









Deep-learning optimization and environmental assessment of nanomaterial's boosted hydrogen and power generation system combined with SOFC

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<https://doi.org/10.1016/j.ijhydene.2022.11.332>

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Abstract

Renewable energy sources are unquestionably required, given that the world's energy consumption is anticipated to increase significantly in the next decades. Besides, fuel cell converts chemical energy directly into electricity, making it the most efficient and environmentally friendly power source. This study examines the viability of producing electricity using a supercritical CO₂ cycle, a methane digester, and a gas turbine. Applying the principles of exergetic balance, mass, energy conservation, and component-specific exergetic balance to each part of the power unit allow for a simulation of the power unit's efficiency. Furthermore, a parametric analysis is performed to establish how the relevant factors will affect the unit's functioning. The optimization algorithms are generated with the help of deep learning methods. It was found that the ratio of the compressor's pressure to the current density was the most crucial element in determining output power. Nanoparticles are used in fuel cells to enhance heat transfer and, thus, the generated power. Through optimization, one might find a product that is both the most cost-effective and energy-efficient option available. Artificial neural networks may be used as a mediator to help expedite the process of reaching optimum performance across several criteria. The optimal settings for the planned power plant are now being determined by studying the correlation between design factors and objective functions. Therefore, the second law's efficiency at its sweet spot was calculated at 61.8%. In the end, the system at its optimum point was found to have an exergo-environmental index of 0.436.