

UNIVERSITY OF LOUISIANA AT LAFAYETTE

STEP Committee

Technology Fee Application

**Bring Vacuum Oven to Analytical Chemistry
Laboratory Courses**

Title

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Name of Submitter
(Faculty or Staff Only)

Chemistry Department

Organization

Title: Bring Vacuum Oven to Analytical Chemistry Date: 06/18/2018
Laboratory Courses

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ABSTRACT (250 words or less):

The purpose of this proposal is to acquire two sets of vacuum ovens for analytes preparations in Analytical Chemistry Laboratory courses including CHEM 222 and CHEM 430G. This two Analytical Chemistry lab courses provide our students with necessary training experience in the application of chemistry concepts by solving analytical problems and using modern instrumentation. Experiments are designed in the courses to measure a variety of trace amount of organic and inorganic analytes in water solution or other matrixes. Vacuum ovens are standard tools in analytical labs for drying glassware and more importantly, sample preparation, especially for those substances which are hygroscopic and heat sensitive. Unfortunately, we do not have any vacuum oven in our Analytical Chemistry teaching laboratories, which limits the sample preparation skills that students should accumulate in college. In addition, the only classic oven is outdated and parts are broken (see the attached pictures in the section A). The acquisition of this basic technology, two sets of vacuum ovens and their accessories including pumps, would provide our students with decent amount of training in sample preparation, so to be better prepared for their career.

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

The purpose of this proposal is to acquire two sets of vacuum ovens, which are basic technology, for general drying purpose and analyte preparations in Analytical Chemistry Laboratory courses, including CHEM 222 and CHEM 430G. Those analytical lab courses provide students with necessary experience in the application of analytical chemistry concepts by solving analytical problems and using modern chemical tools and instrumentation, to obtain precise and accurate results.

A vacuum oven is a standard tool for sample preparation, to remove moisture, in chemical process industries such as food, agricultural, and pharmaceutical companies. The main function of vacuum oven is vacuum drying, which is the mass transfer operation where the moisture present in a substance is removed through a vacuum. Several experiments in the courses are designed to measure a variety of analytes with low concentrations in our environment such as water sample or commercial products. In those experiments, a standard is usually used to generate a standard curve, which is the base for determining the analyte concentration, therefore, if the standards is not pure, the concentration of analyte determined will be very wrong. For example, in the experiment of “Ion-Selective-Electrode Potentiometry”, students learn to analyze the concentration of fluoride in Tap Water. Fluoridated water contains fluoride at a level that is effective for preventing cavities and to reduce tooth decay. However, excess amount of fluoride over a lifetime may have increased adverse health effects of fluoride, such as increased likelihood of bone fractures for adults, and children aged 8 years and younger have an increased chance of developing pits in the tooth enamel, along with a range of cosmetic effects to teeth. Thus, the current enforceable drinking water standard is 4.0 mg/L for fluoride, which is the maximum amount that is allowed in water from public water systems. In the experiment, *students MUST use vacuum oven* to dry NaF, i.e., to remove all the water so to prepare standards with accurate concentrations, which will in turn ensure the correct measurement of concentration of fluoride in unknown tap-water.



Images: front control panel of oven (left), oven (center) and broken latch of oven (right)

Currently, we DO NOT have any working vacuum ovens in our Analytical Chemistry Laboratory courses. The instructors had to dry the chemicals one day ahead of the experimental time, which prevents students from learning the principles of vacuum drying and the skills of using vacuum oven. Furthermore, the only oven (not vacuum, just drying oven) in the analytical chemistry lab is close to its lifetime (the attached pictures) with some parts broken, and deteriorating power cords, which are not maintainable due to the age of the oven. More importantly, the fact that CHEM 222 and 430G students do not currently have any working vacuum oven, will be reflected on students' lack in training that is required for their future career.

Therefore, it is critical that we improve our technology by implement vacuum ovens and their accessories into our analytical chemistry laboratory courses.

The impact to students: most of our CHEM 222 and 430G students are biology, environmental, education, chemical & petroleum engineering, and pre-pharmacy or pre-med as well as forensic majors. Two sessions in the fall and one session in the spring, a total of 34 - 45 students take Analytical Chemistry Laboratories in room 206 of Montgomery Hall, and 6 - 9 students enrolled in instrumental analysis (lecture, lab and essay). Each section of the course is limited up to 14 students because of safety concerns and the lab space. The waiting list for each of sections of these courses is the same as the number of students allowed in each session each semester. Therefore, it is estimated that approximately 50 students will learn how to use vacuum oven and attached knowledge such as vacuum. The two sets of vacuum ovens will give them decent amount of training in sample preparation every semester. This will also enhance their education in science and reinforce what they learned in previous chemistry laboratories.

If the funds are approved, two sets of vacuum ovens in the attached quotes will be purchased and placed into room 206 of Montgomery Hall or nearby labs where space is allowed. The quoted model owns the following features which increase the safety of using any heated devices:

- Automatic time and temperature control with the LED display
- cycle the oven on or off up to eight times per day
- Chamber door with full-view, tempered safety glass
- Self diagnostics for open thermocouple, shorted triac, open heater, and overtemperature prevention plus panel alert lights
- Built-in safety controller prevents temperature runaway
- Backup thermostat

The instructor and professors who oversee the laboratory will maintain the vacuum oven, and ensure that work for all students for many years to come.

B. Projected Lifetime of Enhancement

The projected lifetime of the instruments requested is over fifteen years.

C. Person(s) Responsible for:

Implementation: Hui Yan, Febee Louka and Zachary Highland

Installation: Hui Yan, Febee Louka and Zachary Highland

Maintenance: Routine maintenance covered by the Department of Chemistry

Operation: Faculty of the Department of Chemistry and Analytical Laboratory Students

Training: Faculty of the Department of Chemistry

Budget Proposal

Type	Quantity	Price	Total
1. Equipment	2	\$6,349.45	\$12,698.9
The list price of one vacuum oven is \$4,350.00 (please see attached quote), one pump is \$1999.45, one set is for students in CHEM 222 and the other set for CHEM 430G. The total for two sets vacuum ovens with pumps are \$12,698.9.			
2. Software	0	\$0	\$0
3. Supplies	0	\$0	\$0
4. Maintenance	0	\$0	\$0
5. Personnel	0	\$0	\$0
6. Other (shipping)	1	\$200	\$200

TOTAL: **\$12,898.90**

Other Relevant Information

None

Previous STEP projects

Hui Yan and Febee Louka "Bring Rotary Evaporator for Sample Preparation to Analytical Chemistry Laboratory Courses", Fall 2017, \$8,700

Hui Yan and Febee Louka "Improving Precision and Accuracy in Analytical Chemistry Laboratory Courses", Fall 2016, \$5,137.72

Febee Louka "Economical Micro-scale Vacuum Assisted DigiFILTER Assembly in Chemistry Labs" Fall 2016. \$13,901.24

Febee Louka "Economical Micro scale Equipment in Chemistry Labs" Spring 2016 \$16,843.40

Zachary L. Highland, August A. Gallo, Hui Yan. Acquisition of Vernier Lapquest for Analytical Chemistry. Spring 2018.