UNIVERSITY OF LOUISIANA AT LAFAYETTE

STEP Committee

Technology Fee Application

Stirring Hotplates for Chemistry

Title

Thomas Junk, August A. Gallo and Ryan L. Simon

Name of Submitter
(Faculty or Staff Only)

UL Department of Chemistry

Organization

Title: Professor/Head Date: 1/14/20
Name (Contact Person): Thomas Junk
Address: Department of Chemistry, P.O. Box 44270, University of Louisiana at Lafayette, 70504
Phone Number: 337-482-6735 Email: txj9137@louisiana.edu
Department/College/Org: Department of Chemistry

ABSTRACT (250 words or less):
Funding is requested to purchase 28 stirring hotplates and 100 magnetic stirring bars for the Department of Chemistry. The budgeted stirring hotplates will significantly improve the learning experience of approx. 280 students per year. Stirring hotplates are employed in virtually all chemistry labs, but the significant one-time expense of acquiring them in sufficient numbers to equip our teaching labs has so far precluded their purchase and deployment. The requested 28 stirring hotplates (24 to be deployed, one for each student, with 4 spares) are rugged and of excellent quality, do not require any training or maintenance and are expected to last 15-20 years. They will facilitate countless experiments by allowing students to heat reaction mixtures evenly with simultaneous magnetic stirring, avoiding hot spots and decomposition.

3a. Purpose of grant and impact to student body as a whole

The proposed project consists of the acquisition of 28 stirring hotplates for teaching laboratories in the Department of Chemistry. Many reactions in chemistry, notably in preparative organic and inorganic chemistry, require reactions to be heated and stirred simultaneously for good results. Briefly, these are plates with 4 x 6" heated ceramic tops that are capable of generating a strong, rotating magnetic field suitable to spin a Teflon coated magnetic stir bar inside a glass reaction vessel. Both heating rates and stirring rates are variable and can be adjusted to meet demands. The devices permit even heating while simultaneously thoroughly mixing all reactants to avoid hot spots and decomposition. For some purposes, the spinning and stirring features are employed separately (stirring without heating, or heating without stirring). The devices are ubiquitous in chemical research labs, but due to the significant one-time expense of purchasing one for each student, they currently are not available for our teaching labs. Stirring hotplates cannot be shared by two students during the same experiment, due to the fact that the stirring process requires that the reaction vessel has to be centered over the plate. Consequently, each student has to employ his/her own plate during the experiment. Currently, students try to make do by stirring their reaction mixtures by hand, which is impractical for experiments requiring more than a few minutes. As a result, they risk decomposition and reduced yields by not stirring. A common, more dangerous consequence of heating chemical reactions without proper stirring is delayed or "flash" boiling, in which solvents become superheated and are suddenly ejected violently from reaction vessels. Such occurrences are common and are best avoided by magnetically stirring.

The requested stirring hotplates will benefit all students enrolled in Organic chemistry Labs I and II (CHEM 233 and 234), with an average of eight experiments carried out each semester during which they are needed. With 180 students enrolled each semester and 50 students during summer, this amounts to over 1,800 experiments on account of these two labs alone. In addition, students enrolled in Inorganic Chemistry Lab CHEM 252, Analytical Chemistry Lab CHEM 222 and Undergraduate Research (CHEM 362 and 462) also will benefit from the availability of stirring hotplates. Overall, and estimated 260 students per year will make extensive use of the budgeted items.

The requested hotplates are compact and easy to carry. They are readily moved between different labs by stockroom personnel and also can assist students during titrations carried out in our Analytical Chemistry labs (CHEM 222). The maximum capacity for our labs is 24 students per lab section. Therefore, 24 stirring hotplates are requested in addition to four spares. The selected type of plate is of good quality and sturdy while omitting unnecessarily complex and costly features offered by other manufacturers, such as digital stirring rate control and high precision temperature adjustment, which often result in costs of over $1,000 per unit. Ceramic tops for this model can be purchased separately to replace any that brake. Stirring hotplates are available in several sizes. The selected 4 x 6" model will optimally accommodate the needs of our students. It should be emphasized that the requested equipment will benefit students with a wide range of majors, not only those majoring in chemistry.

