

# MONTANA TECH

## ~ ~ ~ UNDERGRADUATE RESEARCH PROGRAM ~ ~ ~

### **APPENDIX B—Proposal Preparation Helpful Hints**

This Appendix is an attempt to assist you in the development of your proposal for the Undergraduate Research Program (URP). Please keep in mind that these are only general suggestions and not requirements.

#### **General Format for URP Proposals**

1. URP Application Cover Sheet
2. Title Page including:
  - a. Project Title
  - b. Your Name and Department
  - c. Your Mentor's Name and Department
  - d. Date Submitted
3. Project Description/Introduction
  - a. Problem Statement
  - b. Preliminary Studies and/or Literature Review
  - c. Methodology
  - d. Evaluation
4. References (Literature Cited if any)
5. Budget and Budget Justification - See detailed budget information in **Appendix C, Budget and Expenses**

#### **Project Description**

The description of your project should answer basic questions about the project:

1. What problem/need do you address with your project?
2. What do you plan to do?
3. Why is this work important?
4. What have you or others already done on the project?
5. How do you plan to achieve your objectives?
6. Is the project accomplishable by the Spring Fair?

Provide enough detail as necessary to explain what you intend to do and how you will carry out the project in 1,000 words or less. **FORMAT MUST BE DOUBLE-SPACED.** Objectives should match the need statement and the procedures should describe how objectives would be accomplished.

#### **References and Citations**

List full references of any citations made in the project description or body of the proposal and ensure that all references used are up to date. Using updated references demonstrates that the work proposed is on the cutting-edge and provides a background or a foundation on which the study is proposed.

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The following is an **EXAMPLE** of a well-written proposal:

**— BEGINNING OF SAMPLE PROPOSAL —**

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(Cover Page)

**PROPOSAL TO THE UNDERGRADUATE RESEARCH PROGRAM**

By

**Alex Macgregor**

Department of Metallurgical and Materials Engineering

September 22, 2005

Research Advisor

**Dr. L.G. Twidwell**

**An Investigation to Compare Two Dissolution Procedures for Determining the Partitioning of Heavy Metals to Amorphous Ferrihydrite**

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**NOTE: This Proposal is single-spaced for web space-saving purposes only. All submitted proposals must be submitted double-spaced.**

**BACKGROUND**

Hohn and Twidwell<sup>[1]</sup> have been investigating the effectiveness of ferrihydrite (a ferric oxyhydroxide) for adsorbing heavy metals (Cd, Cu, Ni, Zn) from wastewater (Mine Waste Technology Program, MWTP Project 35). The adsorption portion of the study has been completed and the present focus of the project is to evaluate the long-term storage stability of the metal bearing solids. The goal of the long-term stability study is to determine the relative distribution of heavy metals between three phases: a solution phase, a ferrihydrite x-ray amorphous phase and a crystalline hematite phase. From these data, conclusions can be drawn as to whether the product will be stable in an outdoor storage reservoir. Samples will soon be placed in a constant temperature water bath at 70°C and the aging process will be followed as a function of time. Therefore, samples will be available for the proposed URP study in approximately one month (in November or early December).

Ferrihydrite converts to crystalline hematite in a relatively short period of time, e.g. at pH 7 and 70°C, ferrihydrite is partially converted to hematite in approximately one month, and is completely converted in three months. The conversion from amorphous ferrihydrite (surface area ~300 m<sup>2</sup>/gram) to a crystalline structure results in a tremendous decrease in the solid phase surface area (to ~90 m<sup>2</sup>/gram). The question to be answered by Project 35 is “Will the adsorbed metals remain with the crystalline phase or will they be released back into the solution phase?”

The procedure<sup>[2]</sup> that has been used by most investigators to determine the amount of ferrihydrite present

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is based on using a timed leach in a pH buffered oxalate solution. This solution reduces and solubilizes the ferrihydrite ferric iron<sub>(in solid)</sub> to ferrous, Fe(II)<sub>(in solution)</sub> but does not attack crystalline hematite. This procedure has been used to study the transformation rate of ferrihydrite and for studying ferrihydrite loaded with various anionic species such as arsenic, sulfate and selenium. However, it is known that some metals form solid oxalate compounds (Cd and Ni may form solid oxalate compounds), so at present it is unclear as to whether the procedure would be appropriate for determining the amount of heavy metals present in the ferrihydrite solid phase.

