Rec 9/29/23

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MTSU Clean Energy Initiative Project Funding Request

There are five (5) sections of the request to complete before submitting. See http://www.mtsu.edu/sga/cleanenergy.shtml for funding guidelines. Save completed form and email to cee@mtsu.edu or mail to MTSU Box 57.

1. General Information	
Name of Person Submitting Request : Ngee Sing Chong	
Department/Office : Chemistry	Phone # (Office): 615-898-5487
MTSU Box # 68	Phone # (Cell): 615-556-5509
E-mail : nchong@mtsu.edu	Submittal Date: Sept. 29,2023

2. Project Categories (Select One)			
Select the category that best describes the project.			
	Energy Conservation/Efficiency	X	Sustainable Design
	Alternative Fuels		Other
	Renewable Energy		

3. Project Information
a. Please provide a brief descriptive title for the project. **b.** The project cost estimate is the expected cost of the project to be considered by the committee for approval, which may differ from the total project cost in the case of matching funding opportunities. **Any funding request is a 'not-to-exceed' amount. Any proposed expenditure above the requested amount will require a resubmission.** c. List the source of project cost estimates. d. Provide a brief explanation in response to question regarding previous funding.
3a. Project Title: Reducing the Release of Microplastic Particles from Recycled Tire Rubber Products
3b. Project Cost Estimate $3850+$1250+$950=$6050 (see attached quote)
3c. Source of Estimate Shanghai Linbel Instrument Co., Ltd

ITEM#	SPECIFICATION	PICTURE	Package Size / Weight	Quantity	EXW Price	AMOUNT
20L Jacketed Glass Reactor + RC-CS-50-3000 ultrasonicaotr device	1. Volume: 20L 2. Jacket Volume(L):6 3. Stirring power(W):90W 4. Rotating speed(rpm) :50~680 5.Temp range: -120℃-300℃ 6. Power Supply(V/Hz): Single Phase 220V/60Hz		1430*630*720mm 120kg	1	$3,850	$3,850.00
3KW Heater	1. Heating power:3KW 2. Flowing: 45L/min 3. Highest temperature can be 200C. 4. Accuracy: ±1℃ 5. Power Supply(V/Hz): Single Phase 220V/60Hz 6. Pump power: 370W		540*480*980mm 65kg	1	$1,250	$1,250.00
DDP shipping fee including customs clearance and taxes by sea						$950.00
DDP shipping fee including customs clearance and taxes by air						$2,650.00
Total Amount:						$6050 by sea $7750 by air

3d. If previous funding from this source was awarded, explain how this request differs?

This request is for a project related to tire rubber recycling whereas the previous project is related to the reduction of the harmful carbon monoxide emission from biofuel combustion.

4. Project Description

(Completed in as much detail as possible.)

a. The scope of the work to be accomplished is a detailed description of project activities.
b. The benefit statement describes the advantages of the project as relates to the selected project category.
c. The location of the project includes the name of the building, department, and/or specific location of where the project will be conducted on campus.
d. List any departments you anticipate to be involved. Were any departments consulted in preparation of this request? Who? A listing may be attached to this form when submitted.
e. Provide specific information on anticipated student involvement or benefit.
f. Provide information for anticipated future operating and/or maintenance requirements occurring as a result of the proposed project.
g. Provide any additional comments or information that may be pertinent to approval of the project funding request.

4a. Scope: Work to be accomplished

Although the heating value of tire derived fuels (TDFs) is higher than most types of coal, the emission of hazardous gases such as polycyclic aromatic hydrocarbons (PAHs), sulfur and nitrogen dioxide (SO2, NO2), carbon monoxide (CO), and hydrogen chloride (HCl), is an environmental concern. We plan to carry out high-temperature experiments using a pyrolyzer coupled to gas chromatography mass spectrometry (Py-GC-MS) as well as thermogravimetric analysis (TGA) to study the thermal degradation of TDFs. High carbon percentage of tire rubber results in formation of PAHs and carbon-rich particles, and volatile organic compounds (VOCs). Removal of VOCs via thermal desorption and extraction using ultrasonication devices will be explored. Infrared spectroscopy (IR) with a long path-length gas cell will be used to analyze air pollutants including CO, HCl, NO2, SO2, and formaldehyde. A GC-MS instrument outfitted with a cryogenic preconcentrator will be used to measure the concentrations of VOCs. The gaseous combustion products from TGA experiments will be collected for both FTIR and GC-MS analysis. Raman microscopy and IR spectrometry will be used to determine the composition of TDFs, and calorimetry will be carried out to determine their heat content.

