COMPUTATIONAL SIMULATION OF THE COMBUSTION OF GREEN HYDROGEN – HYDROCARBONS MIXTURES FOR ENERGY PERFORMANCE AND CARBON DIOXIDE EMISSIONS

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ABSTRACT

Bolivia, like other developing countries, faces the challenge of reducing its dependence on fossil fuels and moving toward a cleaner energy matrix. In this context, green hydrogen emerges as a viable alternative, although its implementation still requires local research. Countries such as Chile have already taken significant steps through policies like the National Green Hydrogen Strategy, which promotes its use in various applications, including combustion. This work aligns with that line of development by presenting the computational modeling of the combustion of green hydrogen blended with four selected hydrocarbons: methane, liquefied petroleum gas (LPG), octane, and ethanol. For this purpose, a Python code was developed to estimate the physicochemical properties across the entire range of mixtures, which are then integrated into thermodynamic simulations performed in OpenModelica using the ThermoSysPro library. Subsequently, the results are processed using another Python code, enabling the analysis of mass fractions of combustion products under stoichiometric conditions with a 10% excess of air, the degree of decarbonization as a function of hydrogen mass fraction and flow rate, the energy generated with and without accounting for thermal losses, the higher and lower heating values (HHV and LHV), and the Wobbe index in the cases of methane and LPG. The results show that decarbonization depends directly on the carbon content of the base hydrocarbon, and that the addition of hydrogen increases the energy generated per unit mass, reinforcing its potential as an energy vector in the transition toward more sustainable systems.

Keywords: Green hydrogen, Combustion, Energy performance, Carbon dioxide emissions

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