146c Design and Construction of a Cathode Air Filter Using High Contacting Efficiency Microfibrous Carrier

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PEM fuel cells experience performance degradations, such as reduction in efficiency and life, as a result of airborne contaminants affecting the function of the catalytic membrane. Current research provides evidence of fuel cell performance degradation when operated in environments with contaminant concentration levels that can be found in urban environments and battlefield situations. The focus of this study is to develop a cathode air filter to minimize fuel cell performance degradation using high contacting efficiency microfibrous materials. The filter must operate with a low pressure drop, be capable of removing trace contaminants, and operate at a flow rate suitable for existing fuel cells. This study uses a NEXA fuel cell developed by Ballard Power Systems®. Presently, Ballard® does not specify any maximum contaminant concentrations for the cathode air inlet of their NEXA fuel cells; however, they do provide specifications for the anode side. Specifications for the anode (<1 ppm sulfur compounds, <1 ppm hydrocarbons, and <2 ppm carbon monoxide) are used as contaminate maximums for the cathode side. This supposition is based on the fact that both the cathode and anode of PEM fuel cells utilize platinum based catalyst. Microfibrous materials are a sinter-locked network of micron diameter fibers (1-20 microns) used to entrap small particulate (10-300 microns). The production of these media involves a high speed specialized wet-lay processes facilitating the entrapment of fine particulates in the microfibrous carrier. Microfibrous materials are suitable for trace contaminant removal applications by virtue of their high contacting efficiency (90% sorbent utilization in 4mm layer) and low pressure drop (0.45” H2O at 27 cm/s face velocity). In order to optimize fuel cell efficiency while meeting necessary requirements, this study evaluates material composition, bed depth, and microfibrous sheet surface area. Other issues discussed are the effects of various contamination levels on the breakthrough time of the filter, moisture content, regenerability, and particulate levels.