SCHOLARLY PUBLICATIONS
School of Mechanical Engineering
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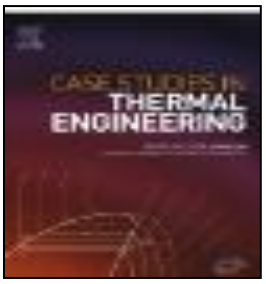
Journal Name: Case Studies in Thermal Engineering **IF: 6.4**

Title: Lanthanum oxide-enhanced botryococcus braunii biodiesel: A sustainable fuel for diesel engines

Author: Nayak, SK; Subbiah, G; Duraisamy, SK; Teja, NB; Yuvarajan, D

Details: Volume 73, September 2025

Abstract: The growing reliance on fossil fuels in diesel engines has led to serious environmental and energy sustainability concerns, necessitating the exploration of renewable biofuels. This study investigates the potential of Botryococcus braunii oil methyl ester (BBOME) as a biodiesel alternative and evaluates the influence of lanthanum oxide (La2O3) nanoparticles as a performanceenhancing additive. The novelty of this work lies in the integration of La2O3 nanoparticles into BBOME biodiesel to improve engine performance, combustion characteristics, and emission reduction, which remains an underexplored area in biofuel research. BBOME was synthesized via transesterification, and two concentrations of La2O3 nanoparticles (100 ppm and 200 ppm) were blended into a 30 % BBOME-diesel mix (BBOME_30). Performance, combustion, and emission characteristics were assessed using a single-cylinder, four-stroke, direct-injection diesel engine at 1500 rpm, a compression ratio of 17.5:1, and an injection timing of 21 degrees bTDC. The results demonstrated that the addition of 200 ppm La2O3 (BBOME_30+La2O3_200) enhanced brake thermal efficiency (BTE) by 6.5 %, while brake-specific fuel consumption (BSFC) was reduced, indicating improved fuel utilization. Emissions of carbon monoxide (CO), unburnt hydrocarbons (UBHC), and smoke opacity decreased by 12 %, 15 %, and 18 %, respectively. These findings establish that La2O3 nanoparticle-enhanced BBOME biodiesel offers a sustainable, highperformance alternative to conventional diesel, contributing to cleaner fuel technology. The study aligns with the United Nations Sustainable Development Goals (SDGs 7, 12, and 13) by promoting clean energy, responsible fuel consumption, and reduced environmental impact. The results indicate that La2O3-doped biodiesel could be a viable solution for improving diesel engine performance in transportation and industrial applications, thereby supporting global sustainability efforts.



URL: https://www.sciencedirect.com/science/article/pii/S2214157X25008548?via%3Dihub

SCHOLARLY PUBLICATIONS
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Journal Name: Scientific Reports **IF: 3.9**

Title: Implementing a novel TOPSIS-sine cosine algorithm-based hybrid optimization in machining medium-hardened steel

Author: Kumar R.; Rafighi M.; Ä°ynen O.; Reddy M.P.K.; Zade S.; Ã–zdemir M.; Pandey A.; Singh R.

Details: July 2025

Abstract: Machining medium-hardened steel is particularly challenging because of its high strength and wear resistance, which generate excessive cutting temperatures. The elevated temperature contributes to rapid tool wear and negatively impacts surface quality. Optimizing tool selection, coating composition, geometry, and process variables is crucial for enhancing machinability. This study applied a novel hybrid TOPSIS-sine cosine algorithm to evaluate the performance of three chemical vapor deposited (CVD)-coated carbide cutting inserts in turning medium-hard AISI 4340 grade steel, considering the depth of cut (a), cutting speed (V), feed (f) and workpiece hardness as input variables. Experimentally obtained machining responses, namely resultant force (Fr), power consumption (Pc), surface roughness (Ra), and sound level (SL), were analyzed and compared to determine the optimum insert type. Insert type-3 (TiCN-Al2O3-TiN) demonstrated superior performance, achieving a 16.68% and 26.74% lower Ra than insert type-1 and type-2, respectively. Moreover, the optimal parameters for the most favorable insert (type-3) are determined as H = 30 HRC, V = 190 m/min, f = 0.1 mm/rev, and a = 0.2 mm. Workpiece hardness (H) emerged as the most influential factor affecting machining outcomes. This research recommended insert type-3 at optimized cutting conditions to improve machinability and sustainability in turning medium-hard AISI 4340 grade steel.

URL: https://www.nature.com/articles/s41598-025-07542-0

SCHOLARLY PUBLICATIONS
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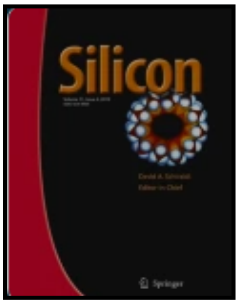
Journal Name: Silicon **IF: 3.3**

Title: Effect of SiC Nanoparticles on the Microstructural and Physico-Mechanical Properties of Agro-Bio-Wastes (RHA-ESA) Reinforced T6 Heat Treated Al Hybrid Nanocomposite

Author: Deb, D; Mishra, PC; Singh, S

Details: June 2025

Abstract: This study investigates the development of environmentally friendly aluminum hybrid nanocomposites by reinforcing Al 7075 alloy with rice husk ash (RHA), eggshell ash (ESA), and varying amounts of silicon carbide (SiC) nanoparticles. The goal is to evaluate the effects of SiC concentration on the composites' physical, mechanical, and microstructural properties, emphasizing the use of agricultural waste for sustainable innovation. The base matrix, Al 7075, was reinforced with 3.75 wt. % RHA and 1.25 wt. % ESA (75-100 microns), along with 0.5 to 2.5 wt. % of < 80 nm SiC nanoparticles. Fabrication involved ultrasonic cavitation-assisted stir casting, followed by squeeze casting. Mechanical testing covered hardness, tensile and yield strength, toughness, compressive and flexural strength. Microstructural evaluation employed optical microscopy, FESEM, EDAX, and XRD, while fracture analysis identified failure mechanisms. Results showed significant performance improvements with up to 2.5 wt. % SiC: hardness increased by 40%, tensile strength from 277 to 493 MPa, and toughness from 23 MJ/m3 to 48 MJ/m3. Improved particle dispersion, interfacial bonding, and grain refinement were observed, though porosity slightly increased at higher SiC content. Phase analysis confirmed the presence of Al, SiO2, SiC, CaO, MgZn2, and Mg2Si. Fracture surfaces showed both ductile and brittle modes. The study demonstrates that using agro-waste with SiC nanoparticles can yield sustainable, high-performance aluminum composites.



URL: https://link.springer.com/article/10.1007/s12633-025-03366-9