SP12 EFFECT OF RELATIVE HUMIDITY ON LOADING CHARACTERISTICS OF CELLULOSE FILTER MEDIA BY HYGROSCOPIC SALT PARTICLES

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Sodium chloride and potassium chloride are typical salt aerosols used in laboratory and some test standards for filter loading test. While in the atmosphere aerosols, what many air intake filters face in their application, ammonium, sulfate, and nitrate are more abundant than laboratory-generated sodium, potassium, and chloride. Different combinations of salt ions have much different hygroscopicity, with ambient ions having higher tendency to bind with free water, which is believed to affect particle morphology, surface properties, and consequently their loading behavior on filter. Considering the hygroscopic properties of these salts and the naturally large variation of relative humidity in ambient air, it is worthwhile to compare the loading performance of sodium chloride and potassium chloride particles to that of ammonium sulfate and ammonium nitrate particles under different relative humidities.

In this study, the loading characteristics of a cellulose air filter media under different relative humidities were experimentally investigated using three sub-micrometer test aerosols including potassium chloride, ammonium sulfate, and ammonium nitrate. Salt particles with very similar size distribution were generated by a home-made Collison-type atomizer with same volume concentration solutions and dilution. A SMPS system was employed to monitor the size distribution of the upstream and downstream of the filter. During the loading, the relative humidity in the system was controlled and recorded. All samples were loaded to the same terminal pressure drop at 10 inch of w.c.. The potassium chloride and ammonium sulfate have similar volume loading when the relative humidity is well below their deliquescent relative humidities, while more volume loading is needed to achieve the same terminal pressure drop for ammonium nitrate particles. Different dendrite structures were found in loaded filter samples by scanning electron microscopy; the morphology of the particles loaded on the filter would affect their resistant to the air flow and further affect the particle holding capacity of the filter.