Master's Thesis Defense Announcement
Mechanical and Aerospace Engineering Department
University of Texas at Arlington

GRAPHENE REINFOCED POLYMER COMPOSITE FOR SMALL-SCALE VERTICAL AXIS WIND TURBINE ROTORS

By: **KUNAL ANANT BACHIM**

Thesis Advisor: Dr. Michael Bozlar

2:00 PM, Tuesday, May 7th, 2024

Woolf Hall 413

Abstract

Polymers have evolved as an indispensable asset in various sectors ranging from packaging and construction to energy and aerospace. However, the accumulation of polymer waste poses a necessity to shift toward sustainable waste management processes. Mechanical recycling is a primary method in establishing a circular economy approach for polymers. However, a fundamental challenge arises in this process: a decrease in the mechanical performance of the recycled product compared to that of its pristine counterpart.

This project addresses the challenge of enhancing the recyclability of polyethylene terephthalate (PET) from discarded polymer material by incorporating graphene nanoparticles into the polymer matrix during the recycling stage. This elevates its mechanical performance and extends polymer material's recyclability. The discarded polymer was processed, reinforced with graphene oxide, and extruded into filaments using a twin-screw extruder. Several recycling iterations were conducted, and the changes in the mechanical characteristics of the reinforced polymers were assessed.

The novel material is then inspected for its viability as a robust material for small-scale rotor turbine blades. Wind climate of a remote region in Sudan was assessed for its potential for harnessing wind energy by designing and analyzing a sustainable, small scale, vertical-axis wind turbine rotor. The rotor undergoes modeling, aerodynamic simulation, and structural analysis to evaluate its performance under the loading conditions generated by average and peak wind speeds in the remote region of Sudan.