Center for Biofilm Engineering
News Update:
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Industry Highlights

DeLaval joins the CBE Industrial Associates program

The CBE recently welcomed DeLaval as its newest Industrial Associate member. DeLaval is a world leader in the dairy farming industry, providing integrated milking solutions designed to improve dairy farmers' production, animal welfare, and overall quality of life. The company develops, manufactures, and markets equipment for milk production and animal husbandry worldwide. **Carolina Mateus**, DeLaval R&D Manager, is the CBE designated representative. Read more about DeLaval at: http://www.delavalcorporate.com/

View a list of CBE Industrial Associates

Read about CBE membership

EPA is seeking public comment on proposed test methods for antimicrobial efficacy

Earlier this month, the EPA announced that it is seeking public comment on two test methods and guidance for evaluating antimicrobial efficacy against biofilm bacteria in hospital settings. CBE's Standardized Biofilm Methods Laboratory (SBML) was part of the academic and industrial team that developed these two test methods by providing statistical support, inter-laboratory study design and analysis, and guidance through the standardization process at the American Society for Testing and Materials (ASTM). The SBML has worked with the EPA for over 20 years measuring how well anti-bacterial products perform against biofilm bacteria in both household and hospital settings. Below is the full press release from the EPA.

Press release from the EPA, October 4, 2016—EPA is seeking public comment on two proposed test methods and associated testing guidance for evaluating antimicrobial pesticides against two biofilm bacteria, *Pseudomonas aeruginosa* and *Staphylococcus aureus*.

Bacterial biofilms excrete a slimy, glue-like substance (extracellular polymeric substances, called the biofilm matrix) that facilitates attachment to many hard surfaces such as glass, metals, and plastics, including those in health-care settings. The biofilm matrix provides embedded bacteria with protection from dehydration and other environmental stresses and interferes with the action of chemical disinfectants.

Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the registrant of an antimicrobial product with a public health claim is required to submit efficacy data to EPA in support of the product's registration.

EPA is soliciting comments on the clarity of the standard operating procedures and the regulatory guidance. **Comments will be collected until December 5, 2016**, at which point the EPA will finalize the procedures and provide the revised methods for use. The methods, guidance, and additional background documents are available in dockets EPA-HQ-OPP-2016-0357 at www.regulations.gov

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Research Highlights

CBE researchers receive funding to study eco-friendly alternatives to cleaning with biocides

CBE affiliated faculty **Christine Foreman**, associate professor in chemical and biological engineering, **Kevin Cook**, associate professor in mechanical engineering, and **Markus Dieser**, assistant research professor, were recently awarded funding from the National Science Foundation's Civil, Mechanical and Manufacturing Innovation program for their proposal "Eradication of microbial contamination in metalworking fluids." As explained in the proposal to NSF, in many manufacturing processes, metalworking fluids (MWFs) are applied to ensure reduced tool wear and workpiece quality. However, microbial contamination is a significant factor in the degradation of these fluids, causing biofouling and corrosion of equipment, imperilment of product quality, and posing occupational safety risks. Even after meticulous cleaning and the use of biocides, biofilms residing within the inaccessible regions of the system rapidly re-populate in MWFs. The study will investigate a novel MWF management strategy for biofilm eradication as an eco-friendly alternative to biocides.

CBE receives grant to acquire new imaging system

The CBE is in the process of making a significant addition to its imaging capabilities. CBE faculty members **Jim Wilking** and **Robin Gerlach**, both of MSU's Department of Chemical and Biological Engineering, were PI's on a proposal which was recently funded through the NSF's Major Research Instrumentation (MRI) program. This funding, along with a match from the office of MSU's Vice President for Research and Economic Development, is for the acquisition of an optical coherence tomography (OCT) imaging system. According to **Betsey Pitts**, CBE microscopy facilities manager, OCT will allow researchers to probe biofilms using light in a manner similar to an ultrasound scan. The imaging will not require fluorescence, can be done on fully hydrated samples, and can penetrate to depths in a biofilm of up to 2 mm. This kind of imaging will be especially useful for studying biofilm structure and mechanics. "This addition

will strengthen the CBE microscope facility as a centerpiece of the student research experience and training infrastructure at the CBE," Pitts stated. Also included on the proposal was CBE faculty member **Phil Stewart** and colleagues Seth Walk and Diane Bimczok of MSU's Department of Microbiology and Immunology.

