Resource Recovery from Produced Water by Sequential Dark–Photo Fermentation for Biohydrogen Generation

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Abstract

Produced water is the petroleum industry's largest waste stream worldwide. The environmental concern about the growing amount of PW from oil and gas activities relates to contamination of soil, groundwater, and surface water. Inappropriate discharge of PW could cause significant pollution of terrestrial and aquatic ecosystems. The recent energy crisis worldwide is due to the high rate of industrialization, population explosion, and too much reliance on fossil fuels. This issue has highlighted energy security, environmental pollution, and climate change. Therefore, there is a need to explore sustainable, clean alternatives. Bio-hydrogen is one of many renewable alternatives identified as promising green fuels due to their high energy potential and zero-carbon emissions. The study aims to produce biohydrogen from produced water via sequential dark photofermentation and to analyze the process parameters using an Artificial Neural Network (ANN). The process involves the collection and characterization of produced water, procurement of seed sludge, reactor design for a sequential dark-photo fermentation process, batch experiments, ANN modelling, and comparison of real-time and ANN-predicted values. The expected results, after reviewing the literature and a proof-of-concept experiment, showed excellent outcomes, with a correlation coefficient (R^2) of 96.07 % and a Mean Squared Error (MSE) of 0.02562. The H_2 yield is expected to be 224.74 mL H2/g CODeq . Bio-hydrogen production from the produced water through dark/photo fermentation is of great interest for sustainable waste valorization. It has the potential to shape the 'Green Hydrogen' economy in the industrial sector by providing an environmentally friendly, energy-efficient, and data-driven approach for its production.