PARTICLE LOADING CHARACTERISTICS OF A TWO-STAGE AIR INTAKE FILTRATION SYSTEM

Qisheng Ou[1], Jingxian Liu[2], Yun Liang[3], David Y.H. Pui[1], Xinjiao Tian[1]
[1]The University of Minnesota, [2]Northeastern University, P.R. China, [3]South China University of Technology

Intake air filters are widely used to mitigate particulate matter load into the key components in many industrial applications. With particle accumulation and pressure drop increase, intake air filters are subject to periodic replacement to maintain their effectiveness and low system operational cost. Installing a pre-stage filter before the main-stage intake air filter is an effective way to improve the overall filtration performance and service lifetime of the main-stage filter. Pre-filters are often inexpensive, they are designed to capture large particles and prevent them from entering the downstream main-stage filter, which reduce the dust loading on the main-stage filter. The pressure drop of the main-stage filter, therefore, increase slowly with extended lifetime.

In this study, a two-stage filtration testing system, consisting of a pre-stage filter and a main-stage filter was successfully developed, which proves capable of being used to investigate the loading characteristics of a two-stage filtration system. Bi-modal aerosols consisting of both super-micrometer coarse mode and sub-micrometer fine mode particles with varied mixing ratios were employed to challenge the two-stage filter system. The influence of pre-filter to the overall filtration performance of the two-stage system were investigated for different pre- and main-filter combinations, aerosol size distribution, and filtration velocity ratio between the two stages, and so on. Suggestions were drawn from experimental results to help the design and optimization of a two-stage air intake filtration system. The focus of this talk will be on the effect of incoming aerosol size distribution and main-stage filter media properties.