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Latest Publications

Barnhart EP, Weeks EP, Jones EJP, Ritter DJ, McIntosh JC, Clark AC, Ruppert LF, **Cunningham AB**, Vinson DS, Orem WH, **Fields MW**
"Hydrogeochemistry and coal-associated bacterial populations from a methanogenic coal bed"
International J of Coal Geology, 2016 May 15; 162:14–26.
Read abstract

Guragain M, King MM, **Williamson KS**, Pérez-Osorio AC, **Akiyama T**, Khanam S, Patrauchan MA, **Franklin MJ**
"The *Pseudomonas aeruginosa* PAO1 two-component regulator CarSR regulates calcium homeostasis and calcium-induced virulence factor production through its regulatory targets CarO and CarP"
J Bacteriol., 2016 Mar 15; 198(6):951–963.
Read abstract

Hommel J, **Lauchnor E**, **Gerlach R**, **Cunningham AB**, Ebigbo A, Helmig R, Class H
"Investigating the influence of the initial biomass distribution and injection strategies on biofilm-mediated calcite precipitation in porous media"
Transport in Porous Media, 2016 September; 114(2):557–579.
Read abstract

James GA, Ge Zhao A, Usui M, Underwood RA, Nguyen H, Beyenal H, **deLancey Pulcini E**, Agostinho Hunt A, Bernstein HC, Fleckman P, Olerud J, **Williamson KS**, **Franklin MJ**, **Stewart PS**
"Microsensor and transcriptomic signatures of oxygen depletion in biofilms associated with chronic wounds"
Wound Repair Regen., 2016 Mar; 24(2):373–83.
Read abstract

Pabst B, **Pitts B**, **Lauchnor E**, **Stewart PS**
"Gel-entrapped *Staphylococcus aureus* bacteria as models of biofilm infection exhibit growth in dense aggregates, oxygen limitation, antibiotic tolerance, and heterogeneous gene expression"
Antimicrob Agents Chemother., 2016 Sep 23; 60(10):6294–301.
Read abstract

Wang X, Koehler SA, **Wilking JN**, Sinha NN, Cabeen MT, Srinivasan S, Seminara A, Rubinstein S, Sun Q, Brenner MP, Weitz DA
"Probing phenotypic growth in expanding *Bacillus subtilis* biofilms"
Appl Microbiol Biotechnol., 2016 May; 100:4607–4615.

Read abstract

Wang R, Xiao F, Wang Y, **Lewandowski Z**
"Determining the optimal transmembrane gas pressure for nitrification in membrane-aerated biofilm reactors based on oxygen profile analysis"
Appl Microbiol Biotechnol., 2016 September; 100(17):7699–7711.
Read abstract

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Education

Thesis Alert

"Multiscale analysis of trophic interactions in microbial communities," successful thesis defense by **Kristopher Hunt**, PhD candidate, chemical and biological engineering, Montana State University, September 2016.
Read abstract

"*Pseudomonas aeruginosa* biofilms in an in vitro chronic wound model," successful thesis defense by **Ben White**, masters candidate, microbiology and immunology, Montana State University, October 2016.
Read abstract

View thesis database

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Outreach

CBE Industrial/Agency visits

The following CBE faculty made industry visits to discuss membership in the Industrial Associates program:

Jim Wilking visited Solvay in Bristol, Pennsylvania, August 9, 2016.

Phil Stewart visited Smith & Nephew in Fort Worth, Texas, September 22, 2016.

Matthew Fields visited ExxonMobil in Annandale, New Jersey, and Solvay in Bristol, Pennsylvania, October 6–7, 2016.

