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Tesis

Automation of Hydrogen Production and Automatic Filling Control

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Automation of Hydrogen Production and Automatic Filling Control

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***Abstract*— According to the Ministry of Energy and Mines (MINEM) in the period 2021 the energy production was 57371 GWh, this consumption can be covered with hydrogen green energy being a clean and environmentally friendly energy vector. This work develops the automation of hydrogen production and automatic filling control. For the simulation and design of the hydrogen plant, FlexSim and Value Stream Mapping were used to improve the production processes, while for the hydrogen balloon filling and transport stage, Factory IO and TIA PORTAL software were used to obtain a filling control, which is optimal for this process. . Finally with the first simulation a total cycle of 28710 was obtained with a tak time of 137.38 seconds / hydrogen cylinder, so in the hydrogen production that the simulation was carried out, 28 units of hydrogen were obtained in 12 minutes with 3 seconds, which is equivalent to 4 hydrogen cylinders produced.**

Keywords—Filling control, Automated, Plant design, Hydrolysis, Hydrogen.

I. INTRODUCTION

According to the Ministry of Energy and Mines (MINEM) in 2021 the total energy production was 57371 gigawatt hours (GWh) increasing by 8.8% over the previous year, but such energy consumption is not environmentally friendly [1]. That is why countries like Iran started to produce hydrogen as it is a clean and environmentally friendly energy vector, which has different applications such as heat, mobility and contributes to the mining industry, thus contributing to the green hydrogen economy in Peru with a production capacity of 850 MW and a cost of approximately 5.23 USD/Kg H2 [2-3].

Green energy is sustainable and pollution-free and is the future according to the China Petroleum Economic and Technological Research Institute because of the use of offshore wind energy for the production of hydrogen through equipment that uses the hydraulic electrolysis process, thus making it easier to store it for use in chemical industries, transportation, and industrial thermal processing [4].

Sustainable energies such as hydrogen is an alternative to traditional energies such as natural gas, oil, coal, since hydrogen is a gas with a lower density of 0.0899 g/L obtained through the electrolysis process, resulting in a pure hydrogen having a ratio of 1/14 of air quality. The use of hydrogen as an energy fuel does not produce air pollutants and generates carbon-free emissions [5-6].

Hydrogen consumption is increasing by 6% per year and has a production of 55 million tons. Fifty percent of the world's hydrogen demand is obtained through reforming with natural gas steam, which ends up emitting a massive amount of greenhouse gases, while 30% is through industrial gases from oil/naphtha reforming coming from refining and 18% from coal gasification, 3.9% through the water electrolysis process, which has a high production efficiency, but is an energy intensive process [7-8].

Dry reforming of natural gas is an alternative to produce hydrogen that allows CO2 reduction through thermal and kinetic models simulated in ASPEN PLUS with a prediction of 95% conversion in the dynamic model when exposed to a temperature of 900 degrees Celsius and 1 bar while the kinetic model predicted only a 36% conversion in the same situation [9].

Photovoltaic systems are applied for load adjustment to produce green hydrogen through resistive loads which demonstrated a high performance for electrolytic applications having an energy transfer higher than 99 % in dynamic conditions of the system through SIMULINK achieving optimized hydrogen cells per stack [10].

Technological progress has allowed the use of aqueous electrolysis that are powered by wind and solar energy to reduce electricity consumption and facilitate the production of green hydrogen for which a coordinated control is developed to suppress the high current fluctuations that are generated due to wind and solar outputs through the predictive control of the