

EXTRACTOR

THE Metallurgical Engineering Newsletter OF Montana Tech

Because it has been awhile since we have heard from one another, I thought I would fill you in on what's happening with The Department and Montana Tech.

As you are probably already aware, I have been named by my fellow colleagues in the department and confirmed by the Chancellor to replace Sam as Department Head. Sam's shoes will be difficult to fill and I look forward to the challenge. Vern, Larry, Huang, Bill, Corby and Rosalie obviously throw support in my direction and are all doing well. Any suggestions or comments that you have, please send -them my way when you see fit.

All is well in metallurgy! In spite of low gold and copper prices, all of our 10 graduates are placed. In fact, 6 found jobs before graduating, 3 within a month of graduation, and the last by summer's end. In spite of losing such a good number of students to graduation, the head count in metallurgical engineering grew; we have a fantastic crew of about 15 freshman and 6 transfers of which 4 are sophomores and 2 are juniors. Of the freshmen, I received scholarships of \$1000 or more and had an average high-school GPA near 3.8 with 2 being 4.0-valedictorians. We are excited about all of our new students. The same, of course, can be said for all of our approximately 40 returning students. By comparison, they have an average (college) GPA near 3.2 with a senior still maintaining 4.0 and another senior just behind at 3.98. Furthermore, approximately half of the returning students are receiving a scholarship averaging \$1250. These are excellent numbers and something to be very pleased with.

Sam Worcester chose to retire this year, effective the end of May, rather than having both he and Vern Griffiths retire at the same time next year. Sam stayed in Butte through the end of summer but moved to Oregon with his wife Katy. We wish them well! Before Sam left, he finished all obligations to his research contracts including, what I have to conclude was his favorite, a stainless steel recycling project shared with Larry Twidwell in which radionuclides (actually surrogates) were selectively and pyrometallurgically removed using an induction furnace. The project lasted approximately four years and allowed three students to obtain their MS degrees. Sam gave a talk for the Montana Tech Chapter of Sigma Xi on this work. The surprise came when we made it into a retirement party. He actually thought we were just going to let him go away! All thanks to Rosalie for making it happen. He will be sorely missed in the department and, of course, by E.S. Welding program as well as the Butte community since he was on the board of the Butte Symphony and the Greenway Project.

However, Sam is continuing to serve on the Montana Tech Foundation Board and will be back October 16 for their board meeting. He will stay around for about a week, enough to help out with our ABET accreditation visit scheduled for Oct. 18-20. This visit will be based on the old criteria but will have some of the new 2000 criteria incorporated. We feel very comfortable about this visit and honestly expect to get the full 6 years (unlike prison terms, the longer the better!). The program is in excellent shape, we were able to purchase new equipment, replace old equipment, offer a few freshman scholarships, etc. All this because we received excellent support from alumni like yourself. Furthermore, we received approval to replace Sam and have been advertising for the past month. The deadline for application was September 21. So far, we received >30 applications and each appears excellent. Although the choice will be difficult, we expect to cut to a final list in the first week of October, conduct interviews, and make an offer by November in order to fill the position by January 1. Vern expects to retire in May of 1999 and go on one-third time through December of 1999. Hopefully we get to replace him in August of 2000. Vern will teach his "normal" load through the 1998-1999 academic year and then come back for the 1999 Fall to teach only Met 305, Metallographic Interpretation. It is hoped that Sam's replacement will be able to work with Vern during all of 1999 and take over the reigns for Met 305 and Met 306

(Physical Metallurgy Lab). These two courses are additionally taken by E.S. Welding students and require three sections to offer. Because circumstances resulted in an enrollment at the beginning of the Fall semester of about 35 in Met 305 and Met 306 (second semester) started out at about 28, there were bottlenecks for polishing and for microscope usage. Without our semi-automatic polishing machines (by LECO) it would not have been possible to prepare specimens for the courses (again, without your kind financial support of our program, this would not be possible!). With much of Vern's time consumed on these two courses, it is amazing he is still able to teach the SEM/EDX course for both semesters and additionally offer at least one course/semester on Physical Ceramics, Mechanical Behavior of Materials, Failure Analysis, Properties of Materials, and/or Nuclear Reactor Materials; however, it is clear that, like the rest of us, it's the love of teaching and interacting with the students. In regards to these courses, the SEM/EDX and Failure Analysis appear to be the most popular. The former is becoming more difficult because of the age of the SEM (it is approaching 20 years of age and so we hope to replace this within the next year and will likely be contacting you via the Foundation in the near future for your help) and the latter more-and-more interesting due to the steady trickle of failure analysis consulting jobs Vern lands which make for interesting class discussions. Vern did manage to get out and play. In April, he attended a one-day meeting of the Williston Basin section of NACE in Billings and, during the summer, visited New England and North Carolina. He was glad to see that the place had not fallen apart in his absence (a joking comment to the 3 -month old department head).

