

INTEGRATED SYSTEMS MODELING FOR A CO₂-EMISSIONS FREE ALKALINE WATER ELECTROLYSIS CYCLE IN FLOWNEX[®] SE

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ABSTRACT

McPhy Energy Germany GmbH designs, develops, manufactures and sells technical systems and components for energy systems and auxiliaries to produce hydrogen and other technical gases. Flownex SE is used by McPhy to model the interaction of piping and process equipment together with the instrumentation and control devices within the electrolyte loops and gases.

CHALLENGE

The main loop and auxiliaries of an Alkaline water electrolysis plant is a sensitive integrate system. The plant needs to be precisely controlled as the main driving force is the chemical process of water electrolysis. Also, high-temperatures and high-pressures further enhance the process but leads to the requirements of increased optimization in the operation of the plant.

BENEFITS

Optimization of the plant that supports the chemical reaction of the water electrolysis boosts efficiency and ultimately creates a viable business model to commercialize the product.

SOLUTION

McPhy Energy Germany GmbH utilized Flownex SE as their tool of choice to optimize the alkaline water electrolysis plant. Analyses of the system behavior at critical modes, for example at a sensor failure could be done. It is envisaged that Flownex SE can be used as a design tool to ease up the product design for different customers.



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Using the Flownex scripting in conjunction with its thermo-fluid modelling capabilities made it a very valuable application for the problem at hand. In addition, Flownex has an intuitive design facilitating the modelling of large, complex systems.



MCPHY ENERGY GERMANY
M. Neben – R&D Manager

INTRODUCTION

McPhy Energy Germany GmbH designs, develops, manufactures and sells technical systems and components for energy systems and auxiliaries to produce hydrogen and other technical gases. With a long-lasting experience in the industrial hydrogen markets and more than 3.000 installed systems worldwide, McPhy is developing climate friendly and secure solutions to design CO₂-free-markets.

The alkaline water electrolysis is based on a chemical reaction of water and electrical energy, which results in a segregation of water into its components hydrogen (H₂) and oxygen (O₂). More precisely hydrogen and hydroxide anions are formed at the negative cathode. The anions are passing through the diaphragm to the positive anode to form oxygen while releasing electrons. Through exclusive use of energy from renewable energy plants, the produced hydrogen is free of CO₂-emission.



Figure 1: Sample image of McPhy Electrolyzer plant

METHODOLOGY

Flownex SE is used to model the interaction of piping and process equipment together with the instrumentation and control devices within the electrolyte loops and gases. A simplified Flownex SE network of the PID can be seen in figure 2.

Pumps, valves, heat loss to the environment, pressure loss and environmental conditions could be simulated in the network. Furthermore, with the help of the C# scripting functionality the electrochemistry within the electrolyzer-stacks could successfully be implemented. The objective of this model is to analyze the system behavior at critical modes for example at a sensor failure. In a next step the whole set of process equipment including the cooling loops will be implemented.

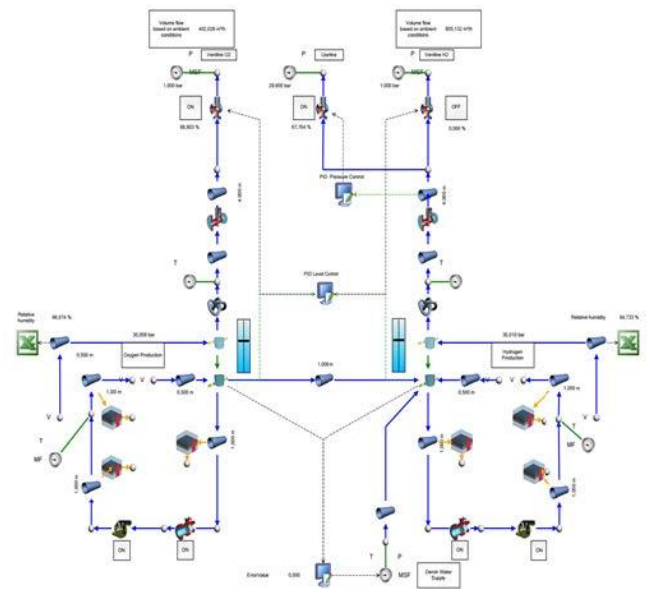


Figure 2: Flownex SE model of alkaline water electrolysis system

CONCLUSION

Critical modes of the alkaline water electrolysis plant could be extensively modelled with Flownex SE. In a next step the whole set of process equipment including the cooling loops will be implemented. Finally, Flownex SE can be used as a design tool to ease up the product design for different customers.