SCHOLARLY PUBLICATIONS
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Journal Name: Reviews in Environmental Science and Biotechnology **IF: 10.6**

Title: Emerging approaches on biomass and water-based hydrogen production and downstream recovery pathways: a review on recent challenges and prospects

Author: Kumar, R.; Chakraborty, P.; Singh, P.K.; Chakrabortty, S.; Tripathy, S.K.; Dattatraya Saratale, G.D.; Kumar, M.; Ghosh, A.K.; Jeon, B.-H.

Details: 29 September 2025

Abstract: Transitioning towards a low-carbon society can be accelerated by producing clean hydrogen fuels from sustainable resources, such as biomass and water, thereby offering a sustainable energy source that effectively reduces greenhouse gas emissions. This review provides a comprehensive analysis of hydrogen production technologies, including fossil fuel-based processes (e.g., thermochemical conversions and steam methane r eforming), electrolysis-based routes (alkaline, polymer electrolyte membrane, and solid oxide water), and biological methods (dark fermentation, photofermentation, and biophotolysis), along with emerging photocatalytic and photochemical systems. For each pathway, we critically assess its technological maturity, deployment status, and potential to enhance the share of clean energy in the global renewable energy supply chain. The manuscript also highlights research gaps, prospects, and challenges for numerous upstream hydrogen generation from both biological and non-biological sources, with a specific focus on enhancing efficiency, reducing costs, and improving environmental performance. Photochemical, electrochemical, and photocatalytic hydrogen generation systems utilizing biomass and water as feedstocks have garnered significant attention.

URL: https://link.springer.com/article/10.1007/s11157-025-09748-0

SCHOLARLY PUBLICATIONS
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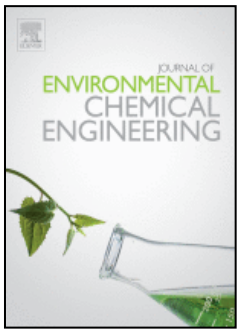
Journal Name: Journal of Environmental Chemical Engineering **IF: 7.2**

Title: AI-driven optimization of the heterogeneous Sono-Fenton process for intensification of bacterial inactivation

Author: Pranjal; G.C., Mahapatra, Gobinda Chandra; A., Panda, Anurag; S., Chakrabortty, Sankha; S., Banerjee, Shirsendu; A., Mishra, Amrita; R.P., Kumar, R. Praveen; B., Jeon, Byong-hun; C., StÃ¥lsby-Lundborg, Cecilia; S.K., Tripathy, Suraj Kumar

Details: Volume 13, Issue 5, October 2025

Abstract: Inactivation of persistent and resistant bacterial species is key to future water treatment technologies and sustainable public health. Standalone unit operations although have been implemented for several decades, are falling short to tackle the issues related to antibiotic resistance and other associated challenges. In this regard, a systematic study is illustrated to assess the intensification in the inactivation of antibiotic-resistant *Acinetobacter baumannii* via novel heterogenous Sono-Fenton process (H-SF). Inactivation via H-SF process was accomplished in 120 min with and above the catalyst dose (Fe_3O_4) of 100 mg L^{-1} due to the ability of the Fe_3O_4 nanoparticles to exhibit peroxidase like activity to decompose H_2O_2 by providing active iron sites. The H-SF inactivation process was found to be effective over a wide-ranging pH (4, 6.5 and 9). No reactivation of the bacterial cell until 96 h indicates the irreversible desolation of the bacterial cell membrane and associated intracellular components. In the H-SF process, H_2O_2 and •OH were experimentally shown to be significant for the inactivation of the bacteria and corroborated from the electron microscopy images. To integrate the effect of Fenton reagents and ultrasound, Response Surface Methodology–Central Composite Design and Gaussian Process Regression were employed. Additionally, the software HSFIN.VB was developed to facilitate process control through a graphical interface. The efficiency of the H-SF process was further authenticated with real water samples and its potential for the future applications was suggested by investigating the reusability of the catalyst which further lessen the risk of sludge formation.



