M.Sc. Thesis Proposal
Department of Energy Technology

TITLE
Assessment of Humidity Effects on PEM-Fuel Cell Performance

Background
Humidity content has profound effects on the operation of proton exchange membrane fuel cell (PEMFC), in particular the performance of the membrane electrode assembly (MEA). The extent of humidification is an important factor when considering the migration of hydrogen ions through the electrolyte and the cooling of the cell to enhance the performance. Limitations to the water transport are expected due to the porous structure of the fuel cell. The electrode thickness has a significant effect on the rate of mass and heat transfer and hence on the electrochemical reactions at the electrode surface. The heat produced during the cell operation could greatly increase the rate of water evaporation from the cell to the extent that it could lead to excessive dry-out of the (MEA) with a possible degradation of cell performance. Thus, proper humidity management is required to safeguard the fuel cell operation and enhance its performance. The objective of the study is to assess the effects of water and reactants flow direction on the performance of the fuel cell. The methodology includes computer modelling and numerical simulation techniques using available commercial software. The results are expected to reveal valuable information to understand the effect of humidification on the performance of membrane electrode assembly (MEA) and to help in the overall design and modelling of proton exchange fuel cells.

Thesis/Learning objectives
After the thesis has been performed the student should be able to:
- Conduct a literature review PEMFC system, operation and characteristics
- Identify major components of PEMFC and the various fluid flows within the cell
- Write simple mathematical models of the components and fluid flows.
- Use available numerical software to simulate the model and generate results.
- Discuss the obtained results and write a final report including his conclusions

Method of attack
Set up a pemfc-model and identify major inputs and outputs of the system, use of suitable computational software to simulate the system.

Preliminary proposed time schedule, including milestones and dates for intermediate reports
- Weeks 1 through 6: literature review on pemfc-systems, components and operation
  Report part 1 due at end of 6th week.
- Weeks 7 through 12: Modeling and simulation of fluid flows in pemfc system.
  Report part 2 due at end of 12th week.
- Weeks 13 Through 18: Run simulation, discuss and analyze results
- Weeks 19 Through 20: Put together final report and present the project results

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Duration: 5-6 months, Start date: Open