

**Michigan Technological University  
Civil and Environmental Engineering Department  
Report on Sabbatical Leave for Spring Semester 2006  
by  
C.R. Bailod, Professor  
December 29, 2006**

**Introduction and Purpose of Sabbatical:**

For most of my career at Michigan Tech, my teaching and research has focused on wastewater engineering and industrial residuals, ranging from ore processing wastewater, to specific pollutants, to oxygen transfer in biological wastewater treatment, to pollution prevention. During fourteen years as Department Chair from 1991 to 2005, I have been able to keep abreast of the wastewater field, but have not had the time to be very active in research. Also, over the past decade, a fruitful partnership focused largely on water resources has developed between Michigan Tech and the University of Sonora (UNISON), Mexico. The main purpose of the sabbatical leave was to allow me to transition back into wastewater engineering teaching and research while also contributing my expertise to the Michigan Tech/University of Sonora partnership.

**The Michigan Tech/UNISON Partnership**

Over the past 15 years, fifty Michigan Tech faculty members have visited UNISON, seven UNISON faculty have visited Michigan Tech, and about 30 students from each institution have visited as exchange students. Particular efforts have focused on the graduate program. By December 2006, at least ten UNISON students will have received masters or doctoral degrees from Michigan Tech, and approximately \$1 million will have been received from external sponsors to support this partnership. This partnership has helped to enhance Michigan Tech's diversity while also enhancing Michigan Tech's national and international reputation.

UNISON is a 19,000 student university located in Hermosillo, a city of 600,000 people situated about 200 miles south of Tucson in the Sonoran desert. Hermosillo is a rapidly developing industrial area, largely due to a large Ford plant opened in 1990. Although the city has modern water supply and wastewater collection facilities, the water supply is from ground water, and drought conditions have caused gradual depletion of the aquifer. Moreover, there is essentially no wastewater treatment prior to reuse for irrigation. The University is planning to build a small wastewater treatment plant on campus to increase public awareness and acceptance of wastewater as a resource. Hence there is a great need and opportunity for education and research related to water conservation, treatment and reuse.

**Objectives of Sabbatical**

The overall objective of the sabbatical was to provide time for me to refocus my wastewater engineering teaching and research program and to advance the Michigan Tech/UNISON partnership. Specific objectives were:

- to study new developments such as membrane reactors and sophisticated process models to upgrade my teaching materials and to discover practical research needs;
- to participate in teaching a wastewater treatment course to assist with Unison's new Master of Environmental Engineering program;
- to help write a proposal to continue the Michigan Tech/Unison partnership;
- to write a journal paper based on recent graduate student work.

### **Summary of Sabbatical Activities**

My sabbatical activity generally followed the plan outlined in Attachment B of the Sabbatical Proposal submitted on March 8, 2005. The following discussion summarizes the activities and compares the actual and planned activity.

- **Fall Semester 2005:** Taught CE 4508 Water and Wastewater Treatment (60 students) and CE 4905 Senior Design (12 students). Took a course in Spanish through Gogebic Community College and studied Spanish with help of a tutor.
- **December 26 to January 20:**  
**Plan:** was to work on Campus in Houghton studying of new developments in membrane technology and process model software  
**Actual:**  
 At the request of President Mroz, I chaired the University Plan Progress Committee, and during late December and early January, I worked on campus in Houghton mostly on preparation of the final report of that Committee. The Plan Progress Committee was formed by President Mroz in early November 2005. The charge to the Committee was to assess progress toward the vision and goals of the Michigan Tech Strategic Plan. The final report was completed and submitted on January 13, 2006. I also studied Power Point presentations developed by engineering consultants on the water and wastewater situation in Hermosillo.
- **January 23 – 27**  
**Plan:** drive to Hermosillo  
**Actual:**  
 Departed on January 19 and arrived in Hermosillo on Friday, January 27.
- **January 30 to April 7:** University of Sonora  
**Plan:** Further study of new developments in wastewater technology; work with new wastewater treatment plant; help teach wastewater treatment course; work on proposal to advance partnership; work on journal paper.  
**Actual:**  
 I met with Jose Luis Garcia Ruiz on February 1 and moved into a comfortable residence in the LaPaloma district of Hermosillo provided by UNISON. Jose is the Director of Inter-campus Exchange and Cooperation Programs at UNISON and is the main contact for cooperative programs between UNISON and Michigan Tech. Jose also holds a faculty appointment as Professor of Chemical Engineering at UNISON. Initially,

there was no telephone service to this house, but Jose Luis arranged to have a telephone and DSL internet access installed. Later that week, I met with Dr. Jesus Leobardo Valenzuela Garcia, the Head of the Chemical Engineering Department and was assigned to a very pleasant office in a new building reserved primarily for visiting faculty members. It was interesting that this office was available for use only between the hours of 8 AM and 3:30 PM.

