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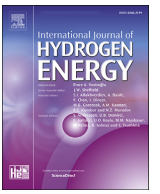

Catalytic dehydrogenation of formic acid-triethanolamine mixture using copper nanoparticles

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HIGHLIGHTS

- Hydrogen was produced from formic acid using triethanolamine and copper nanoparticles.
- Copper concentration, pH, size and reaction time influenced hydrogen production.
- 1 M copper-catalysts had the best performance with reusability of 20 cycles in 120 h.
- Kinetics of the reaction shows that the reaction is first order.
- The estimated conversion is 82.2% accurate.

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ABSTRACT

In a bid to complement the lost reserves from fossils, recent advances in research are tailored towards producing hydrogen as an alternative source of fuel which is aimed at fostering a globally sustainable and reliable energy-economy. In this work, hydrogen was produced from formic acid (FA) using a new technology that involves the use of copper nanoparticles (CuNPs) supported on triethanolamine. The CuNP-catalysts of variant concentrations (i.e. 0.6–1.2 M) were synthesized using the conventional chemical deposition method. Also, a novel approach that bothers on the application of the Differential Method of Analysis (DMA) was used in determining the kinetic parameters for the FA-dehydrogenation. Based on the results, the volume of H_2 produced varied with time, pH, concentration and catalyst-size. At 6 h, the 1 M CuNPs gave the highest volume (815 mL) of hydrogen with corresponding pH, particle size and approximate conversion of 3.19, 1.5 nm and 100% respectively, whereas, over extended periods i.e. over 6 h, the approximate volume-conversions of FA increased insignificantly for all catalysts. According to the investigation, the optimum CuNP-catalyst concentration required to produce 815 mL H_2 in 6 h is 1 M. The decomposition was a first-order-type with a rate constant (k-value) of 1.0041 s^{-1}.

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