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Fitting regression model and experimental validation for a high pressure PEM electrolyzer

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Abstract. Hydrogen production is the main obstacle today to develop a real future hydrogen economy. Research has focused many efforts in extracting it from clean and renewable sources. Different processes are analysed: photolysis, thermochemical cycles, algae, etc; these processes are still far from practical use. Electrolysis has represented the most studied and experimented area for obtaining hydrogen without employing fuel cracking. Nevertheless, for its practical storage, the hydrogen produced at low pressure needs to be mechanically compressed, with a high consumption of electric power. Advanced materials and improved design allow to obtain hydrogen from electrolysis directly at medium-high pressure (70 bar) with no need of mechanical compression stages. This single-step process is more efficient than the two-step electrolysis + mechanical compression process. In this paper the authors display the experimental results obtained with a prototype of high pressure PEM electrolyzer manufactured by Giner Electrochemical Systems LLC, including the description of the test bench for the experimental characterization. The experimental design, based on Design of Experiments techniques, studied the effect of the main operation factors (temperature, pressure, water flow) at different levels of power load, presenting a regression model of the electrolyzer voltage as a function of the operating factors, at different values of the electric load.

Keywords

hydrogen production, PEM electrolyzer, high pressure electrolysis, design of experiments

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