ANALYSIS ON COOLING PERFORMANCE OF AIR COOLING CHANNELS FOR PROTON EXCHANGE MEMBRANE FUEL CELL USING COMPUTATIONAL FLUID DYNAMICS (STANDARD, C-SHAPE, MULTI-PASS CHANNELS)

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"I declared that this thesis is the result of my own work except the ideas and summaries which i have clarified their source. The thesis has not been accepted for any degree and not concurrently submitted in candidature of any degree."

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ABSTRACT

For a Proton Exchange Membrane Fuel Cell (PEMFC) to operate efficiently, specific temperature of fuel cell must be held constant during operation at around 80°C – 130°C. One of the common ways to cool down fuel cell is by using air that will pass through the cooling channels which vary in design inside the bipolar plate (one of PEMFC component) to cool the PEMFC. The purpose of this study was to analyse the cooling performance of air cooling channels of PEMFC using CFD. Multi-pass configuration emulating heat exchanger (parallel and counter flow), C-shape and standard configuration models are the air cooling channels of interest all of which were designed and integrated into bipolar plate model using CATIA. These designs were simulated using STAR-CCM+ by varying cooling air speed from 0.5m/s to 4m/s while applying constant heat flux of 2400W/m^2 to the bipolar plate at room temperature (30°C) and pressure (1atm). The simulation then tabulated the parameters needed such as temperature of bipolar plate and cooling air and heat transferred to both aforementioned components. The cooling effectiveness was calculated by obtaining the percentage of heat absorbed by cooling air over heat accumulated by the bipolar plate. The optimum cooling channel is determined by the highest percentage of cooling effectiveness that will maintain the PEMFC temperature at a value needed for efficient operation.

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