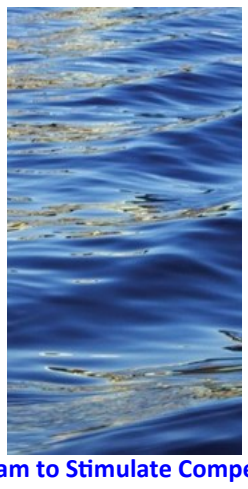
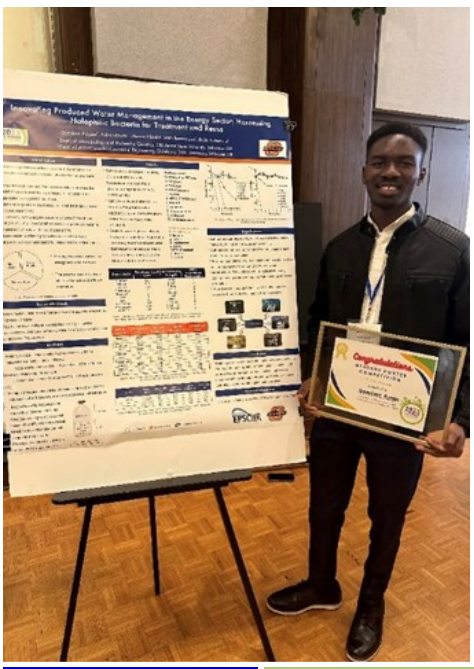
OKLAHOMA EPSCoR UPDATE

Promoting Innovative Research



OK NSF Established Program to Stimulate Competitive Research | November 2023

OSU Graduate Student Wins Poster Contest at an Annual Energy Conference



Damilare Ajagbe, a Ph.D. student in Dr. Babu Fathepure's laboratory at the Department of Microbiology and Molecular Genetics, Oklahoma State University, won first place in the 2023 Roger Farer Annual Conference's student poster competition, which was held on October 10, 2023 at the University of Central Oklahoma, Edmond, OK. The conference was hosted by the Oklahoma Chapter of the Association of Energy Engineers (AEEOK) and the Oklahoma Renewable Energy Council (OREC).

Mr. Ajagbe presented his work on bioremediation of oil contaminated hypersaline produced water using halophilic bacteria. To determine the potential of the isolated bacteria for produced water clean-up, Mr. Ajagbe investigated the ability of the bacteria to tolerate high salinity, degrade hydrocarbons, and tolerate heavy metal toxicity.

Ajagbe's research is supported by the National Science Foundation under Grant No. OIA-1946093 through the OK -NSF EPSCoR.

Three Students Gained Summer Research Experience

Pedro Antonio, Abby Oakes, and Sean Smart, undergraduate students from Oklahoma State University (OSU), successfully finished their respective projects through the OK NSF EPSCoR Research Experience for Undergraduates (REUs) program this past summer.

Pedro Antonio and Abby Oakes, both mechanical engineering students at OSU, performed their individual projects under the supervision of Dr. Srinivas S. Kolla from the same department.

Pedro Antonio conducted a study to improve the design of Liquid-Liquid Cylindrical Cyclone (LLCC) Compact Separator performance for effective cleaning of produced water with low quantities of oil.

"During my summer research, I constructed and implemented two different inlet and outlet designs to enhance the LLCC Compact Separator using SolidWorks software and top-of-the-line plastic welding equipment," Antonio said.

"We tested the two types of inlets and outlets in the lab for various flow conditions and for their structural integrity. A single radial outlet has shown better separation results than the axial outlet. The multi-radial outlet has not been studied fully due to lack of time during the summer and I am continuing this part of the project during the Fall semester out of enthusiasm and keen interest to learn more," Antonio added.

"Although it is only a three-month project, it has been invaluable for my academic growth and development. I feel as though I have gained a year's worth of knowledge, particularly in my understanding of fluid mechanics. Despite the time crunch, I treasured every moment spent in Dr. Kolla's lab. Such experience has inspired me to consider pursuing a graduate degree and research in the future. Clean water is a vital necessity for our survival, and this project's exploration of innovative separation/filtration methods for oil-contaminated water is crucial. Moving forward, I am eager to continue working on this project with the goal of contributing to the advancement of water technology," Antonio said.

Abby Oakes together with Dr. Srinivas Kolla analyzed a variety of meshing and geometry configurations to validate older works and improve theoretical framework for Liquid-Liquid Cylindrical Cyclonic (LLCC) Separators with a focus on oil-water separation of produced water, using Computational Fluid Dynamics (CFD). Ms. Oakes spent the first quarter of the project reviewing the concept of numerical modeling such as Computational Fluid Dynamics, basic fluid mechanics principles, and becoming familiar with ANSYS SpaceClaim for this project's CAD models, ANSYS CFD Prep-Post for meshing the CAD geometry, and ANSYS Fluent for CFD.

Ms. Oakes investigated the optimal meshing configuration, determined the optimal turbulence model to use for the flow and vortex dynamics, and tested various configurations for optimal vortex stability and oil separation.

"The REU grant was an invaluable opportunity for me where I was introduced to the world of CFD used in industry and academia. It provided me with knowledge of flow modeling, which is rare at an undergraduate level, and allowed for the comparison of my results with experimental results obtained in Dr. Kolla's multiphase flow lab. This work will benefit my home state of Oklahoma and others by creating sustainable produced water solutions. I would like to thank OK NSF EPSCoR for supporting my summer research, and I look forward to continuing this research after my undergraduate studies," Oakes said.

Sean Smart, a senior at OSU, together with his research advisor Dr. Hong Je Cho both from the School of Chemical Engineering, successfully investigated carbon formation from the pyrolysis of spent coffee ground (SCG) with metal chlorides such as $FeCl_3$ and studied nitrate adsorption capability of the carbon. Mr. Smart demonstrated that spent coffee ground (SCG) derived carbon adsorbents show potential in the removal of nitrates from water.

"Our study reveals that SCG-derived carbon prepared with 50 wt% FeCl3 exhibits a higher removal of nitrate than 33 wt% and 67 wt% FeCl3, which is probably caused by a larger number of iron species on the carbon that facilitates greater accessibility on carbon with 50 wt% FeCl3 for nitrate adsorption," Smart said.

"Additional investigation is needed to fully confirm and understand the basis of our findings. Overall, the results obtained from this project hold great promise for the utilization of SCG-derived carbon as an effective means for eliminating aqueous nitrates. However, further research and exploration are required to fully understand the underlying mechanisms and to validate our findings," Cho said.

"The REU program was very helpful, as it provided me with the excellent opportunity to observe the methods employed at a research facility. I also gained hands-on experience in coming up with and executing my own experiments based on observations in the laboratory. With my goal of graduating with a chemical engineering degree and entering the industry, I am very pleased to have worked in an environment that fosters the development of my critical thinking skills and allows me to put my observations and goals to the test, ensuring the attainment of the best possible outcomes. The ability to adapt when things do not go as expected, and the experience of observing, quantifying, and modifying systems to yield improved results, are also invaluable to my experience this summer," Smart said.

Funding for the REU projects was provided by the National Science Foundation under Grant No. OIA-1946093 through OK NSF EPSCoR.