Visiting Scholars

CBE is pleased to welcome the following visiting scholars:

Marketa Hulkova, Fulbright PhD student
Hometown: Brodek u Přerova, Czech Republic
Home university: Masaryk University, Brno, Czech Republic
Research at the CBE: Ecotoxicity of silver nanomaterials (May 2017)
CBE Host: **Ross Carlson**, professor, chemical & biological engineering

Kristina Block, Masters student
Hometown: Berlin, Germany
Area of study & home university: Environmental Engineering, Berlin Technological University
Research at the CBE: Use of struvite from different sources (synthetic, biogen, and wastewater) as an alternative nutrient for cultivation of algae (March 2017)
CBE Host: **Robin Gerlach**, professor, chemical & biological engineering

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People in Action

Jim Wilking, assistant professor, chemical & biological engineering, presented "Structure and mechanics of microbial biofilms," at the 2016 SIAM Conference on Nonlinear Waves and Coherent Structures meeting, Philadelphia, PA, August 8–11, 2016.

Phil Stewart, professor, chemical & biological engineering, as an invited speaker presented "Antimicrobial tolerance in biofilms: Physics, chemistry, biology," at Vikki Biocenter Lecture, University of Helsinki, Finland, August 22, 2016

Sarah Codd, professor, mechanical and industrial engineering, presented an invited lecture "Characterizing gels by NMR porous media methods: Direct measurement of glass dynamics and mesh network size in a solvent polymer system by multidimensional relaxometry and diffusometry," at the 13th International Conference on Magnetic Resonance in Porous Media, Bologna, Italy, September 4–8, 2016.

Mari Eggers, CBE research scientist, as a platform speaker presented "Water, our voice to the future: Climate change adaptation and waterborne disease prevention on the Crow Reservation," EPA STAR Tribal Progress Review Meeting City, Durham, NC, September 20, 2016. Co-presenters: John Doyle and Anne Camper

The following CBE faculty, students, and researchers presented research at Geological Society of America (GSA), Denver, CO, September 25–28, 2016:

Oral Presentations:

Katie Davis, PhD student, chemical & biological engineering, "Identifying the source, pathways, and rates of enhanced microbial coalbed methane."

Margaux Meslé, postdoctoral research associate, “Design of a small-scale high-pressure reactor system to study microbial bioconversion of coal to methane.

Adrienne Phillips, assistant professor, civil engineering, “Biomineralization: A strategy to modify permeability in the subsurface.”

Poster presentations:

Katie Davis, PhD student, chemical & biological engineering, “Scale-up of microbially enhanced coalbed methane strategies using a column upflow reactor.” Katie received the Outstanding Poster Presentation Award for the Environmental and Engineering Geology Division Student Research Competition.

Drew Norton, master’s student, environmental engineering: “Visualizing and quantifying biomineralization in a wellbore analog reactor.”

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Darla Goeres, associate research professor, chemical & biological engineering, was invited to present “The need for standardized biofilm methods for medically relevant applications,” at the Antimicrobial Resistance in Microbial Biofilm and Options for Treatment conference, Ghent, Belgium, October 5–7, 2016.

Diane Walker, CBE research engineer, as an invited speaker presented “Modifications to the CDC biofilm growth reactor method (ASTM E2562-12) for mixed species and *Legionella pneumophila* studies,” at the Recent Advances in Microbial Control (RAMC) meeting in San Diego, CA, October 9–12, 2016.

Phil Stewart, professor, chemical & biological engineering, as an invited speaker presented “Preventing biofilm infections,” at Biofilms, Ecology, and Human Health Symposium, University of Michigan, Ann Arbor, MI, October 21, 2016.

Robin Gerlach, professor, chemical & biological engineering, presented “Alkaliphilic algal cultivation as a means for improved productivity and stability of algae-based production systems,” and was a moderator for the Synthetic Biology for Algae and Consortia panel at the Algal Biomass Summit in Phoenix AZ, October 23–26, 2016.

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