Investigating the Effects of Carbon-Based Nanomaterials on the Combustion Properties of Multicomponent Fuel Droplets

Lodh, Anjali (School: West High School)

Modern diesel engines exhibit a maximum fuel efficiency of only 50%, primarily due to inefficient combustion processes resulting in unburned hydrocarbons and. This experiment aimed to minimize this inefficiency by implementing the use of nanoparticles in base fuels to create a hybrid nanofuel. Past studies have demonstrated the efficacy of various nanomaterials in improving the thermal conductivity and combustion characteristics of fuels. This project specifically investigated the impact of nanocellulose (NC) particles as an additive on soy-based biodiesel, a relatively new and sustainable fuel source. The selection of NC represents a novel approach, as its effects on fuels have not been explored by other researchers. NC also offers advantages such as non-toxicity, affordability, and renewable sourcing from plants, making it an ideal nanomaterial. Experimental procedures involved analysis of nanofuel droplets using high-speed imaging, quantifying parameters such as droplet diameter at various combustion stages to elucidate combustion characteristics. Results revealed major improvements in combustion rate, with a 10% increase observed at 2% NC concentration. Moreover, a 14.05% reduction in total combustion time is achieved at 3% NC concentration, indicating enhanced combustion efficiency. Faster combustion rates lead to improved fuel economy, enabling longer distances per unit of fuel consumed and therefore minimizing costs. Additionally, the use of NC contributes to reduced emissions and particulate matter, thereby addressing environmental concerns associated with diesel engine operation. This research carries significant practical implications, as these outcomes can lead to diverse applications of the developed nanofuel in diesel-powered vehicles and equipment.