The EPA (Ford<sup>[3, 4]</sup>) has supported a few studies that have utilized both the oxalate and a timed hydrochloric acid leach. The hydrochloric leach has been shown to leach heavy metals but results in low iron recovery. It may be necessary, therefore, to use both the oxalate leach (for the iron content from which the amount of ferrihydrite can be determined) and the hydrochloric leach for determining the amount of heavy metals present in the amorphous ferrihydrite.

It is proposed in the present study that the two procedures be compared.

### STUDY OBJECTIVES

The objectives of the proposed study will include:

- Conduct dissolution test work on similarly aged materials using both the oxalate and hydrochloric leach techniques, and
- Recommend an appropriate treatment technique to account for the iron and heavy metals associated with the ferrihydrite.

### PROJECT APPROACH

The proposed study will be conducted as follows:

- Recover two sample bottles from the aging series.
- Centrifuge the samples and collect triplicate solution samples from each bottle. Preserve the solution samples according to established EPA Quality Control (QC) procedures. Have each solution analyzed for iron and heavy metal concentrations.
- Collect triplicate solid samples from each sample bottle, wash the solids three times with pH adjusted deionized water, dry at 50°C for 3 hours. Subject each dried sample to either the oxalate or hydrochloric leach (Procedures are presented in Appendix). Recover the leach solution and have analyzed for iron and heavy metals.
- Calculate the amount of ferrihydrite present and the concentration of heavy metals in the ferrihydrite. Perform a mass distribution for each heavy metal present in the solution phase, the ferrihydrite phase and the crystalline phase.

**TIMELINE:** The project would be initiated Fall 2005 and will be completed prior to the end of Spring Semester 2006. A final report and a presentation to the Undergraduate Research Program will be completed by April 2006.

**BUDGET:** The cost to the Undergraduate Research Program will be the stipend for the undergraduate student. All other costs will be borne by MWTP Project 35.

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### REFERENCES

1. Hohn, J., L. Twidwell, *Heavy Metals Removal by Modified Ferrihydrite Adsorption*, Montana Tech of the University of Montana, MWTP Project 35, January 2005-September 2006.
2. Schwertmann, U., R. Cornell, *Iron Oxides in the Laboratory*, VCH, New York, New York, 1991
3. Ford, R.G., *Rates of Hydrous Ferric Oxide Crystallization and Influence on Coprecipitated Arsenate*, EST, Vol 36, 2002, pp 2459-2463.
4. Ford, R.G., K.M. Kemner, P.M. Bertsch, *Influence of Sorbate-Sorbent Interactions on the Crystallization Kinetics of Nickel- and Lead- Ferrihydrite Coprecipitates*, *Geochimica et Cosmochimica Acta*, Vol 63, No 1, 1999, pp 39-48.

### APPENDIX

#### **Oxalate Leach Procedure**<sup>[2]</sup>

This procedure utilizes an oxalate solution to remove amorphous or poorly crystalline ferrihydrite, by reduction of ferric to ferrous which is soluble in the pH 3 buffered oxalate solution (BOLS). Solids remaining after the leach are considered crystalline material. The experimental procedure follows:

- Ferrihydrite sample (0.2 gm) is dispensed into a 100 mL polyethylene bottle.
- To prevent any UV light interference with the leach test, the 100 mL bottle is then wrapped with aluminum foil.
- 40 CC of the BOLS solution is dispensed into the vessel.
- The bottle is then capped and the aluminum foil folded over the top to eliminate any sources of light.
- The bottle is then agitated on an orbital shaker at 120 cycles per minute for 2 hours.
- After 2 hours a solution sample is taken, filtered, preserved, and saved for ICP analysis. The solution is analyzed for Cd, Cu, Fe, Ni, and Zn.