Larry was named the Anaconda Distinguished Professor of Metallurgical Engineering about two years ago and continues to teach courses on Pyrometallurgy, Corrosion, Metallurgical Wastes, Metallurgical Thermodynamics, Arsenic Control in Metallurgy, Ternary Phase Diagrams, Materials Selection, and Gold Processing. His current research efforts are in regards to using and developing extractive metallurgy processes to solve environmental problems typically associated with the mining industry. These research efforts have currently centered around arsenic, selenium and thallium but have included mercury and acid rock drainage (ARD) for which the nearby Berkeley Pitlake is so famous.

Larry's arsenic research efforts to formulate a solution for recovering arsenic from waste solutions has recently come to fruition. During the summer of 1997, he developed and demonstrated a "Mineral-Like Precipitation Technology" at a pilot scale level for each of three very different waste waters significantly reducing arsenic concentrations from 3.3 gpl to <20 ppb; 6 ppm to <20 ppb; and 500 ppb to <10 ppb. This technology is now being patented. Dr. Twidwell has also developed a second arsenic removal technology (Reductive Precipitation) that has progressed through numerous bench scale tests and to both pilot and full plant scale. The technology is presently being installed at a paint manufacturer in California with an anticipated start up in October. These demonstrations culminated from a research program over the past decade which included numerous theses and a thorough literature review of arsenic remediation technologies.

In hopes of establishing the same success on selenium and thallium, Larry has also written literature reviews for comparing potential technologies for their remediation with pilot scale level demonstrations. The reviews should be available in the near future. Dr. Twidwell has also been invited by AKITA University to, at their expense, attend, chair, and present a paper at the upcoming International Conference on Materials Engineering and Resources, ICCR'98, October 26-28, in AKITA, Japan. His invited talk will summarize the doubly-patented work that Universal Dynamics and he performed on recovering and recycling mercury from various waste products and will also include discussions on the three full scale industrial plants in operation. In the past five years, Larry has published and presented over 15 papers. Hsin-Hsiung Huang, or H 3 for short, teaches Hydrometallurgy and Electrometallurgy; Momentum, Heat and Mass Transfer; Thermodynamic Modeling of Aqueous Systems; Metallurgical Kinetics; various advanced courses; and one service course for the campus, E.S. 335, Engineering Thermodynamics. His recent research efforts have included the leaching of galena with a copper catalyst, the recovery of copper and disposal of arsenic from electrorefining bleed-stream sludges, and treating ARD such as Berkeley Pitlake Water with lime and other chemical additives. His two-stage, lime-precipitation technique is recognized by the U.S. EPA as the best-determined available technology (BDAT) for treating Berkeley Pitlake Water. Currently, Dr. Huang is investigating a leach technology for recovering the

valuable metals such as copper and zinc from sludges precipitated in the two-stage process. Finally, H 3 has, for the past 15 years, been developing a software program called STABCAL for thermodynamic modeling of aqueous systems. The world-renowned program can, for example, calculate speciation diagrams such as EH - pH, log ai - pH, and log aj - log a.; determine adsorption isotherms; and simulate titration experiments. The program is PC-compatible and can be obtained in Windows-format. STABCAL is currently being used at a number of industrial sites including several gold and copper leach and recovery operations. Furthermore, the program was used successfully in his research just noted as well as that of mine (discussed later) and Dr. Twidwell's.

William "Bill" Huestis continues to be our Laboratories Director and, of course, the instructor of our mineral processing labs including the service labs to Mining and Geological Engineering students. Because of his hands-on, mechanical expertise at maintenance and repair, his help with our research projects whether they be bench scale or pilot plant studies conducted on-site or at our research park facilities, and his analytical skills with various equipment including our XRD scanning goniometer, ICP, ion-chromatograph, and SEM/EDX, Bill is invaluable. Without Bill, mineral processing courses at Montana Tech simply could not be offered.

