

Report on Sabbatical Leave Report on Sabbatical Leave

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Proposed Sabbatical Leave Plan:

The main objectives for my sabbatical leave were to 1) become familiar with molecular techniques such as fluorescence *in situ* hybridization (FISH) and quantitative real-time polymerase chain reaction (qPCR), 2) learn how to operate lab/pilot-scale (industrial) fermentors and incorporate these activities into Industrial Microbiology-related courses and labs, and 3) gain hands-on experience with biofilm analyses and imaging (using confocal scanning laser microscopy, CSLM). I had selected three different institutions to visit during my sabbatical leave: Mississippi State University (Starkville); the National Sanitation Foundation (NSF) International; and Montana State University. The following report describes my activities with respect to these objectives, plus other significant scholarly activities during my one-semester sabbatical leave.

The tentative schedule for my sabbatical leave during Spring Semester, 2007, was: Mid-January - Review procedures and systems to be studied during sabbatical in Houghton; February - at Mississippi State University (Starkville, MS); March - at NSF International (Ann Arbor, MI); and April - at Montana State University (Bozeman, MT).

Actual Sabbatical Leave Activities:

One of the first things I learned was that my schedule was a bit too ambitious, i.e., to spend an extended period of time at three different institutions. I did spend the first part of the Spring, 2007 semester reviewing the relevant literature (and starting work on proposals). I was then in residence at Mississippi State (MS) for approximately five weeks, followed for approximately five weeks at NSF International (MI). At this point, I could not arrange a schedule with Dr. Geesey to visit Montana State University; however, I was able to visit two locations in Duluth, MN having CSLM capability (more information, below).

Objective 1: I was able to work with both Dr. Susan Diehl at Mississippi State University and Rob Donofrio (one of my PhD students) at NSF International on a variety of microbial-molecular techniques, including qPCR and denaturing gradient gel electrophoresis (DGGE). Although I later decided not to pursue use of DGGE in my own studies, I did start using qPCR techniques. In fact, one of my other Ph.D. students later conducted a summer internship at NSF International to work with qPCR and then FISH techniques for his thesis research. These assays are now being conducted at Michigan Tech.

Objective 2: I worked with Dr. Todd French at Mississippi State University on the scale-up from lab (flask) to bench (fermentor) scales for microbial processes as part of his Renewable Fuels & Resources laboratory. Since then, my lab group has “resurrected” a 10-L fermentor (obtained by a retired faculty member) for use in externally funded studies on biofuel and bio-polymer production. I was also able to learn more about the possibilities of using microbially produced fatty acids for fuels; this concept has since been modified for the microbial production of fatty acid-based fuel additives. Some of these approaches were incorporated into the Bioprocess Engineering Course taught jointly by myself and Dr. David Shonnard, Chemical Engineering.

Objective 3: Along with other faculty at Michigan Tech, I was working to obtain a CSLM for Michigan. As our Major Research Instrumentation (MRI) grant had not been funded, I not only visited several facilities having CSLMs but also discussed plans for revising our proposal. Mississippi State has an excellent CLSM facility and its director has been on the NSF review panels; she, in particular, was able to provide very good comments for use in a future proposal. I also discussed possible In later visits to the US EPA's National Health and Environmental Effects Research Laboratory and the University of Minnesota Medical School in Duluth I was able to discuss possible use of their CSLMs for some of my research samples (being the closest locations having CSLMs). In discussions back at Michigan Tech, though, it was decided to take a different approach to obtaining a CSLM so another MRI proposal was pursued at that time. Also, faculty in Biomedical Engineering obtained a microscope that provided adequate (for our purposes) capabilities that traveling elsewhere for sample analysis was no longer considered necessary.

Other Activities:

While at NSF International I also met frequently with other staff members in charge of areas such as sustainability, regulatory affairs, wastewater, and water distribution. As a result of these interactions, I was appointed to NSF's Council of Public Health Consultants (an advisory board) and placed on several working groups dealing with development of new standards and testing procedures.

I was also involved in preparing several proposals while on sabbatical. One was funded, by General Motors concerning ethanol and bio-polymer production from woody biomass; David Shonnard was the PI; Pat Heiden, Chemistry, and I were co-PIs. Work on this project has involved application of many of the techniques and ideas I gained on this sabbatical.