ABSTRACT

INVESTIGATION OF HYDROGEN GAS PRODUCTION IN ALKALINE WATER ELECTROLYSIS BY APPLYING MASS TRANSFER THEORY

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Doctoral Thesis
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July 2018, 104 pages

Energy is one of the most important necessities in the social and economic development of human and in meeting basic inputs. It is known that the increase in energy demand with the rising momentum is the most advanced hydrogen energy system that can provide environmentally friendly and sustainable. Hydrogen energy has taken its place as one of the most important alternative energy sources in the coming years due to its characteristics, potential and usage areas. The development of clean, sustainable and cost-effective hydrogen production processes is the key to the future hydrogen economy. All theoretical analyzes of hydrogen gas producing applications by water alkaline electrolysis ($2H_2O \rightarrow 2H_2 + O_2$) have been carried out from a perspective of classical physics. It is known that energy efficiency is an important key point in all future work. Therefore, the interdisciplinary structure of the different dimensions of electrolysis in the thesis is important. In the literature, the alkali electrolysis decomposition voltage is 1,227 V. In this thesis study, the potential voltage required for decomposing hydroxyl ion (OH^-) from hydrogen atom (H^+) by performing water molecule and hydrogen atom modeling is calculated to be lower than the decomposition voltage in the literature by using quantum tunneling method. In the studies, the positive effect of the wave motion, which is realized by the molecular particles, on the separation from the motion orbit is evaluated. This work reevaluated the concept of alkaline electrolysis from the point of view of modern physics and quantum physics. Particularly, approaches that are presented about energy efficiency are important. It has adapted the new concepts that the quantum physics has gained to the scientific world to energy efficiency and has given a different perspective to the literature. This thesis analyzes and proposes new systems to be produced today and tomorrow with regard to electrolysis by means of analytical and numerical methods which shed light on the design of new electrolysis reactors.

Keywords: Alkaline electrolysis, Energy, Hydrogen, Two phase flow, Quantum tunneling.