Removal of sulfur from tire rubber will be carried out with both the ultrasonication and devulcanization methods. This process involves selective breaking of sulfide cross-linking bonds, which leads to the scission of main chain, yielding lower molecular weight polymeric fractions. Dynamic desulfurization and microwave treatment will be studied as devulcanization techniques. Experiments will be carried out at different reaction conditions; the variables of temperature, reactant ratios, and reaction time will be optimized. With devulcanization, we expect to improve the cost-effectiveness of recycling while ensuring environmental sustainability and human health protection via the minimization of toxic emissions in tire-derived products.

4b. Scope: Benefit Statement

Our long-term goal is to develop innovative recycling technologies that will help reduce the disposal of solid waste including tires and plastic products at landfills. With the proposed research, we hope MTSU will be able to play an important role in helping the City of Murfreesboro and Rutherford County deal with environmental quality issues related to solid waste disposal at the Middle Point Landfill. MTSU students will benefit from gaining first-hand knowledge of waste tire disposal issues and recycling options in addition to learning useful laboratory techniques used in the development of recycled tire rubber products.

4. Project Description (continued)

4c. Location of Project (Building, etc.)

The Analytical Chemistry Research Laboratory (SCI 3070), the Gas Chromatography Laboratory (Room 3101), and the Molecular Spectroscopy Laboratory (Room 3093) in the Science Building will be used for carrying out this project.

4d. Participants and Roles

Project Leader-Dr. Ngee Sing Chong (Planning and implementing the project and directing students in the testing and evaluation of recycled tire rubber products.)

Research Collaborator-Dr. Mina Mohebbi (MTSU Engineering Technology Department) will review test results on the chemical properties of the recycled tire rubber products and evaluate the cost-effectiveness of the production of the recycled products.

4e. Student participation and/or student benefit

Research Students-Ms. Amrutha Pogadapula (MTSU Master of Professional Science) and two undergraduate students will be conducting the experiments and measuring the chemical properties of the recycled tire rubber products. She will acquire useful laboratory skills such as IR spectrometry, X-ray fluorescence spectroscopy, and GC-MS that are helpful to getting a job in industry. The ultrasonication equipment used in this project can also be used as a laboratory instruction tool for students in CHEM 4231/6231 class (Instrumental Analysis).

4f. Future Operating and/or Maintenance Requirements

The project will receive funds from Chemistry Department at MTSU for the purchase of lab supplies. The preliminary data collected will be used to prepare a proposal for Tennessee Department of Environment and Conseration. The MTSU lab fees for chemistry courses will be used to purchase liquid nitrogen and other supplies required for FTIR analysis.

4g. Additional Comments or Information Pertinent to the Proposed Project

MTSU Chemistry has all the laboratory instruments needed for analyzing the contaminants that are derived from the used tire material. However, we are lacking the ultrasonication equipment needed to extract or remove the tire contaminants and the reactor for converting the material to fuel products.

5. Project Performance Information

Provide information if applicable.

a. Provide information on estimated annual energy savings stated in units such as kW, kWh, Btu, gallons, etc.
b. Provide information on estimated annual energy cost savings in monetary terms.
c. Provide information on any annual operating or other cost savings in monetary terms. Be specific.
d. Provide information about any matching or supplementary funding opportunities that are available. Identify all sources and explain.

5a. Estimated Annual Energy Savings (Estimated in kW, kWh, Btu, etc.)

Not applicable

5b. Annual Energy COST Savings ($)

Not applicable

5c. Annual Operating or Other Cost Savings. Specify. ($)

Not applicable

5d.Matching or Supplementary Funding (Identify and Explain)

Dr. Chong receives financial support from Chemistry Department and CBAS for the purchase of consumable research supplies. The graduate student working on this research project is supported by graduate stipend from CBAS. The undergraduate students involved in this project receive course credit for the CHEM 3880 research course.