Corby Anderson was recently named Director for The Center for Advanced Mineral and Metallurgical Processing (CAMP). He will continue to be Research Faculty of Metallurgical Engineering. CAMP is a State (of Montana) Center of Excellence and is available for research, education, and consulting activities for the mineral and metallurgical processing areas. Corby joined us 1.5 years ago and brought with him invaluable experience in silver and antimony processing from Sunshine Mining in Idaho and numerous projects in gold, copper, nickel/cobalt, etc. processing from Simons in Vancouver. His efforts have been recognized: he is on both SME and IPMI Board of Directors and is nominated as trustee for NWMA. With CAMP, Dr. Anderson has been the principal investigator on over 25 projects employing over 10 students, both graduate and undergraduate. Highlights of these research projects include gold and copper diagnostic leaching, gold ore/auriferous pyrite pressure oxidation, silver electrowinning, nickel/cobalt laterite leaching, copper/cobalt ore-process development, and copper electrorefining with detailed design. Finally, Corby teaches one 2-credit course/semester: Survey of X-Ray Diffraction as required in the Spring and Ni/Co Processing for an elective in the Fall. In his short time here, Corby has additionally given 12 presentations, published 8 papers, and organized 3 technical sessions for SME and NWMA. Currently, he is the technical Chairman for 1999 IPMI Annual Meeting and is helping Larry and me organize a symposium entitled "Minor Elements 2000: Process and Environmental Concerns for As, Sb, Se, Te and Bi" scheduled for the 2000 SME Annual Meeting in Salt Lake City, March 6-9.

Rosalie, the real department head, continues to be the best secretary on campus. Without her, the ABET Volume II report would never have been finished on time. I am just tickled that she never went on vacation until that report was in the mail; however, if I do have a beef to pick, it's to Sam for leaving us and making me write it! Seriously though, Rosalie is a dream; you ask her to do something and she literally drops everything to get it done. Having been with the department for 20+ years, she knows the ins-n-outs of the whole institution; a valuable asset indeed! It should be noted that, once that ABET report was gone, Rosalie began to enjoy her summer: the Murphy clan came in from everywhere (Missouri, Colorado, etc.). She played with the grand kids (how lucky they are to have her for Grandma) and golfed with the boys. She made the mistake (?) of telling me they were going to the Old Works so, when they showed up, they found that their carts had already been paid for. Thanks again for everything Rosalie; you can't leave us for another 20+ years!

Finally, I was named the ASARCO Distinguished Professor of Metallurgical Engineering two years ago. I teach courses in Introduction to Mineral Processing, Coal Processing, Materials Handling, Flotation, and Advanced Flotation. For the past five years, I have examined cyanide recycling and destruction technologies and specifically studied advanced oxidation processes involving UV radiation. The research has resulted in a better understanding of the mechanisms involved and simultaneously spawned a research effort for developing a non-cyanide, precious-metal leaching technology, exclusive of thiosulfate, thiourea and the various halogens. The

technology has shown to be promising, yielding leaching efficiencies as high as 65% and solution recoveries near 100%. Recently, Corby joined in on this effort due to his having similar but then-unexplained experiences at Sunshine. I presented some results at the 1998 TMS Annual Meeting in San Antonio. In addition, I have also been extracting currently-valuable mineral commodities from old mill tailings, investigating the use of industrial minerals for remediating ARD, examining the interaction of UV radiation on ARD systems such as the Berkeley Pitlake, and, with Larry, defining the characteristics and properties of deep water/sediment materials precipitated from ARD systems. Each of these efforts are experiencing excellent success. The ARD projects have lead to a better understanding of Pitlake systems. My research efforts have culminated in over 20 publications and presentations since my being awarded the tenure-track position vacated by Gordon Zucker upon his retirement just 3.5 years ago. Furthermore, my research has involved both undergraduate and graduate students. To date, I have had the pleasure of graduating 3 MS students with thesis options and 3 with non-thesis options. Currently, I have 2 MS students conducting thesis research and another going through the MWTP option. As a result of all these activities, I was lucky enough to be awarded SME/MPD Young Engineer Award and be recognized by SME as a Future Leader and by TMS as a Young Leader.

As for the campus, the state of flux that Montana Tech has been in the last year or so appears to be coming to an end. Dr. Lindsay Norman served his last year and turned over the reigns on July 1 to Dr. Frank Gilmore who hails from West Virginia Institute of Technology. Frank has an excellent track record in teaching, research, and fund-raising. Not only that, he is a fine and warm person. If you get the chance to meet him, you should jump at the opportunity. He will do well here! Lastly, Tom Waring, as many of you know, had a heart attack and resigned from the Vice-Chancellor position last year. Doug Coe was named interim-VC for the subsequent year. He did a fantastic job. Dan Bradley was appointed interim-VC by Dr. Gilmore for the upcoming year in lieu of impending accreditation visits this coming fall; Dan has excellent accreditation experience which bodes well for the campus and the ABET visit just one-month away.

We hope all is well with you. Can you drop us a brief note to let us know what you have been doing? I hope to put together a newsletter incorporating all your responses so you can read how and what others are doing. I look forward to hearing from you soon (406)496-4158 (office phone); (406)496-4664 (fax) or e-mail cyoung@mtech.edu. Take Care and Thank You!

Sincerely,

(on behalf of the MET faculty and staff)