#### **Hydrochloric Leach Procedure**<sup>[3,4]</sup>

This procedure utilizes a 0.4 M hydrochloric solution to remove amorphous or poorly crystalline ferrihydrite and heavy metals associated with the ferrihydrite. Solids remaining after the leach are considered crystalline material. The experimental procedure follows:

- The ferrihydrite sample (0.2 gm) is dispensed into a 100 mL polyethylene bottle.
- 40 CC of 0.4M HCl solution is dispensed into the vessel.
- The bottle is then capped then agitated on an Orbital Shaker at 120 cycles per minute for 30 minutes.
- After 30 minutes a solution sample is taken, filtered, preserved, and saved for ICP analysis. The solution is analyzed for Cd, Cu, Fe, Ni, and Zn.

— END OF SAMPLE PROPOSAL —

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### APPENDIX C—Budget and Expenses

Students, with their Mentor's concurrence, may include an operation budget request in their proposal. The request must be **less than or equal to \$300** and should be limited to related travel, consumable supplies and expenses involved with constructing scientific apparatus. **Matching funds from the Department are encouraged.** You must **IDENTIFY, QUANTIFY and JUSTIFY** each item for which you request money. Computer hardware including CDs, floppies, flashes, etc., are **NOT allowable budget items** and must be supplied by the student, Mentor and/or Department. The request **MUST** be entered onto the cover sheet. If there is no budget request, the proposal should state so.

- 1) **Supplies.** Consumable supplies, such as laboratory and other reasonable supplies are allowed. The procedure to purchase supplies is as follows:
  - i) Mentor contacts Joanne Lee, of the Office of Sponsored Grants (ext. 4176), to request a purchase order. A purchase order is required for all purchases not made with a ProCard (campus credit card). Mentor should be prepared to provide the following information: place of purchase, a description of what is being purchased, banner# to charge to (B28023) and the estimated cost.
    - (a) If a Mentor makes the purchase with a ProCard, a copy of the receipt and a description of what was purchased should be submitted to Courtney Young, URP Chairman, for his approval, within 48 hours of purchase. The name of the ProCard holder, and a Banner # (B28023) are required on the receipt. Upon approval, Courtney will forward to the Research Office, a copy will be made for the student's file and the originals forwarded on to Joanne for processing.
    - (b) Should a student need to purchase a supply at a business that does not accept purchase orders and a ProCard is not available, the student must write a memo to Joanne stating that he/she tried to use a purchase order and could not. The memo must contain the student's full name, ID#, mailing address, and signatures of the mentor and Courtney Young, URP Chairman. Upon approval, Courtney will forward to the Research Office, a copy will be made for the student's file, and the originals forwarded on to Joanne Lee for payment. The reimbursement may take up to two weeks.
  - ii) It is the Mentor's responsibility to ensure that all purchases comply with Montana Tech policies and that the purchases do not exceed the student's approved budget. If the budget is exceeded, the Mentor's department will be responsible for the excess.

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- 2) **Travel Expenses.** Travel expenses may include cost of transportation, lodging and meals to support the objectives of the student proposal. [Note: Separate funds are available to present your research results at National Conferences or Competitions. See **Appendix I, Presenting at National Conferences.** Prior to travel, all students must complete Form W-9 for prompt payment upon return. The form W-9 can be found at [http://www.mtech.edu/accts\\_pay/pdf/IRSW9Form.pdf](http://www.mtech.edu/accts_pay/pdf/IRSW9Form.pdf). The form W-9 should be completed and sent to Joanne Lee in the Office of Sponsored Grants.

Transportation. If your research involves traveling out of town, it is preferred that you reserve a campus vehicle. To reserve a campus vehicle, please contact Sis Barnes, at the Physical Plant, 496-4168, email: [sbarnes@mtech.edu](mailto:sbarnes@mtech.edu). Operation of campus vehicles requires completion of training prior to use of the vehicle. Sis Barnes can assist you with this training. **[Note: Individuals who are not Montana Tech Students or employees may not ride in State Vehicles.]** The mileage rate charged to your budget for the use of a campus vehicle is presently 48.5 cents/mile. If you plan to use a personal vehicle when a campus vehicle is available, the reimbursement rate to you is 23.5 cents/mile. Please be sure to document mileage.

