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College of Engineering News

Georgia Southern University

NSF Awards $200K ERI Grant to Dr. Prakash Bhoi

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The National Science Foundation has just announced its award of an Engineering Research Initiation (ERI) grant to Prakashbhai Bhoi, assistant professor of Mechanical Engineering, who will serve as PI of the $199,998, two-year grant. Dr. Bhoi's project is entitled: *"Elucidating co-gasification of biochar and waste mixed plastics to produce low-cost, net-zero carbon, hydrogen-enriched syngas for polygeneration systems."*

To achieve net-zero emissions goal by 2050, the United States is prioritizing decarbonization of the transportation, aviation, and energy-generation sectors. Hydrogen fuel holds great promise as a clean alternative to fossil fuels. However, hydrogen is now produced primarily through steam methane reforming (SRM) and coal-gasification processes that both emit significant CO_2, exacerbating climate change. This Engineering Research Initiative (ERI) project is designed to address two major environmental threats simultaneously: eliminating CO_2 from clean hydrogen fuel production pathway while reducing the amount of waste mixed plastics now dumped in landfills and the ocean. Specifically, this project will develop methods to produce carbon-neutral or -negative, hydrogen-enriched syngas. Successful results will contribute to national health, prosperity, and welfare by advancing clean energy technology and to national security by moving toward energy independence. The project will also provide hands-on training in experimental and modeling approaches to graduate and undergraduate students, who will learn to work and communicate effectively in diverse teams. Their research engagement will prepare them for further education and careers as leaders of the 21st-century clean-energy workforce.

The project will produce clean, hydrogen-enriched syngas through the co-gasification of biochar with waste mixed plastics. The specific objectives are: 1) to modify a fixed-bed reactor to generate fundamental data on hydrogen-rich syngas production using catalytic steam co-gasification of biochar and mixed waste plastics; 2) to identify the optimal catalyst-to-feedstock and steam-to-feedstock ratios to improve hydrogen content in syngas; 3) to determine the effects of temperature and feed composition on syngas yield and composition, cold and hot gas efficiencies, tar content, and carbon-conversion efficiency; and 4) to develop numerical models to predict and optimize syngas composition from co-gasification of biochar and mixed waste plastics. A laboratory-scale, fixed-bed, batch-gasification system will be used to accomplish the objectives. Numerical models will be developed using commercially available finite-element analysis (FEA) software. Research outcomes have potential applications in carbon-neutral or -negative polygeneration processes, such as power generation, and commercial products, such as jet fuels, methanol, olefins, and plastics.

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