Prior to leaving for Hermosillo, Agustin Robles (a Michigan Tech environmental engineering doctoral student from Hermosillo) had provided me with copies of power point presentations summarizing the results of an engineering study of the Hermosillo water and wastewater problem. I studied these reports and familiarized myself with the situation with the hope of helping the municipal authorities to select an optimal alternative. It was apparent that there was an acute water shortage in the Hermosillo area, with most residences having the municipal water supply turned on for only about four hours per day. Because of this, I decided to focus on "water reuse" as a main theme for my stay in Hermosillo.

During the week of February 6, I met with Chemical Engineering Professor Miguel Cuevas Guerrero who was in charge of the new, novel wastewater treatment facility "soon" to be constructed on campus. This small, pilot scale, 0.03 MGD facility is to be based on the activated sludge process, but with gravity clarification replaced by dissolved air flotation and is termed the "Krofta" process. It will also serve as a teaching and research laboratory facility. Miguel informed me that a snag in funding for the new treatment plant had developed and even though much of the equipment was already on site, no construction would begin for at least a few months. I asked Miguel to give me the plans and engineering report for the new facility so that I might review them and familiarize myself with them. I received the drawings a few days later, but never did receive any engineering report and was told that no such report existed. Based on this, it seemed pointless to spend any more effort trying to help with this facility.

Also, during the week of February 6, I reviewed the draft report of the WERC Senior Design Group working on the Contaminated Water Distribution System Task. I wrote a three page commentary on the draft report and sent it to the students.

During the week of February 13, I met with Chemical Engineering Professor Gilberto Garcia Navarrete who was teaching the graduate course in water and wastewater treatment. We agreed that I would work with him on team teaching the course and that I would provide about four weeks of lectures on the topics of: fundamentals of biological treatment, membranes, adsorption, ion exchange, and practical aspects of treatment

plant design. The class of nine students met twice a week for about 1 hour and 20 minutes per meeting. I gave about eight lectures during the period of March 1 to April 5. I also provided problem assignments with solutions for Gilberto. I spent significant time developing the membrane and ion exchange lectures, and this was most applicable to my water reuse focus. Because this was a graduate course, the students were required to know English and I was able to present the lectures in English. Communication with the students was not a problem, but communication with Professor Gilberto was somewhat of a problem. His English was better than my Spanish, so our conversations were generally 75% English and 25% Spanish. During my last lecture, I gave a presentation on the Michigan Tech Environmental Engineering graduate program and encouraged the students to think about applying to the doctoral program at Michigan Tech. We also discussed career plans. Most of the students seemed eager to get employment in Sonora, but some might apply to graduate school at Michigan Tech. Their names and e-mail addresses are:  
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[hguzman35@hotmail.com](mailto:hguzman35@hotmail.com)  
Diego Javier Robles de Jesus, [iqdiegojavier@hotmail.com](mailto:iqdiegojavier@hotmail.com)  
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During the week of February 20, I met with Ryan Biehl and Jeff Dambrun, two Michigan Tech environmental engineering students who were studying at UNISON as part of the Michigan Tech/UNISON exchange agreement. Ryan and Jeff expressed an interest in learning more about the water/wastewater situation in Hermosillo. At their suggestion, I gave them the power point presentations on the water and wastewater situation in Hermosillo, and they agreed to write a short report summarizing these presentations. The power point presentations were in Spanish, so this exercise helped them to understand some of the technical water/wastewater terminology used in Mexico. Also, during the week of February 20, I reviewed Helen Muga's doctoral dissertation proposal on Optimizing Pathogen Removal for Wastewater Reuse, and sent my comments to her.

On February 28, I participated in a meeting with officials of UNISON (Director Jose Luis Garcia, Rector Pedro Ortega Romero, Diana Meza, Dr. Alejandro Castellanos Villegas), USAID (Kenneth Weed, Penelope Martinez), and SEDESOL (Mexican Social Work Ministry) (Carolina Romero) to evaluate the progress made by the TIES Project funded by

USAID. Bruce Barna was present at UNISON, and other Michigan Tech faculty (Alex Mayer, David Watkins) and graduate students (Agustin Robles, Andrea Hernandez, Luis Garcillaso, Michelle Halleck) joined the meeting via videoconference. The meeting focused on the achievements of the various sub-projects supported by TIES over the past three years. The USAID representatives seemed to be most pleased with the progress made by Agustin Robles on the wastewater treatment project at Rosario.