Meals. The present in-state meal rates are Breakfast, \$5, Lunch, \$6 and Dinner, \$12, for a total of \$23/day. You do not need receipts, but there are additional rules and restrictions regarding how many meals you can claim depending on time of day, whether your hotel serves complimentary breakfast, etc. Ask your Mentor to explain this to you, or contact Cheryl duToit (4781) or Irvena Kavanagh (4102) in the Research Office for more information.

Lodging. Government rates should always be requested and will require ID upon check-in. Typically, these rates are at or below the allowable in-state lodging rate reimbursement which is \$60 for most Montana cities. **YOU MUST RETAIN YOUR RECEIPT!** If you do not have receipts or if you stay with a friend, camp, etc., the daily reimbursement rate is \$12 per night.

Required Forms. You are required to complete a **Request and Justification for In-State Travel Authorization form prior** to your trip. Mentors will assist students with completion of this form. The Mentor and the URP Committee Chair, Courtney Young must sign the completed form. A travel authorization form is required to be on file with Joanne prior to travel. The travel authorization form can be found at:

[http://www.mtech.edu/accts\\_pay/pdf/TravelAuthorizationForm092806.pdf](http://www.mtech.edu/accts_pay/pdf/TravelAuthorizationForm092806.pdf). Upon returning, the student must complete a **Travel Expense Voucher**, which will also require your Mentor's assistance and signature and the signature of the Committee Chair. This form can be found at: [http://www.mtech.edu/accts\\_pay/docs/CampusTravelExpenseForm.xls](http://www.mtech.edu/accts_pay/docs/CampusTravelExpenseForm.xls). The form will then be submitted to the Research Office, for recordkeeping and then forwarded to the Office of Sponsored Grants for processing. The reimbursement may take up to two weeks.

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A sample of an estimated budget follows.

### SAMPLE BUDGET

Item	Description	Quantity	Price	Total Cost
Travel Allocations - Vehicle & Mileage	Travel to Research Sites in Campus Vehicles	Estimate 1 Trip at 367 miles per trip	1 Trip @ 367 miles at current travel rate of 48.5 cents per mile = \$178.00	\$178.00
Travel Allocations - Hotel & Meals	Reservations at The Hotel Montana Breakfast, Lunch & Dinner - Day 1 Breakfast - Day 2	1 Night 3 Meals - Day 1 Breakfast - Day 2	Hotel - \$60 Meals - \$28	\$88.00
LM 335 Temperature Sensors	Sensors to measure temperature of slab and conduit	5	\$2.40	\$12.00
Shielded Instrument Cable	Cable for connecting sensors to data acquisition device	100 ft.	\$0.10/ft.	\$10.00
Circuit Board	A printed circuit board to efficiently house all circuitry	1	\$12	\$12.00
			<b>Total</b>	<b>\$300.00 Maximum</b>

*(Note: The itemized budget MUST be preceded or followed by a Budget Justification section. This should be a short narrative explaining why each of the requested budget items, including travel, meals and lodging, are needed. See the following example.)*

### SAMPLE BUDGET JUSTIFICATION

**In order to measure the temperature of the concrete slabs and conduit at each of the 5 dam sites near Great Falls, MT, it will be necessary to purchase 5 sensors at \$2.40 per, 20 ft of cable per sensor for a total of 100 ft at a cost of \$0.10/ft, and 1 detachable circuit board for \$12 from Radio Shack in Butte.**

**Of course, travel to the various sites is needed and is estimated to be 367 miles round trip. Using the state travel rate of \$0.485/mile, this will cost \$178. It is estimated that it will take a total of 22 hours to do this including 2.5 hours to drive there, 2 hours to drive to each of the sites, 3 hours per site to attach the sensors and get them running properly, and 2.5 hours to drive back.**

**Consequently, a night's stay is requested at the Montana Hotel for \$60 along with a breakfast as well as a full day of per diem charges for \$28.**

**The total request for doing this project is \$300 as shown in the Budget Table.**