ANALYSIS OF COOLING PERFORMANCE FOR AIR COOLING CHANNELS OF A PEM CELL USING CFD: INLET GEOMETRY DESIGN

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ABSTRACT

This study focused on designing and simulating alternative air inlet geometry of air cooling on a single channel (SSI) and multichannel (MS60) channel types for PEM fuel cell bipolar plate with a power rating of 3kW. Two air inlet geometry designs generated are nozzle type with three different angles and quarter circle type with three different radiuses. The designs were generated using CATIA software and simulation work using STAR-CCM; a CFD (Computational Fluid Dynamics) software type. The simulations were conducted to observe and determine whether these new inlet geometry designs give some improvement and better results in heat transfer rate of fuel cell compare to conventional design. The higher heat transfer rate of the fuel cell results in higher heat transfer efficiency of the fuel cell. Each design was simulated in four different velocities from 0.5 m/s to 3.0 m/s with similar boundary conditions such as laminar flow, air inlet temperature, and constant heat flux. The simulation results show that each design generates different flow field that gives higher heat transfer rate than conventional design. The simulated air inlet geometry shows 0.04% to 24.6% improvement on heat transfer rate of a bipolar plate fuel cell. The best design of air inlet geometry is 15 degree nozzle type.

TABLE OF CONTENTS

CONTENTS		PAGE