During March, Gilberto Garcia Navarrete guided me on three wastewater field trips. The first was to a 1 MGD contact stabilization activated sludge wastewater reclamation plant built to reclaim water for reuse to irrigate a golf course in Los Lagos (a neighborhood in Hermosillo). This plant incorporated a sand filter for tertiary treatment and discharged to a series of about 8 lagoons from which water was withdrawn for irrigating the adjacent golf course. The plant withdrew the 1 MGD from the main Hermosillo interceptor sewer and discharged its residual biosolids back into the interceptor sewer. Gilberto was acquainted with the plant superintendent and it was clear that arrangements with an internal contact were required to gain admission to the facility. The second visit was to the area in which the Hermosillo interceptor sewer left the city. Here, 40 MGD of high strength (BOD 400 mg/l) leaves the city and follows the general path of what once was the Sonora River. I called it the Rio de Agua Negra (River of Sewage) and had never seen anything like it. But, over a few miles, the entire flow was diverted into a series of irrigation ditches and used for agricultural irrigation (pastures, orchards, and what-not). This emphasized why one should not eat any fruit or vegetable that could not be cooked or peeled. The third trip was with the students in the water and wastewater treatment class to a small (0.1 MGD) activated sludge plant that was in the final stages of construction in the village of San Pedro (about 10 miles north of Hermosillo). This plant was notable for some of its strange design features (aeration tanks with unnecessary reinforced concrete covers, final clarifiers configured in series so that the overflow from one clarifier discharged to the adjacent clarifier). It was apparent that this design could have benefited from some pre-construction review.

During late March and early April, I helped Director Jose Luis Garcia, Alex Mayer and Vice Rector Saul Robles Garcia to write a proposal on Sustainable Development for Rural Communities for submission to the Program for North American Mobility in Higher Education (NAMHE) of the Fund for Improvement of Postsecondary Education (FIPSE) of the US Department of Education. This was conceived as an extension of the current ExCIT (Expanding Cities) urban project to include a rural component. Because of the rural emphasis, Saul Robles Garcia, vice rector of the Navajoa Campus of UNISON, was a co-principal investigator. Also, the NAMHE program required that there be two

partner universities in each of the three countries (US, Canada, Mexico). Alex Mayer handled recruitment of the US and Canadian Partners. My main contribution was to strengthen the sustainable development component of the proposal by aligning it with the thrusts of the Sustainable Futures Program. I submitted a three page commentary to Jose Luis Garcia on March 30, and Jose Luis told me that he used my ideas in the final proposal that he submitted.

- **April 10-15:**

**Plan:** drive to Houghton

**Actual:** Left Hermosillo on April 11 and arrived in Houghton on April 18

- **April 17 to May 5:**

**Plan:** Complete work in Houghton

**Actual:**

I had been appointed to chair the Publications Committee of the American Academy of Environmental Engineers (AAEE), and proposed a new initiative to upgrade the Environmental Engineer Magazine by adding a new section titled Applied Research and Professional Practice. This was well-received, and, during April, I worked on recruiting an editorial board. I also worked on organization of a paper related to water reuse in Sonora.

**Evaluation of Sabbatical:**

Overall, the sabbatical leave achieved its goals. It helped me to transition back into wastewater engineering teaching and research and helped to strengthen the Michigan Tech/UNISON partnership. I was able to study membrane technology and indirect water reuse and to upgrade my teaching materials in those areas. I gained a better understanding of research needs in the water reuse area. I helped to teach a water and wastewater treatment course in the new environmental engineering program at UNISON, and helped to make the UNISON students aware of the Michigan Tech doctoral program. Although I did not complete a journal publication, I did lead the development of a new section of The Environmental Engineer Magazine that will feature refereed papers focused on Applied Research and Professional Practice in environmental engineering.

**Recommendations:**

The Michigan Tech/UNISON partnership is strong, and I would recommend UNISON as a host institution for future sabbaticals related to civil and environmental engineering. There are many opportunities for senior Michigan Tech faculty to contribute to development of Mexican infrastructure and UNISON programs. However, there are also cultural and language barriers to this contribution. Because of the limited research/scholarly opportunities a UNISON sabbatical would be less appropriate for junior faculty.