# EX-SITU INVESTIGATION OF GAS DIFFUSION LAYER AND CHANNEL WATER MANAGEMENT IN PROTON EXCHANGE MEMBRANE FUEL CELLS

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Two-phase flow of water and reactant gases in the gas distribution channels of Proton Exchange Membrane Fuel Cells (PEMFCs) plays a critical role in proper water management. In this work, an ex-situ test section is designed to represent an operating fuel cell with eight parallel cathode channels by sandwiching a gas diffusion layer (GDL) between a gas channel plate and a water channel plate. Water is supplied via four syringe pumps at desired rates while air flow rates are controlled using a bank of rotameters at correlating stoic ratios to investigate several possible operating conditions. The instantaneous air flow rate in each individual channel is measured with an array of differential pressure sensors located in the entrance region of each channel. The real time water flow structure is simultaneously recoded with a high speed video camera. The main focus of this work is to investigate the effects of GDL materials on the two-phase behavior in gas channels. Three GDL samples, a Baseline Sample, SGL-25 BC sample, and Plain Toray Paper, are studied and compared. The flow rate data and visualization are used to create flow pattern maps which are used to compare and characterize the condition of the GDL at any given instant. The results show that the Plain Toray Paper is unfavorable to PEMFC operation relative to the other samples tested.