Journal of Environmental Chemical Engineering, vol. 6(1): 762-772

Depth filtration of airborne agglomerates using electrospun bio-based polylactide membranes

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ABSTRACT:

We have investigated the filtration properties of electrospun bio-based polylactide air filter membranes by studying the kinetics of filtration and the influence of fiber diameter, fiber size, and the nature of dust particles on the depth of filtration of airborne agglomerates. The penetration of three different test dust particles (clay, carbon black, and titanium dioxide) into filter membranes of varying fiber diameter was determined gravimetrically. The clay dust, with a large particle size (12.07 μm) was best captured by all the membranes (with efficiencies > 99%), while the smallest (0.095 μm) titanium dioxide particles resulted in the lowest capture efficiency of 92.97%, due to their high penetration ability and this can reach as high as 7% penetration. A kinetics study, involving stacking of membrane layers consisting of the fiber of the lowest diameter (6.5%PLA-J0.5, 450 ± 200 nm diameter), showed a higher dust capture efficiency within the layers, and therefore a higher depth of filtration compared to other membranes. This is an indication of effective capture of deeper penetrating particles that are usually not captured by air filter membranes produced by electrospinning.