Proton Exchange Membrane Fuel Cells (PEMFC) demonstrate great potential as power sources for a number of applications. As the technology develops and requirements become more demanding, a precise knowledge of major water transport properties including the electroosmotic drag coefficient (EODC) will become increasingly critical. Numerous techniques have been proposed and investigated to measure electroosmotic drag, including various proton pump\textsuperscript{1, 2, 3, 4}, concentration cell\textsuperscript{5, 6}, and NMR type\textsuperscript{7} experiments. Unfortunately, no consensus has yet been reached on even the qualitative behavior of electroosmotic drag, particularly at relatively low levels of humidification. Presented here are methods and preliminary results for a dead ended hydrogen pump experiment that essentially eliminates undesired water activity gradients throughout the system that have been a potential source of error in previous EODC measurements.

To measure the electroosmotic drag through a specific membrane, a 50 cm\textsuperscript{2} MEA is fabricated and loaded into single cell test hardware. Current is applied to the cell, and hydrogen is fed into the cell through a humidifier at a known dewpoint and pressure with no outlet, so there is no excess feed gas. The same humidification is maintained on the cathode of the cell by varying an applied vacuum to control relative humidity. The ratio of water molecules to protons fed to the MEA is determined by the pressure and dewpoint of the feed stream. If the feed ratio is not equal to the EODC of the MEA, there will be an unstable condition at the anode causing it to either flood or dry out. This can be observed through a rapid rise in cell voltage. If the feed rate is equal to the EODC, the hydrogen pump will operate in steady state as water and hydrogen are fed to the anode at the same rate that they are transported through the membrane.

Data showing how long the system remains stable for a measurement of EODC at 80°C and 75%RH for an MEA fabricated with platinum black electrodes and Nafion membrane is shown in Figure 1. Additional results are shown in Figure 2 along with previous measurements attained with a traditional hydrogen pump experiment.

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Figure 1. The EODC of Nafion is observed to be 0.27 molecules of water per proton at 80°C and 75% RH.

Figure 2. Electroosmotic drag at 80°C for three MEAs over a range of humidification. The Nafion and Gore MEAs were measured using a traditional hydrogen pump experiment, and the 500 \( \mu \)m Nafion MEA was measured using the dead ended technique.