3b. Projected lifetime of enhancement

Quality stirring hotplates such as the ones requested can fail, but such occurrences are rare. Typically, they last for 15-20 years. The most common reason for failure is that they are dropped in an inverted

position, resulting in a broken ceramic top. This occurs rarely. The ceramic top can be replaced for the selected model. Consequently, the four budgeted spares should compensate for such losses for several years to come. No regular maintenance of any kind is required for the requested units.

3c. Person(s) responsible for:

i. Implementation
Dr. Thomas Junk will procure the hotplates. Drs. Gallo and Simon will assist in the initial setup, during which each student workspace in MY 232 will be fitted with one stirring hotplate.

ii. Installation
There is no installation, the plates simply get plugged in.

iii. Maintenance
Normally, no maintenance is required. In case a ceramic top breaks it will be replaced by stockroom personnel.

iv. Operation
The stirring hotplates will be operated by our students, under the supervision of faculty teaching our laboratories (primarily Drs. Simon, Gallo and Junk).

v. Training (with qualifications)
The use of stirring hotplates is self explanatory: one knob controls the heating rate, the other the stirring speed. No training is required.

Budget Proposal

1.	**Equipment**	**$**	**0.00**
2.	**Software**	**$**	**0.00**
3.	**Supplies**	**$**	**11,167.94**
4.	**Maintenance**	**$**	**0.00**
5.	**Personnel**	**$**	**0.00**
6.	**Other**	**$**	**476.95 (shipping)**
TOTAL:		**$**	**11,644.89**

d. Budget Narrative:
Equipment covers 28 Corning PC-200 stirring hotplates ($369.10 each, $11,090.80 in total), as well as magnetic stirring bars (Fisher Scientific #03 990 252, pack of 100, $77.14).

Shipping covers freight and handling charges of the hotplates, $476.95.

Previous funded STEP projects

Ryan Simon has previously authored the following funded STEP proposals:

- Organic Chemistry Laboratory Equipment Grant, R. Simon and A. Gallo, $3666.50, awarded in May 2016.
- Demonstration Equipment Grant, R. Simon, $501.64, awarded in January 2017.
- Maker Lab for Montgomery Hall, R. Simon and Y. Wang, $3649.79, awarded in May 2017.
- Whiteboards for Montgomery Hall, R. Simon, $6371.96, awarded January 2018.
- Chemical Reactions with Light: UV Lamps for Photochemical Experiments in Organic Chemistry Labs, T. Junk and R. Simon, $2100.00, awarded January 2018.
- Electric Thermometers Grant Proposal, R. Simon and A. Gallo, $1850.00, awarded May 2018.
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August Gallo has previously authored the following funded STEP proposals:

- Smart Classrooms in Chemistry, T. Junk and A. Gallo, $30,000, Awarded 2012.
- Purchase of an Attenuated Total Reflectance (ATR) Tool for Chemistry to Conduct Infrared Spectroscopy on Solids, T. Junk and A. Gallo, $5,602.50, Awarded 2016.
- Organic Chemistry Laboratory Equipment Grant, R. Simon and A. Gallo, $3666.50, awarded in May 2016.
- Acquisition of a Polarimeter for Chemistry Laboratories, A. Gallo and W. Xu, $540.00, awarded January 2017.
- Digital Thermometers Grant Proposal, R. Simon and A. Gallo, $1850.00, awarded May 2018.

Thomas Junk has previously authored the following funded STEP proposals:

- Smart Classrooms in Chemistry, T. Junk and A. Gallo, $30,000, Awarded 2012.
- Laptop Computers for Chemistry Lectures, T. Junk, $3,285, Awarded 2013.
- Raman Spectroscopy in Chemistry Labs, T. Junk, $10,655, Awarded 2015.
- Purchase of an Attenuated Total Reflectance (ATR) Tool for Chemistry to Conduct Infrared Spectroscopy on Solids, T. Junk and A. Gallo, $5,602.50, Awarded 2016.
- ChemDraw Chemical Structure Drawing Software for Student Use and Training, T. Junk, $4,460, Awarded 2017.
- Chemical Reactions with Light: UV Lamps for Photochemical Experiments in Organic Chemistry Labs, T. Junk and R. Simon, $2,100.00, awarded January 2018.
- Purchase of an Infrared Spectrometer for Chemistry, T. Junk and R. Simon, $23,595.20, awarded December 2019.