AN EXPERIMENTAL STUDY OF SPATIAL DISTRIBUTION OF AIR FLOW ON OUTLET SIDES OF AIR FILTER ELEMENTS

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Fluted air filters used in engine air filtration are known for their high media packing density and high dust holding capacity. Fluted elements consist of parallel channels with the alternate ends of adjacent flutes blocked. Air flows into the open end of a flute, passes through the media and exits an adjacent flute through its unblocked end. This should enable optimal usage of filter element volume to hold dust. Unfortunately, performance is compromised when the inlets to flute channels are blocked by macroscopic debris. This can be mitigated by a new approach whereby media is formed into elongated tetrahedra rather than flutes. The nested tetrahedra allow air to pass axially and laterally through the filter element. It permits a redistribution of flow within the element and recovery from potential inlet-side blockages, thereby enables more robust use of the media volume for holding dust compared to fluted media, with comparable pressure drop and dust holding capacity under unblocked conditions. In this paper, we compare fluted and tetrahedral filters in terms of their response to inlet-side blockages using Constant Temperature Anemometry (CTA). CTA measures the velocity of air flow with high spatial and temporal resolution. It reveals the two-dimensional velocity distribution across the filter at outlet-side of an element. It shows that the effect of inlet-side blockages for fluted filters perpetuate throughout entire element, while tetrahedral filters fully recover, eliminating the effect of blockage. Moreover, fluted air filters with inlet-side blockage were found to suffer a reduction of up to 40% in dust holding capacity, while the impact of blockage on tetrahedral filter was negligible.