URL: https://www.sciencedirect.com/science/article/abs/pii/S2213343725034803?via%3Dihub

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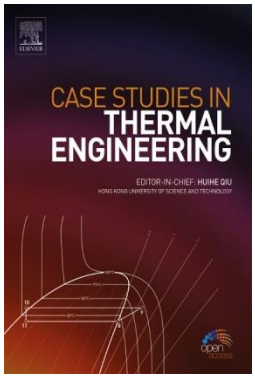
Journal Name: Case Studies in Thermal Engineering **IF: 6.4**

Title: Combining Babool wood-derived producer gas and hydrogen with biodiesel as efficient strategies for dual-fuel diesel engine in advancing sustainable energy

Author: Huynh, DNL; Hoang, AT; Nayak, SK; Guerrero-Perez, MO; Rodriguez-Castellón, E; López-Escalante, MC; Sanduleac, M; Efremov, C; Bui, VG; Luu, VC; Nguyen, XP; Cao, DN

Details: Volume 75, November 2025

Abstract: The present investigation aims to provide a comparative assessment of using hydrogen-enriched wood waste-derived producer gas (PG) for a dual-fuel diesel engine fueled with a 20 % Jatropha biodiesel/80 % diesel b lend (BD20) with the traditional mode. The experiments were conducted at 23°bTDC of injection timing, 240 bar of injection pressure, 17.5:1 of compression ratio, and 1500 rpm of engine speed under various engine loads. Gas carburetor induction (GCI), port injection (PI), and inlet manifold injection (IMI) methods were used to supply H_2-enriched PG, while B20 is directly injected into the combustion chamber. Among all the combinations, the IMI method provided the highest brake thermal efficiency of 30.91 %, the lowest CO emission of 0.08 % and smoke opacity discharge of 49.26 HSU, while NOx emission reached 1744.32 ppm, which was lower than that of the PI mode. Furthermore, the IMI method recorded the highest heat release rate of 91.17 J/°CA, and peak cylinder pressure of 83.29 bar, reflecting superior combustion quality. Finally, using the IMI method for H_2-enriched PG in dual-fuel diesel engines could improve combustion efficiency, reduce greenhouse gas emissions, and improve fuel economy, showing that the combination of BD20 with H_2-enriched PG offers a cleaner, more sustainable, and economically viable technology.



URL: https://www.sciencedirect.com/science/article/pii/S2214157X25013577

SCHOLARLY PUBLICATIONS
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Journal Name: ACS Applied Engineering Materials **IF: 3.5**

Title: ZnO-Functionalized Carbon Dots/Poly(methyl methacrylate)-Grafted Natural Rubber Nanocomposites as an Efficient Absorbent for Industrial Dye Removal

Author: Nayak, SS; Padhan, S; Gartia, J; Mishra, S; Kotnees, DK; Panigrahi, H

Details: October 16, 2025

Abstract: This study presents the fabrication of a multifunctional nanocomposite by incorporating zinc-functionalized carbon dots (Zn-f-CDs) into poly(methyl methacrylate)-grafted natural rubber (PMMA-*g*-NR) via solution mixing and solvent casting. Zn-f-CDs were synthesized hydrothermally using varying ZnO concentrations, with Zn-f-CDs-5 selected based on their optimal fluorescence, colloidal stability, and surface functionality. Morphological and elemental analyses using FESEM and EDAX validated the structural integrity and composition of the functionalized carbon dots. Incorporating 4 phr Zn-f-CDs-5 into PMMA-*g*-NR significantly enhanced mechanical performance, increasing tensile stress by 87% and improving storage modulus due to strong interfacial interactions between Zn-f-CDs and the polymer chains. The glass transition temperature (T_g) also shifted from −58 to −54 °C, indicating restricted polymer chain mobility. Thermal analysis revealed improved stability with an increase in initial and maximum degradation temperatures and higher char yield at 700 °C. High-resolution transmission electron microscopy confirmed uniform dispersion of Zn-f-CDs-5 within the PMMA-*g*-NR matrix. Beyond mechanical, dynamic mechanical, and thermal improvements, the nanocomposite demonstrated excellent dye absorption properties, achieving up to 82% removal of Rhodamine B (RhB) under dark conditions within 72 h. This performance is attributed to the high surface area and functional group density of Zn-f-CDs within the PMMA-*g*-NR matrix. Overall, the PMMA-*g*-NR+Zn-f-CDs nanocomposite exhibits a synergistic enhancement in structural and environmental performance, making it a promising candidate for advanced applications in wastewater treatment and sustainable functional materials.

URL: https://pubs.acs.org/doi/full/10.1021/acsaenm.5c00582