S3.4.4 EFFECT OF RELATIVE HUMIDITY ON LOADING CHARACTERISTICS OF NANO-FIBER COATED CELLULOSE FILTER MEDIA BY HYGROSCOPIC SALT PARTICLES AND COMPARISON WITH CONVENTIONAL CELLULOSE FILTER

Chenxing Pei*[1], Qisheng Ou[1], David Pui[2]

[1]University of Minnesota, [2]Department of Mechanical Engineering, University of Minnesota

In the atmosphere, abundant NH3, SOx and NOx could form ammonium sulfate and ammonium nitrate fine particles. However, in the lab condition and some test standards, sodium chloride and potassium chloride are the most common salts used in the filter loading test. The ambient relative humidity varies in a very wide range depends on the location, weather, and some other factors. However, the lab loading test seldom monitoring and controlling the relative humidities. While the hygroscopic properties of these salt differ significantly. To understand loading behavior of the air intake filter in the working condition, it is necessary to use ammonium sulfate and ammonium nitrate sub-micrometer particles as challenge particles to load it under different relative humidities.

Besides the conventional cellulose air filter, nanofiber layer coated cellulose filter are widely used to reduce the flow resistance while maintain the efficiency. The nano-fiber layer would affect the loading performance greatly, hence it is worthwhile to study the differences of the loading performance between the conventional cellulose air filter and the nano-fiber coated cellulose air filter.

In this study, a nano-fiber coated cellulose air filter was tested by loading three kind of salt particles, including potassium chloride, ammonium sulfate, and ammonium nitrate. The particles were generated by a Collison-type atomizer. To achieve the similar particle size distribution, the volume concentrations of the particles were same. The particle size distribution was monitored by a SMPS system and the distribution stay unchanged during the loading period. All nano-fiber coated filters were loaded to the same pressure drop. The volume loading results for the potassium chloride and ammonium sulfate particles were comparable. This is consistent with the conventional cellulose filter loading results. However, their volume loading at the 4 inch of water column on the nano-fiber coated cellulose air filter was more than that at 10 inch of water column on the conventional cellulose air filter. This type of nano-fiber coating could reduce the air flow resistance while hold more volume loading compare to the conventional cellulose filter. The behavior of the ammonium nitrate was also different to that on the conventional cellulose filter. The volume loading of the ammonium nitrate was less than volume loading of the other two salts, while the conventional cellulose filter could hold more ammonium nitrate than the other two salts. The loading samples were observed by the scanning electron microscopy to assist the analysis.