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The Effect of Air Filter Performance on Gas Turbine Operation

Authors : Iyad Al-Attar

Abstract : Air filters are widely used in gas turbines applications to ensure that the large mass (500kg/s) of clean air reach the compressor. The continuous demand of high availability and reliability has highlighted the critical role of air filter performance in providing enhanced air quality. In addition to being challenged with different environments [tropical, coastal, hot], gas turbines confront wide array of atmospheric contaminants with various concentrations and particle size distributions that would lead to performance degradation and components deterioration. Therefore, the role of air filters is of a paramount importance since fouled compressor can reduce power output and availability of the gas turbine to over 70 % throughout operation. Consequently, accurate filter performance prediction is critical tool in their selection considering their role in minimizing the economic impact of outages. In fact, actual performance of Efficient Particulate Air [EPA] filters used in gas turbine tend to deviate from the performance predicted by laboratory results. This experimental work investigates the initial pressure drop and fractional efficiency curves of full-scale pleated V-shaped EPA filters used globally in gas turbine. The investigation involved examining the effect of different operational conditions such as flow rates [500 to 5000 m3/h] and design parameters such as pleat count [28, 30, 32 and 34 pleats per 100mm]. This experimental work has highlighted the underlying reasons behind the reduction in filter permeability due to the increase of flow rates and pleat density. The reasons, which led to surface area losses of filtration media, are due to one or combination of the following effects: pleat-crowding, deflection of the entire pleated panel, pleat distortion at the corner of the pleat and/or filtration medium compression. This paper also demonstrates that the effect of increasing the flow rate has more pronounced effect on filter performance compared to pleating density. This experimental work suggests that a valid comparison of the pleat densities should be based on the effective surface area, namely, the area that participates in the filtration process, and not the total surface area the pleat density provides. Throughout this study, optimal pleat count that satisfies both initial pressure drop and efficiency requirements may not have necessarily existed.

Keywords : filter efficiency, EPA Filters, pressure drop, permeability
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