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Professor Sanggyu Kang's research team finds the optimum temperature for improving the operation of alkaline water electrolysis system

- GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) School of Mechanical Engineering Professor Sanggyu Kang's research team developed a numerical analysis model that can predict and analyze the effect of temperature on the operating performance of an alkaline water electrolysis* system for green hydrogen production.

  * alkaline water electrolysis: A technology that electrolyzes water in a basic environment that uses an aqueous KOH or NaOH solution as an electrolyte. Among the representative water electrolysis technologies, it has been studied for the longest time and is the most complete technology.

- In the inevitable event of surplus power generation from renewable energy, which is expanding to reduce greenhouse gas emissions, it can contribute to energy storage, transport, and utilization by linking water electrolysis technology. Among them, alkaline water electrolysis technology has the advantage of being able to build large-scale facilities with high technological perfection and low cost. However, the commercialization of the technology is being delayed due to the high production cost of green hydrogen* compared to the existing gray hydrogen** or blue hydrogen***.

* green hydrogen: hydrogen produced by electrolysis of water with renewable energy without emitting greenhouse gases during the process

** gray hydrogen: natural gas modified hydrogen and derivative hydrogen generated from petrochemical processes accompanied by carbon dioxide emissions during the production process

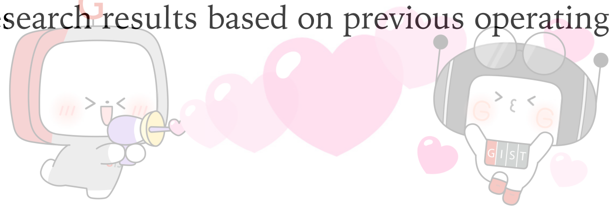
*** blue hydrogen: it is extracted from fossil fuels like gray hydrogen but captures and stores the carbon dioxide that is generated and emits much less carbon during the production process

- ◦ To reduce production costs by improving water electrolysis operation efficiency, research on materials such as electrodes and catalyst materials is being actively conducted. Research on optimizing system operating conditions is lacking, and even that is focused on experimental-based research.

□ The research team developed an alkaline water electrolysis stack (core component) model based on numerical analysis to understand the change in the operating performance of the stack according to the operating temperature, and the BOP device (core operating device, Balance of Plants) were analyzed comprehensively to derive operating temperature conditions with optimal hydrogen production efficiency.

- ◦ Through this, it was confirmed that the system efficiency under the current density of 0.4A/cm² when operating at 80℃ at atmospheric pressure was lower than that of the 70℃ condition. This can be attributed to an increase in the BOP power consumption (heater) for system temperature control because the latent heat of evaporation due to the generation of saturated water vapor increases in high-temperature operation and the stack heat generation due to overvoltage at low current density is not sufficient.

□ Professor Sanggyu Kang said, "This study is most significant in that it confirmed the possibility of improving the operation efficiency of the water electrolytic system for green hydrogen production. It is expected to be used for optimizing operating conditions of alkaline water electrolysis system considering comprehensive variables along with research results based on previous operating



pressure. Furthermore, we hope that it will contribute to the realization of a zero-emission society using hydrogen energy."

□ The research was led by GIST Professor Sanggyu Kang and conducted by master's student Dohyung Jang with support from the Hydrogen Energy Innovation Technology Development Program of the National Research Foundation of Korea and was published online on June 2, 2021, in the *Journal of Power Sources*, a world-renowned academic journal in the field of electrochemistry.