Discourse on Parameters which Influence Biofilm Growth, Treatment, Sampling and Analysis.” International Biodeterioration Research Group (IBRG) Meeting, Athens, Greece. September 2014.

“Development & Validation of Biofilm Standard Methods.” Dow Microbial Control, Horgen, Switzerland. June 2014.

“Development & Validation of Biofilm Standard Methods.” Faculty of Pharmacy, University of Helsinki, Helsinki, Finland. June 2014.

“Development & Validation of Biofilm Standard Methods.” VTT Technical Research Centre of Finland, Espoo, Finland. May 2014.

“Biofilm Standard Methods: Building Bridges between Finland and the US.” Fulbright Forum, Jyväskylä, Finland. April 2014.

“Development & Validation of Biofilm Standard Methods.” International Biodeterioration Research Group (IBRG) meeting, Prague, Czech Republic. April 2014.

“Biofilm Research: Organic Matrix of People, Microorganisms and Ideas.” Åbo Akademi University, Turku, Finland. February 2014.

“Results of a Multi-Laboratory Evaluation of the Single Tube Method.” Webinar presented to US EPA. August 2013.

“Results of a Multi-Laboratory Evaluation of the Single Tube Method.” CBE Biofilm Science & Technology Meeting, Bozeman, MT. July 2013.

“ASTM Test Method E2871-12: ILS #853 Results.” E35.15 Subcommittee Meeting, Indianapolis, IN. April 2013.

“Grow, Treat, Sample and Analyze: Standardizing Methods for Routine Use.” Sherwin-Williams, Cleveland, Ohio. April 2013.

“Understanding the Importance of using Biofilm Methods in Anti-Biofilm Efficacy Testing.” Åbo Akademi University, Turku, Finland. November 2012.

“Research vs. Standard Methods: What is the Difference?” ASM Biofilms Conference, Miami, FL. September 2012.

“Recent Developments in the Standardized Biofilm Methods Laboratory.” 3M, St. Paul, MN. June 2012.

“Evaluation & remediation of bulk soap dispensers for biofilm.” GOJO, Akron, Ohio. August 2011.

“Update on the Validation of a Biofilm Disinfectant Efficacy Test.” CBE Biofilm Science & Technology Meeting, Bozeman, MT. February 2011.

“Validation of a Biofilm Disinfectant Efficacy Test.” Recent Advances in Microbial Control Conference sponsored by the Society of Industrial Microbiology, Arlington, VA. November 2010.

“Single Tube Efficacy Test: Results of a Two Laboratory Validation Study.” EPA Office of Pesticide Programs (OPP) Biological & Economic Analysis Division, Ft. Meade, MD. November 2010.

TEACHING EXPERIENCE

University Honors College. Instructor for the University Honors College freshman seminar course Fall 2010 – Spring 2015.

Internship Program. Oversaw the development of a program designed to provide undergraduate students in science, engineering and statistics experience working on relevant research in a laboratory environment. During their internship, students were encouraged to become independent thinkers and problems solvers while functioning as part of a research team. Every semester each student gave a technical presentation of their research data and presented one review of a journal article.

UNIV 125 Microbes in the Environment. Helped to develop and teach a natural science core course in which undergraduate students learned about biofilm microorganisms in industrial, medical and environmental systems.

Research Experience for Undergraduates (REU) Program. Facilitated the development of research projects and pairing of students and mentors. Instructed students on maintaining laboratory notebooks, writing work plans and final reports. Mentored individual students when a project was available.

OUTREACH ACTIVITIES

STEM Presentations. Developed and presented 30-minute hands-on workshops on various science and engineering topics appropriate for children in grades 1 – 12.

Expanding Your Horizons. Worked with a team of researchers to create a short hands-on workshop designed to encourage middle school females to remain interested in science, math and engineering.

Technology Transfer. Experienced in collaborating with industrial, nonprofit, and government organizations.